

CHAPTER II

LITERATURE REVIEW

The analysis of unit cost of Maharaj Nakhon Si Thammarat hospital had gathered the concept, theory and related literatures and determined the scope of research as follow.

1. Health Care Reform, Health Service System and Unit Cost
2. Concept of Public Health Cost
 - 2.1 Definition of Cost
 - 2.2 Hospital Cost
 - 2.3 Unit Cost
 - 2.4 Perspective or point of view
 - 2.5 Cost Classification
3. Steps in Hospital Cost Analysis
 - 3.1 Cost Center Identification & Grouping
 - 3.2 Direct Cost Determination:

Finding the total direct cost of each cost center which consists of

 - Labor Cost
 - Material Cost
 - Capital Cost
 - 3.3 Allocation Criteria Determination
 - 3.4 Full cost Determination
 - 3.5 Unit cost Calculation
4. Review the Related Literature

Health Care Reform, Health Service System and Unit Cost

Health system refers to the entire associated system that causes an affect to the entire national population's health, which include overall health-related factors. Examples of health-related factors include environment, economic, social, physical, biological and the health service system. (Office of National Health System Reform, 2001) Health service system refers to a system that function in taking care of health. A proper health service system is crucial to ensure a normal function of the health system. A good health service system has three basic characteristics which consisting of equality, quality and efficiency (Praves Wasee, 2000).

During the past decade, change had taken place in a variety of areas, for instance, economic, political, technological, communication and information. They cause a critical effect to the national health system. Moreover, these changes can create a great demand of health service system and the complexity in health service provided. A rapid growth of economic results in the change of health service payment form towards the National Health insurance and Social Security Welfare Scheme. This change will force the government to change the concept and the structure of health service system that seems to be inefficient and not meet the social needs. This brings about the bureaucracy reform policy. The phenomenon leads a major change in the health service system which known as "Health System Reform" (Charus Suwanwela, 2000). The principle of health system reform is to seek for the best economic solution to solve Thai citizen health problems as well as find the new patient service pattern. Moreover, it also aims to control the cost in the health service system with an expectation to see an improvement in Thai health system from what it is today.

Currently, there are only some groups of population have the health insurance coverage whereas the others do not. Further, there is still an excessive waiting time and over crowded when going to get the health service at the public hospital. The service charge of the private hospitals is too expensive and the drug expense seems a big burden for the citizen due to the sharp increase in price. The service quality in many hospitals is questionable. The current health system utilizes the large amount of resource for providing the medical treatment to the patients. Providing the medical treatment is regarded as the wrong solution as the root of problem is still not solved completely. The new healthy system will give citizens the equal access to the health service system regardless of their social and economic status. A desire for a new health system that effectively serves patients at their most convenience. They are well treated as if they were members of the family. A new system needed is to utilize and manage its resources more effectively and efficiently. Health system needs to focus on health promotion and prevention and give more alternatives to the patients as well. (Sauwakon Ratanawijitrasin, 2001).

According the health expenditure in 1998, it stated that the total healthcare expenditure from both private sector and government budget was at Bht179,689.15 million approximately which 70.55 per cent was the personal healthcare expense. When taking the personal healthcare expenditure into consideration in particular, it comprises in-patient health care 30.22 per cent and out-patient healthcare 40.33 per cent (Sathirakorn Pongpanich et al., 2000). It also identified the main problem in public health system that more than 20 per cent of Thai citizen did not have right to basic healthcare services equally. This can result in the inequality of access to quality health

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Cost also refers to the expense in the monetary form and non-monetary form used in order to produce the product and service. There are three different perspectives in cost analysis which consisting of provider perspective, consumer perspective and social perspective. (Anuwat Supachutikul et al., 1996).

Cost refers to the amount of money or expense that the producer or service provider must pay in order to obtain the necessary raw material or service to use in producing goods or service. (Piyathida Treedech, 1997).

Cost refers to the value of resources used to produce the final products or outputs or service. The cost will not be equal to the service charge, as the service in the public sector will be subsidized by the government. Therefore, the service is always lower than the cost in the public organizations. On the contrary, providing service in the private sector is aimed to make the profit. This result the service charge is always more expensive than its cost. Cost can be classified into two types, that is, financial cost and economic cost. Cost in economic standpoint consists of three distinguish characteristics. First is the “usage of real resource” such as usage of land, labor or asset. These resources have “alternative use” in economic system. When being used in one activity, another benefit will be lost (benefit foregone). Therefore, the economic cost often refers to what known as “opportunity cost” in using the resource. (Pirom Kamolrattanakul, 2000).

Cost refers to the loss of resources which can be the value of benefit or monetary value in order to achieve the objective (value of resource used in production process). (Arthon Rewpaiboon, 2001).

Cost refers to cash or something equivalent paid out to obtain the goods or service, which bring about the benefit to the organization at the present or in the future. When the benefit has occurred, the accounting will regard cost as an expense. (Sasiwimol Mee-ampol, 2003).

To summarize, cost refers to the investment made in order to obtain the final product, asset or any service. In accounting viewpoint, the cost that can be measured in the monetary unit will be taken into account whereas in economic viewpoint, opportunity cost, negative consequence and implicit cost are included into cost of the investment.

Hospital Cost

Hospital cost refers to the expense of the hospital in managing or operating the patient service. Examples of vital hospital costs are out-patient and in-patient cost. These costs can be identified as the standard unit cost and determined by the type of patient service. It is called as unit cost of out-patient per case or per visit and unit cost of in-patient per patient day. Moreover, the hospital cost also refers to the full cost of every departments which involving in patient service area. Generally, hospital consists of several departments, which their functions associated to the work of all other

departments Therefore, hospital cost finding is different from the business organization cost finding. (Pirom Kamolrattanakul, 2000).

Although hospital operation is divided into different departments, every department works together cooperatively according to their functions. In order to provide correct service to patient, no single department works independently. As a result, there is a cost allocation amongst department reciprocally and the full cost will be gradually summed up in direct patient service area. When dividing the full cost by the number of patients or number of visits, the unit cost can be determined eventually. (Pirom Kamolrattanakul, 2000).

Unit Cost

Unit cost refers to the comparison between the resource used and result or output. Unit cost can be a tool to measure the efficiency of resource management, budget allocation, service charge determination or the decision to maintain or cancel some services. (Anuwat Supachutikul, 1996).

Unit cost or average cost is the calculation of the health institutions' possible expense that will be incurred in operating the health service for one patient or per visit or per patient day. (Pirom Kamolrattanakul, 2000).

Average cost is the value, which illustrating the overall of the production cost or a service cost on the average. The value can be calculated from the full cost divided by the final output, for example, the average cost of out-patient service is the full cost of

the out-patient service divided by the number of all out-patients. A similar calculation can be also done for the average cost of in-patient service per case or per patient day. Hence, the average cost will represent the value that can be equally compared regardless of the size of the production. (Suppasit Pannarunothai, 2001).

Unit cost analysis will be carried out in the period of time. Normally, it will be done on the yearly basis, during the end of fiscal year. However, to gain the better control of the resource, it can be conducted more often than once a year.

$$\text{Unit cost} = \frac{\text{Full Cost of Patient Service}}{\text{Number of Patient Service Unit}}$$

In order to find the unit cost of the Patient Service Area (PS), the in-patient unit cost and out-patient unit cost will be calculated differently. The number of visit and number of patient day represent the number of service unit that are used to calculate the unit cost of the out-patient and in-patient service respectively.

$$\text{Unit cost of out-patient service} = \frac{\text{Full cost of out-patient service}}{\text{Number of out-patient visit}}$$

and

$$\text{Unit cost of in-patient service} = \frac{\text{Full cost of in-patient service}}{\text{Number of in-patients or patient days}}$$

(Walaiporn Patcharanarumol & Kanjana Tisayaticomand & Wiroj Tangcharoensathien, 2001).

Perspective or point of view

The perspective of cost estimation can be classified into three groups as following:

1. Cost in the provider's perspective, it refers to all expenses incurred when providing health service to the patients, which consist of labor cost, material cost and capital cost. This cost is not equal to the service fee charged to the patients.
2. Cost in the patient's perspective, it refers to all expenses incurred when going to get the treatment from the hospital. It will include the expenses caused by the sickness, for example, loss of income when taking sick leave.
3. Cost in the society's perspective, it refers to the sum of all expenses incurred, for instance, sick leave, environmental pollution or a harmful epidemic.

The research of unit cost of out-patient and in-patient services of Maharaj Nakhon Si Thammarat hospital will study from the provider or hospital's perspective and estimate the unit cost by using the accounting calculation method. The other expenses of the patients or the negative consequence to society or the intangible cost will not be taken into account. The economic cost or the opportunity cost will not be calculated in this study for some reasons. The main reason is about the difficulty in cost data collection. It is difficult to identify, measure and value the opportunity cost or social cost. Moreover, to measure the health service in term of value of life, sorrow, worry, or efficiency of work is unlikely to be reliable. (Pirom Kamolrattanakul, 1994

refer in Walaiporn Patcharanarumol & Kanjana Tisayaticom & Wiroj Tangcharoensathien, 2001).

Cost Classification

Cost classification or cost grouping and identification can be done in several ways depending upon the classification criteria. It can be divided into four different groups. (Somkid Kaewsonthi & Pirom Kamolrattanakul, 1991).

1. Cost classification by cost absorbing criteria. This can be divided into two groups, which consisting of cost generated inside the organization called “Internal cost” and cost generated outside the organization called “External cost”.
2. Cost classification by activity criteria. This can be divided into two groups, which consisting of Direct cost and Indirect Cost.
3. Cost classification by the disbursement criteria. It can be divided into two groups which comprising tangible or explicit cost, the cost which paid out and can be seen and intangible or implicit cost, the cost which not paid out and can not be seen.
4. Cost classification by medical criteria, which is divided into two groups. Cost associated with medical issues called “Medical Cost” and other that is not associated called “Non-Medical Cost”.

In addition, this cost classification depends on the objective of the usage. Some cost can be useful for one analysis but useless for the other. Cost factors can be classified by several criteria. However, a good classification needs to be consistent to

the situation or the objective of use so that no overlap of cost will occur. Cost can be classified into six different types.

1. **Cost classification by Input:** It is the simplest classification. The same type of input will be classified into the same group. Input criteria can be divided into two major groups.
 - 1.1 Capital Cost is cost invested to obtain the resource which its total life is more than one year. This includes building and heavy equipment (including training cost that affect the hospital cost in the long run, generally it occurs once in a long while which can be considered as human capital development).
 - 1.2 Operating costs, Recurrent costs or Running costs are costs invested in order to obtain the resource which usually worn down. This includes labor cost for the personnel, maintenance cost, utility cost and short-term training cost.
2. **Cost determination:** cost classification for the purpose of public health project analysis can be classified by the following characteristics.
 - 2.1 Determined by activities: it can be Training, Orientation, Management, Administration, Following up and Appraisal, Support and transportation.
 - 2.2 Determined by the level of use: it can be national, regional, provincial, or district level.
 - 2.3 Determined by the source: it can refer to Ministry of Public Health, Other Ministry, International Organization or Local Government. However, thing to be considered here is that not try to classify a lot of

sources at the same time. Since it might be difficult to justify which category the cost center belong to and finally they might be overlapped.

3. Classification for purpose of Production analysis and Financial report

3.1 Direct Costs and Indirect Costs

Direct cost refers to the material cost and labor cost that is directly associated with the production process or service. It can be clearly identified which product or service it belongs to. Direct cost will vanish only when the production or service is written-off.

Indirect cost refers to cost that can not be identified which product or service it belongs to specifically. Since they are associated with various production processes and service. For example utility cost, depreciation cost, office rent or equipment cost. In management perspective there is a consideration whether indirect cost should be included into the product or service price. In case there is no relation between indirect cost and product or service, such as, how the utility expense should be included in the service charge. In other word, how to calculate the cost of product or service need to find the suitable method to distribute indirect cost to the product and service appropriately.

3.2 Product costs and Period expense

Product cost is cost which relating to the output or final products. It can define to be the cost of goods. It comprises the labor cost, material cost and overhead cost. Actually, this cost is the inventory in the asset part of the balance sheet. When

goods get sold, this cost becomes the cost of goods sold in Profit and Loss statement or Income statement. Therefore, the product cost will be considered as asset when the goods or products remain unsold but will be considered as expense when they are sold out.

Period expense is the expense which can not be defined whether it belongs to any product or services. It will be reported as the expense in the reporting period, for example, the promotion expense, the administration expense.

4. Cost Classification for Cost Control

To control cost, it needs to understand the concept of responsibility center. This center refers to any departments in the organization that can measure its performance, has a responsible person who can interfere the department's operation so that the cost will be in the acceptable level. The fundamental principle is that the cost will be controlled by human. Therefore, to control the cost, it needs to define the responsibility center and responsible person to compute the cost data of each department and compare the incurred cost to the estimated cost in order to find the cause of deviation and take any possible action. Cost classification for cost control can be summarized as follow:

- 4.1 Traceable costs and Non traceable costs: For traceable cost, it can be defined clearly that which responsibility center it relates to. On the contrary, non-traceable cost is the cost, which can not be defined the responsibility center. Therefore, it needs to be allocated to the other cost centers at the activity level in the responsibility center, for instance, quantity of product, space, and the number of workers. The

responsibility center normally can not control this kind of cost. This cost determination will help distinguish the clear role in cost control. The administrator of the responsibility center will control only the traceable cost. The role of non-traceable cost controlling will be responsible by the other cost centers.

4.2 Controllable costs and Non controllable costs. Although the cost can be traceable which responsibility center it belongs to, in some cases, the cost can not be controlled by the head of that responsibility center. For example, the maintenance expense of the equipment in one department is not under control of that department head, but the cost is under control of the maintenance department head. Another example is the depreciation cost of equipment and building, they are not under the control of the responsible center head. Determining cost into the controllable cost and non-controllable cost is to help the administrator focusing on the controllable cost, which deviates from the budget plan.

4.3 Fixed Costs and Variable Costs

In cost controlling and price setting, the management should understand the behavior of cost or the change of cost in any activity level, for example, quantity of product or service. Fixed Cost is the cost, which the value will not change when the activity level or the quantity of output or service change, unlike the other indirect cost. However, it does not mean there will be no change occurs. The change will not occur automatically when the level of activity changes only. The change in fixed cost will be possibly caused by the administrator's decision, for example, salary increase. Furthermore, it can be occurred in the long term in case the administrator decides to

invest in increasing the building or equipment as the health service increase dramatically.

Variable Cost is the cost that varies to the level of activity, for example, the pharmaceutical product cost.

Determining the cost into fixed cost and variable cost needs to define the specific time frame and scope. In the long run, the fixed cost can be changed to the variable cost, for example, selling out the unused equipment, reducing the employment due to the decreasing workload.

5. Costing Concept for Planning

Planning is the objective setting for the future operation. In economic term, the vital objective of operation is income, expense and profit. Estimating the figure of income, expense or profit can help the administrator to compare what is expected and the actual. The process in estimating and analyzing the income, expense and profit is called budgeting. Budget plan can cover the budget for each responsibility center, Income and Expense statement estimation and Balance Sheet estimation.

In expense estimation, the estimated cost or standard cost will be taken into account, which basing on the actual cost analysis during the previous period systematically. The labor cost, material cost and overhead costs will be analyzed in order to get the unit cost. When it is calculated together with the estimated quantity of output or service, this will help estimate the total expense accordingly.

6. Costing Concept for Alternative Decision

Decision-making is not the routine job so it needs the cost concept as following.

- 6.1 Differential cost: In case there are some similar costs amongst the considered alternatives, the administrator can easily focus on comparing the different cost. This helps reduce workload in the calculation process.
- 6.2 Sunk costs: It is the cost which incurred from the decision in the past which there will be no change happened due to the current or future decision. Therefore, sunk cost remains unchanged in any alternatives and not necessary to be considered, for example, the purchased equipment is considered as the sunk cost. Although there is a closure of department or cancellation of some service and that equipment was not in use any longer, the depreciation cost is still exist.
- 6.3 Opportunity costs: When deciding to invest resource in one alternative, there will be the opportunity cost occurs or it means the possible revenue occurs if we invest the money or resource in the better or best alternative. This concept is the economic concept. The opportunity cost occurred is not cash. It is not recorded in the accounting system. However, it is the cost that the administrators need to consider comparing the alternatives appropriately.

The expenditure to produce the health service can be interpreted as the cost in different point of views. As a result, the cost classification and grouping is essential as well as the reliability and correctness of the cost calculation in goods and service

production. If the unrelated cost has been included to cost calculation, the calculated cost will be higher than actual. One expense must be calculated only once, not redundantly. Moreover, it is very vital to ensure that all the relevant expenses or costs have been included in the calculation completely and concisely. (Suppasit Pannarunothai, 2001).

In conclusion, the cost classification depends on its application. Therefore, this study will classify cost into two main groups which consisting of the total direct cost and indirect cost since the service operations in each department are related and associated to each others. The cost will be distributed and received amongst the cost centers reciprocally and the entire cost will be allocated to the patient service area eventually. By using the accounting cost analysis to compile the allocated indirect cost from the other supporting departments and the total direct cost, each department will get its full cost accordingly.

Steps in Hospital Cost Analysis

The hospital cost analysis is based on the statistical expenditure data and operating time from the all departments within the hospital mainly. It can say the hospital cost calculation refers to hospital cost analysis or hospital cost finding. Therefore, it is crucial to have an accurate information that associating to actual situation in each hospital. The hospital cost finding procedure can be divided down into five following steps (Pirom Kamolrattanakul, 2000).

1. Cost Center Identification & Grouping
2. Direct Cost determination

3. Allocation Criteria determination
4. Full Cost determination
5. Unit Cost Calculation

The full detail of hospital cost analysis procedure will be described as below.

1. Cost Center Identification & Grouping

According to Mehta and Maher (1977) (refer in Pirom Kamolrattanakul, 2000) hospital cost center identification and grouping are divided into four different groups.

- Non – Revenue Producing Cost Center: NRPC or Non charging Directly to Patients refers to any departments that their main responsibility relating to the administrative work and providing support to other departments. Their service will not be charged directly to patients. These departments can not produce any revenue to the hospital. Examples of department include General Administration, Academic, Finance and Accounting, Telephone, Security Guard, Laundry, Public Relation and Social Work and etc.
- Revenue Producing Cost Center: RPCC or Charging to Patients for their services refers to any departments that provide health service to patients which can produce the revenue to the hospital. These departments include Radiology, Laboratory, Operating Theater, Pharmacy and etc.
- Patient Service Area: PS refers to the direct patient service department, which includes out-patient and in-patient department.
- Non – Patient Service Area: NPS refers to any departments that provide the service relating to Health Promotion and Disease Prevention.

During the cost distribution process, the name given to the department that distributed all its cost to other department is Transient Cost Center: TCC_s. These cost centers refer to Non Revenue Produce Cost Center (NRPCC) and Revenue Produce Cost Center (RPCC). The department that absorbing all the allocated cost is Absorbing Cost Center: ACC_s. These refer to the departments that provide health service to patient which consist of Patient Service Area (PS) and Non – Patient Service Area (NPS).

Cost Center Identification Criteria and Method

Cost center identification is one crucial process since it sets and determines the boundary of data collection and the final result. The characteristic of cost center identification criteria is outlined as below. (Anuwat Supachutikul, 1997).

1. Cost centers that have a specific and clear role or function in the operation of the hospital. However, they may or may not need to have a distinct structure. The distinct structure of cost center refers to its separate office location, having own staffs working particularly for its department. A distinct structure will help simplify the cost data analysis. In case the cost centers do not have a distinct structure, but a clear result or output, they will include the unit which provide service to patient after the normal operating hour, provide service to social security patient or medical student program.
2. Cost center shall have a distinct data of its resource consumption and its cost level is relatively high. Examples of resource consumption data include number of personnel and material consumption record and etc. Generally, the more cost center can be identified, the more accurate the cost calculation will be. However, with more cost center identified, it simply means more

workload in data collection. As a result, in order to simplify the calculation, department with similar function and those with relative low operating cost are grouped together, for example, grouping all administrative departments into a single cost center (General Administration).

3. Cost center shall have a tangible and measurable result. The result will be used in the unit cost calculation for the absorbing cost center or in cost distribution (transient cost center which providing support to the absorbing cost center).
4. It is required by the hospital administrator to know the unit cost of that particular department and the data collection is not too complicated.

For the purpose of this study, various cost centers are classified into four different groups. Each group is designated with letter A, B, C, D and E as follows:

- A represents Non Revenue Producing Cost Center (NRPCC),
- B represents Revenue Producing Cost Center (RPCC),
- C and D represents Patient Service Area (PS)
- C represents Out-Patient Service (PS - OPD)
- D represents In-Patient Service (PS - IPD)
- E represents Non-Patient Service Area (NPS)

2. Direct Cost Determination

Direct cost determination aims to identify the value of all resource that cost center used up. It divides the resource into small units so that it will be easier to analyze its relation to the final product or output. Cost data of each cost center are gathered in

logical steps depending on the characteristic of each cost center. The study will start with identifying the elements of production, how much each element is used and calculating the unit cost. This will allow us to calculate the cost of each element in the production process. (Anuwat Supachutikul et al., 1996).

Total direct cost of each cost center is found by summing their labor cost, material cost and capital cost.

$$\begin{aligned} \text{Total Direct Cost} &= \text{Labor Cost} + \text{Material Cost} + \text{Capital Cost} \\ (\text{TDC}) &= \text{LC} + \text{MC} + \text{CC} \end{aligned}$$

1. Labor cost means the cost that paid to the staffs in exchange of their work. This includes wage, salary, overtime and other expenditure in performing their duty. Additionally, it includes the other allowance that paid out in term of money such as child tuition fee, medical fee, housing allowance. In accounting viewpoint, it is quite complicate to determine the labor cost as an indirect cost or direct cost. Overtime is generally regarded as indirect cost or overhead cost. However, in the cost analysis of medical care service, overtime can be specified directly to one patient service area, for example, Accident and Emergency patient or patient who get operation after normal operating hours, in-patient in each ward. The next thing to be considered is whether to separate cost analysis during the normal operating hours or after normal operating hours. For examples, labor cost of physician should include the extra working hours or calculate separately.

Some organization treated all kinds of the allowance as the indirect cost. In this case, all allowance is gathered to the central unit or administration unit. While some organizations will consider which department the allowance belongs to. If the allowance belongs to the person whose work directly associated with operating process or service provision, the allowance will be considered as the indirect cost. In this case, allowance and fringe benefit will be added directly to the other labor cost of that cost center.

In economic viewpoint, the fringe benefit can be in the other form, which is not the monetary form, such as, cars and houses that provide for staff. However, this can be converted into monetary form by using the housing and car rental rate. In addition, some people will further consider the future staff benefit, such as, retirement mutual fund. (Anuwat Supachutikul, et al. 1996).

2. Material Cost refers to all kinds of material supplies that each cost center requisite from the disbursement unit during the study period. The primary disbursement units include Material Supply and Pharmacy. The material cost also refers to the maintenance cost and utility cost. Estimating the material cost can be done by using material requisition record if the record is particularly accurate. If the requisition record does not exist, the unit cost of material needs to be calculated by finding the price of the materials and their quantity. (Anuwat Supachutikul, et al., 1996).

3. Capital Cost refers to annual depreciation costs of equipment and building, including the training expense that affect the hospital cost in the long run. This kind of cost generally occurs once in a long while. In accounting viewpoint, depreciation cost will be calculated by using Straight-line method. This means the depreciation cost will be equally averaged out by their total life. Otherwise it can be calculated by taking the initial cost subtracted by the salvage value (the price when the equipment reach its total life) and divided by the total life of building or equipment. Total life of building and equipment generally equals to 20 years while total life of vehicle equals to 3 to 5 years. The medical equipment's total life equals to 5 to 15 years depending upon the type of equipment.

$$\text{Depreciation Cost} = \frac{\text{Initial Cost} - \text{Salvage Value}}{\text{Total Life (Year)}}$$

Generally, one building will be utilized by various departments in a period of time. Therefore, after getting the depreciation cost of each building, the cost must be divided by the number of departments, which utilize that building in accordance with its usage proportion. In case the area of the building is occupied by more than one department, the proportion of their time spent need to be included in the calculation accordingly. (Supachutikul, Anuwat, et al, 1996).

3. Allocation Criteria Determination

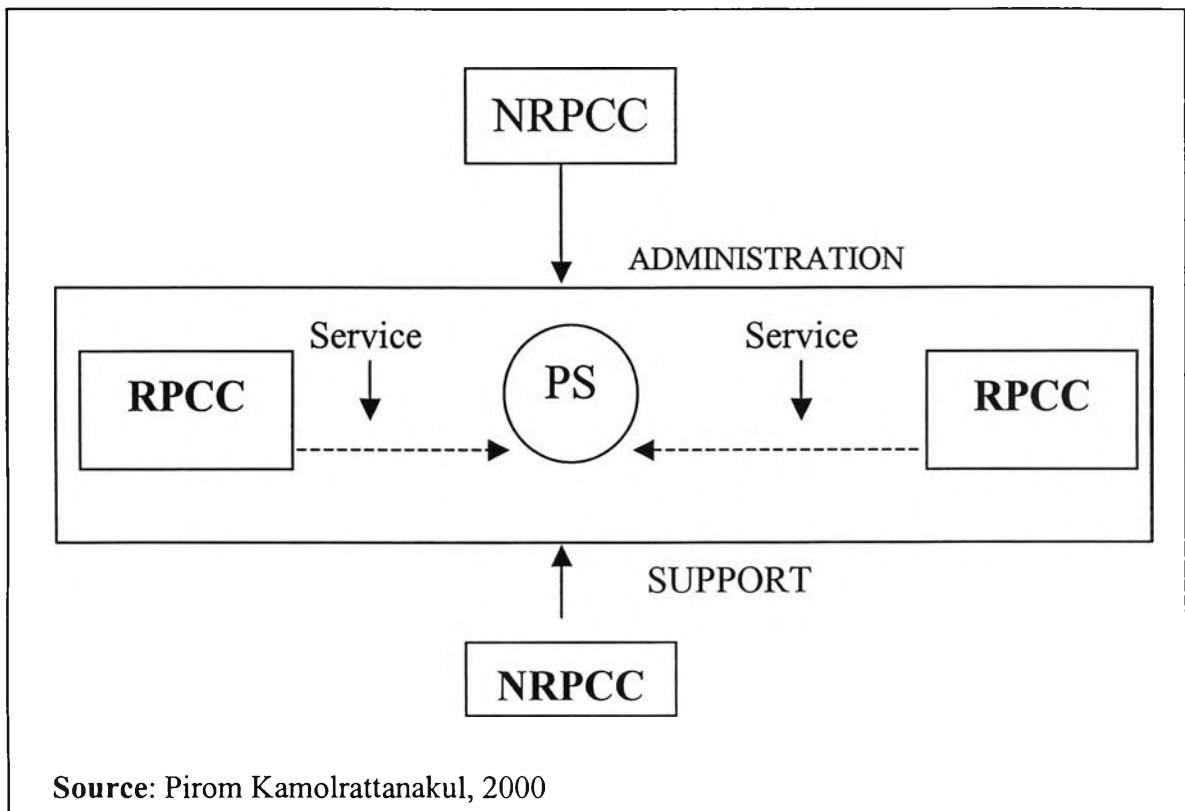
Cost allocation Criteria

For the transient cost center, there must be cost allocation criteria to determine which data used to distribute their cost to other cost centers. The criteria can be divided into four following groups (Anuwat Supachutikul et al.,1996).

- Personnel Criterion: it relates to the hospital personnel, for example, the number of full time personnel or equivalent in the hospital, in Nurse department or Physician.
- Cost Criterion: it relates to the expense in each cost center, for example, wage, salary, material cost and etc.
- Patient Criterion: it relates to the patient, for example, the number of patient day and number of visit.
- Service Criterion: it relates to general service of the hospital, for example, weight of the cloth used or occupied area and etc.

Indirect Cost Allocation

The principle of the cost allocation is that direct cost of the non revenue producing cost center (NRPCC) and revenue producing cost center (RPCC) which are transient cost center (TCC_s) will be distributed to other cost center as an indirect cost according to their function and relation of service and support provided to each other. The full cost will then be distributed to patient service area (PS) which known as an absorbing cost center (ACC_s) plus the indirect cost allocated from transient cost center (TCC_s: NRPCC and RPCC) as illustrated in figure 1.



Source: Pirom Kamolrattanakul, 2000

Figure 1: Indirect Cost allocation

Cost allocation means the cost distribution of supporting department to the direct patient service area (PS). Cost allocation is performed for the following reasons,

- To ensure that all cost are allocated entirely to Patient Service Area (PS) so that unit cost can be calculated with no cost left.
- To reflect the relation and association between each cost center, which leads to the most accuracy in performance efficiency evaluation.

The result of cost allocation will transform the cost of transient cost center to be the indirect cost of the absorbing cost center entirely. There will be no cost remained at the transient cost center. (Anuwat Supachutikul et al.,1996).

Generally, there are four basic cost allocation methods commonly used in cost analysis, which include:

- Direct Distribution Method
- Step-Down Method
- Double Distribution Method (Double Apportionment)
- Simultaneous Equation Method

In term of simplicity in calculation, the direct distribution method is the simplest. On the contrary, if we take the accuracy into consideration, this method is least. As known, the cost from one cost center will not be allocated to another cost center simply and directly as there are several cost centers providing support and services amongst each other according to their related functions. In the meanwhile, one cost center allocates its cost to the other cost center, they will absorb the cost from the other cost center reciprocally. It is called the reciprocal service allocation problem. (Canadian Hospital Association, 1985 refer in Pirom Kamolrattanakul, 2000) There are two ways to solve such problem, which include

- Ignore such relation amongst cost centers when allocating the cost. When allocating the cost to the other cost centers, there will be no cost absorbed from other cost centers. This results in the low reliability of indirect cost calculation.
- Take that relation into consideration when allocating the cost. This means that when one cost center allocating the cost to another cost center, it can also absorb the cost from the other cost center and continue allocating the received cost to the other center reciprocally.

The differences in those four cost distribution methods can be explained below (Berman H.J.,1976 refer in, Walaiporn Patcharanurumol & Kanjana Tisayaticom & Wiroj Tangcharoensathien, 2001).

1. **Direct Distribution Method** is one kind of cost allocation method which used to distribute all direct cost of transient cost center (TCC_S) to the absorbing cost center (ACC_S), regardless the relation of support provided between the transient cost centers. There is no cost distribution between the group of transient cost centers, for example, no cost allocated from Administration to Laundry, no cost allocated from Pharmacy to Radiology. The entire cost of transient cost centers will be allocated directly to the patient service area.

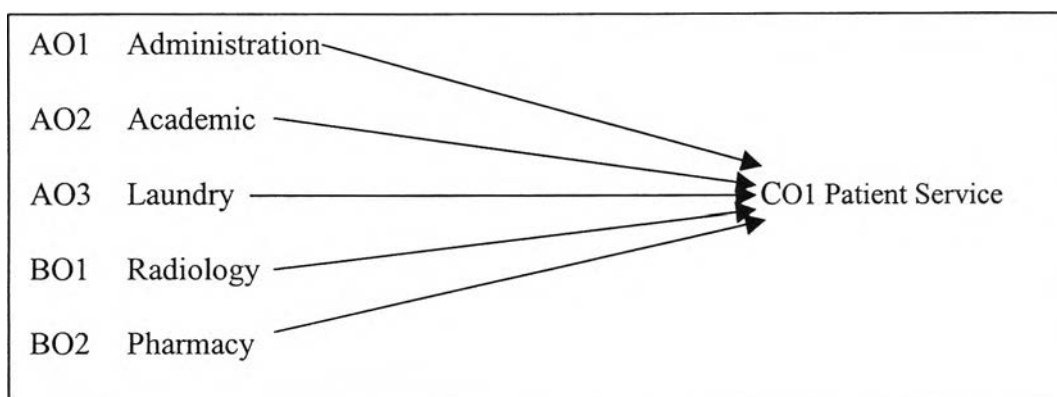


Figure 2: Illustrates the relation of cost center according to the direct distribution method (Wiroj Tangcharoensathien,1997 refer in Walaiporn Patcharanurumol &, Kanjana Tisayaticomand & Wiroj Tangcharoensathien, 2001).

The direct distribution method is the simplest method, as there are no cost allocation between the non-revenue producing cost centers and revenue producing cost centers. Nevertheless, this method has a drawback because the support provided between the transient cost centers themselves is ignored.

2. Step - Down Method is the cost distribution method, which gives the ranking to each transient cost center respectively. As a general rule, the cost center that provides the greatest amount of services to other cost center will be set in the first rank. The order of allocation continues on this basis. For example, Administration department provides the greater support to other department than Academic department and Academic department provides the greater support to the other department than Laundry unit. Therefore, the distribution order will be Administration, Academic, and Laundry respectively. The transient cost center, which is ranked in the first order, will have more opportunity to allocate the cost to other cost centers. On the other hand, the transient cost center that is in the last ranking will have least chance to distribute its cost to other cost centers. On the other hand, it will have most chance to receive the allocated cost from the other cost centers.

This cost distribution method can help compute the result more accurately than the direct distribution method. The cost distribution will start from the first rank cost center and follow by the second and third until the last respectively. After the cost is allocated to the other cost centers, there will be no cost left to allocate. Then the next rank cost center will start allocating its cost which is the sum of its own direct cost and

indirect cost allocated by the superior step to the next lower step. This distribution will continue in this pattern until the entire cost of the non-revenue producing cost center and revenue producing cost center is distributed completely. The full cost will be allocated to the patient service area eventually. Although this step-down allocation method is more accurate than the direct distribution method, it still has two drawbacks, which are below:

- It is difficult to rank the transient cost center into the correct order, as it is only the comparison. There are no standard allocation criteria. This can cause the difference of the full cost which result from the different ranking method of cost center.
- The cost centers which are in the first rank will not receive any cost allocated from the other cost centers although in the real term it will get some service or support from the other cost centers.

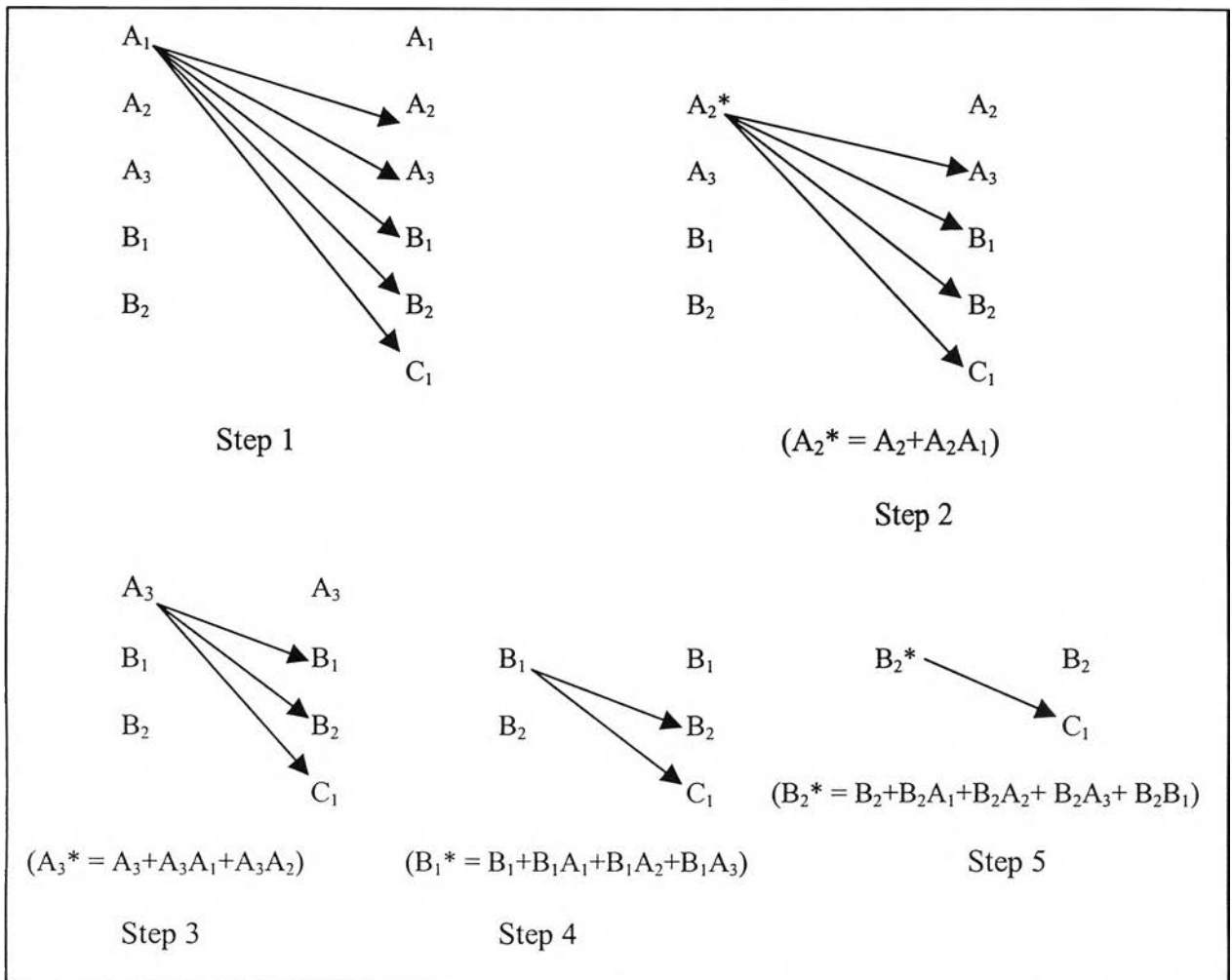


Figure 3: Illustrates the cost allocation using step-down method (Wiroj Tangcharoensathien, 1997 refer in Walaiporn Patcharanarumol & Kanjana Tisayaticomand & Wiroj Tangcharoensathien, 2001).

- 3. Double Distribution Method:** In the first distribution, every cost centers in the non-revenue producing cost center group and revenue producing cost center group can allocate their cost to the patient service area and allocate amongst each other unlimitedly. After the first distribution, the non-revenue producing cost centers and revenue producing cost centers will get the indirect cost which need to be distributed completely in the second round.

Therefore, the step-down distribution method will be used in the second distribution.

This distribution method help calculate the cost value more accurately than the first two methods as it is the distribution which allocate the cost according to the true relation of service and support provided amongst the departments. However, it is more complicated in cost calculation, as the cost will be allocated reciprocally amongst the cost centers.

If the cost distribution is done recurrently in such way but more than twice until the value of cost distributed is least, then follow by the step-down distribution method, it will be called the multiple distribution method.

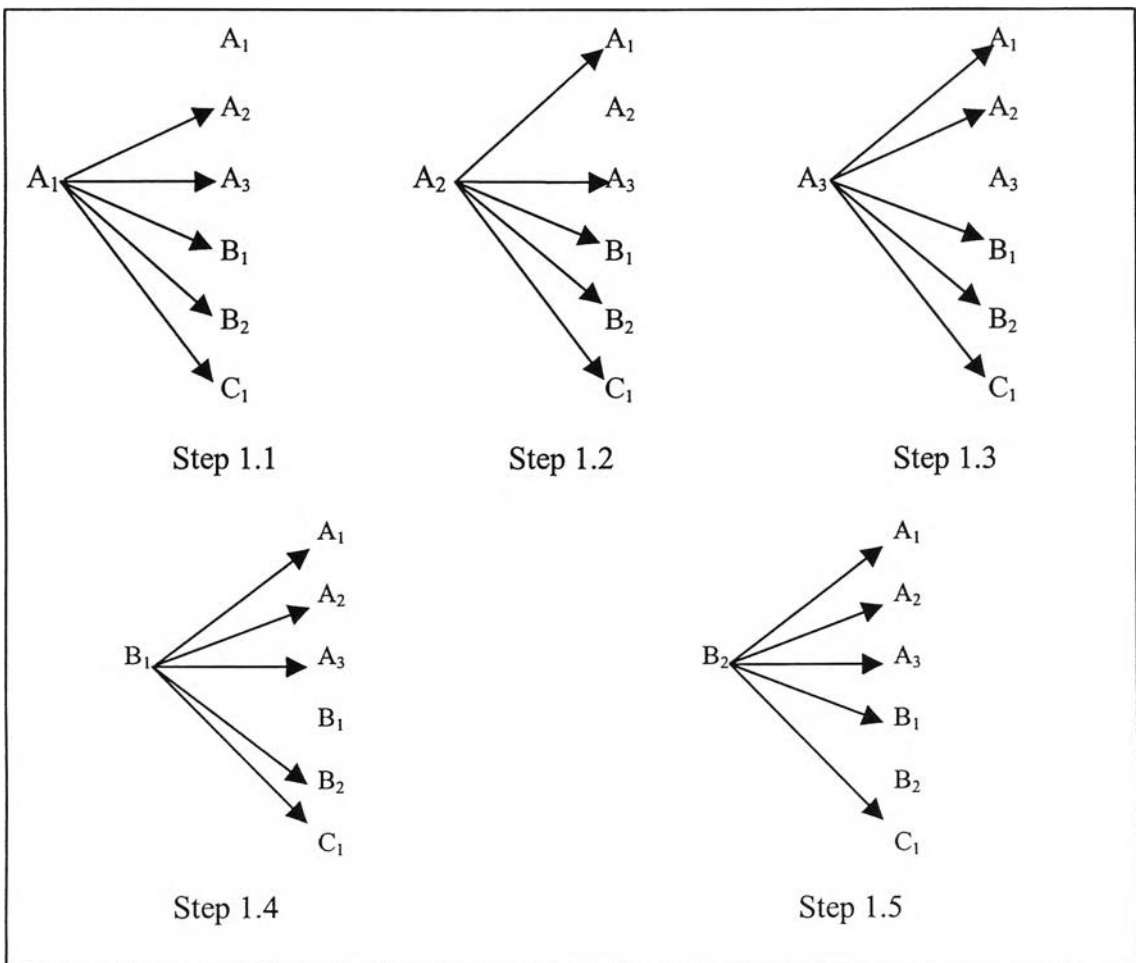


Figure 4: Illustrates the first distribution of double distribution method (Wiroj Tangcharoensathien, 1997 refers in Walaiporn Patcharanarumol & Kanjana Tisayaticom & Wiroj Tangcharoensathien, 2001.)

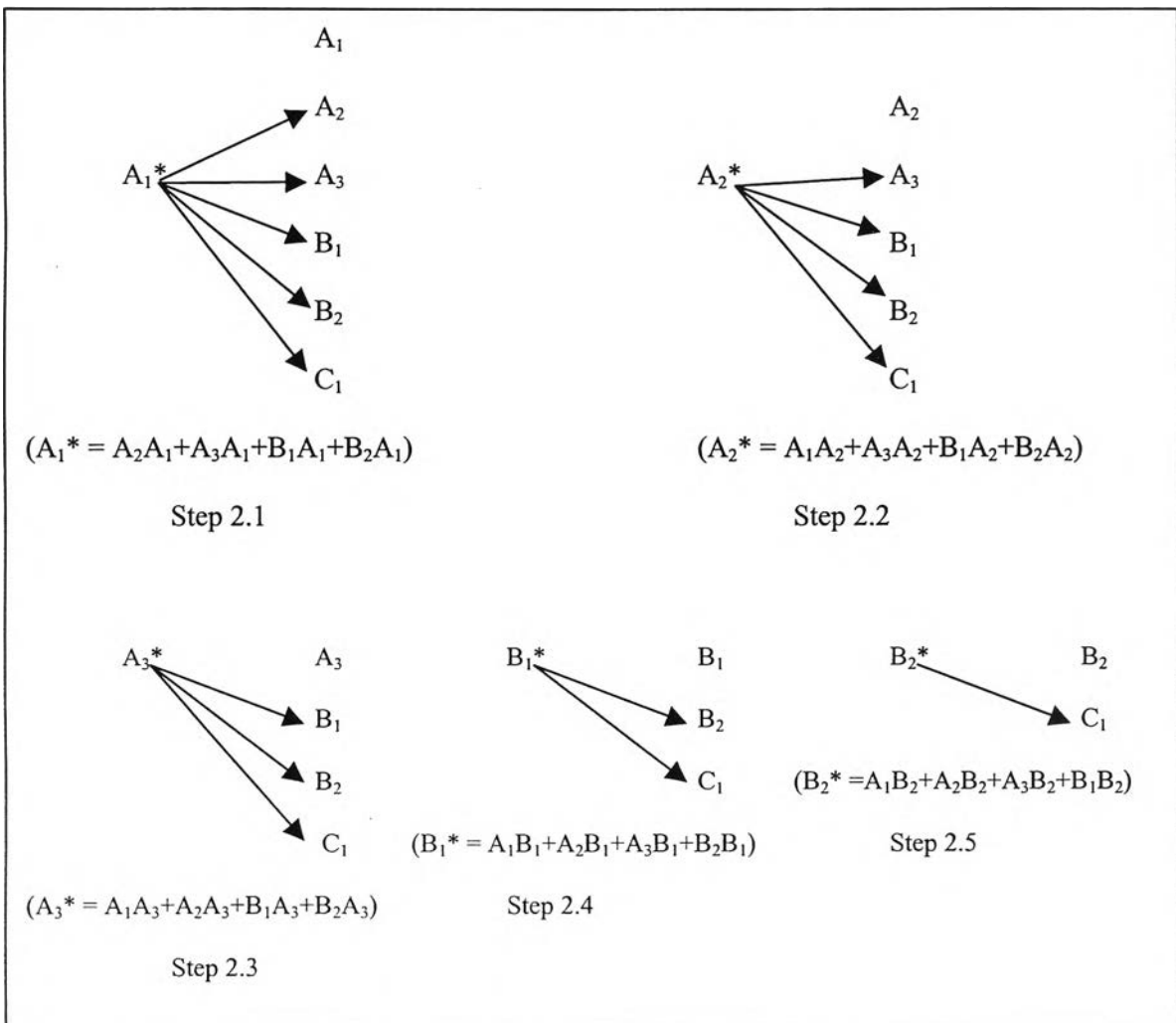


Figure 5: Illustrates the second distribution of double distribution method (Wiroj Tangcharoensathien, 1997 refer in Walaiporn Patcharanarumol & Kanjana Tissayakhom & Wiroj Tangcharoensathien, 2001)

4. **Simultaneous Equation Method:** To allocate the cost by using this method, the non-revenue producing cost center and the revenue producing cost center will allocate the cost to the patient service area. This method will use straight line equation to help allocate and absorb the cost and reciprocate the cost infinitely until reaching the equilibrium point, which no cost left in the supporting unit. It is the most accurate and meticulous method. (Meeting DT, 1978 refer in Walaiporn Patcharanarumol & Kanjana Tisayaticom &

Wiroj Tangcharoensathien, 2001). The cost calculation will use Matrix to help solve the equation. This can be done by using Microsoft Excel.

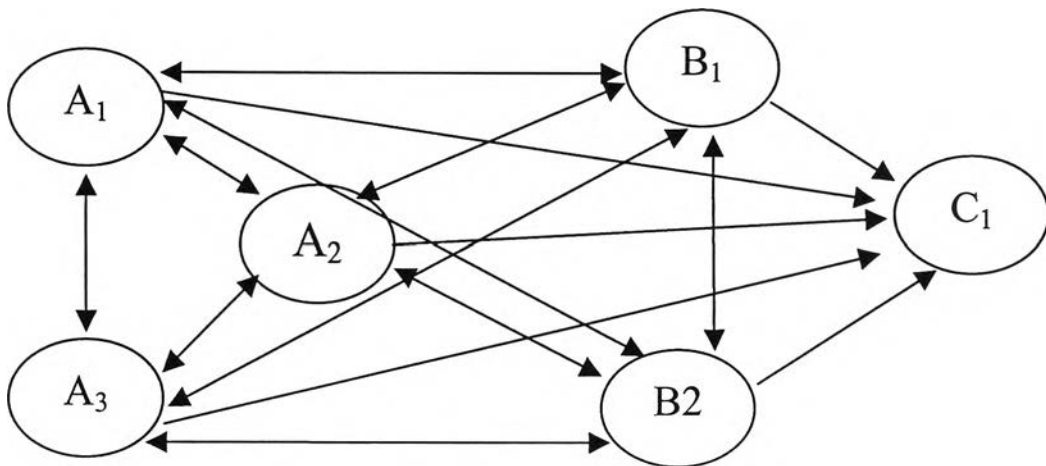


Figure 6: Illustrates the relation of cost allocated to each cost center by using the simultaneous equation method (Wiroj Tangcharoensathien, 1997 refers in Walaiporn Patcharanarumol & Kanjana Tisayaticom & Wiroj Tangcharoensathien, 2001)

This study used the cost allocation criteria according to the appropriate attribute of cost center and the simultaneous equation method to distribute the cost. This distribution method can help allocate the cost to the absorbing cost center absolutely by using the computer program to help calculate the matrix equation.

Table 1: Comparison of Different Cost Allocation Methods

	Direct	Step –down	Double	Multiple	Simultaneous
Absorbing the cost while allocating to other unit.	Nil	Nil	Yes	Yes	Yes
Allocate to transient cost center	Nil	Yes	Yes	Yes	Yes
Equality in the transient cost center group.	Yes	Nil	Yes	Yes	Yes
Number of distribution	1	1	2	>2	Infinity
Complexity	Less	Less	Medium	Complex	Complex
Necessity of Computer Program	No	No	No	Yes	Yes
Accuracy	Acceptable	Acceptable	High	Higher	Most

Source: Anuwat Supachutikul et al., 1996.

4. Full Cost Determination

The full cost is the sum of the direct cost of patient service area and the indirect cost which allocated from the revenue producing cost center (RPCC) and the non-revenue producing cost center (NRPCC).

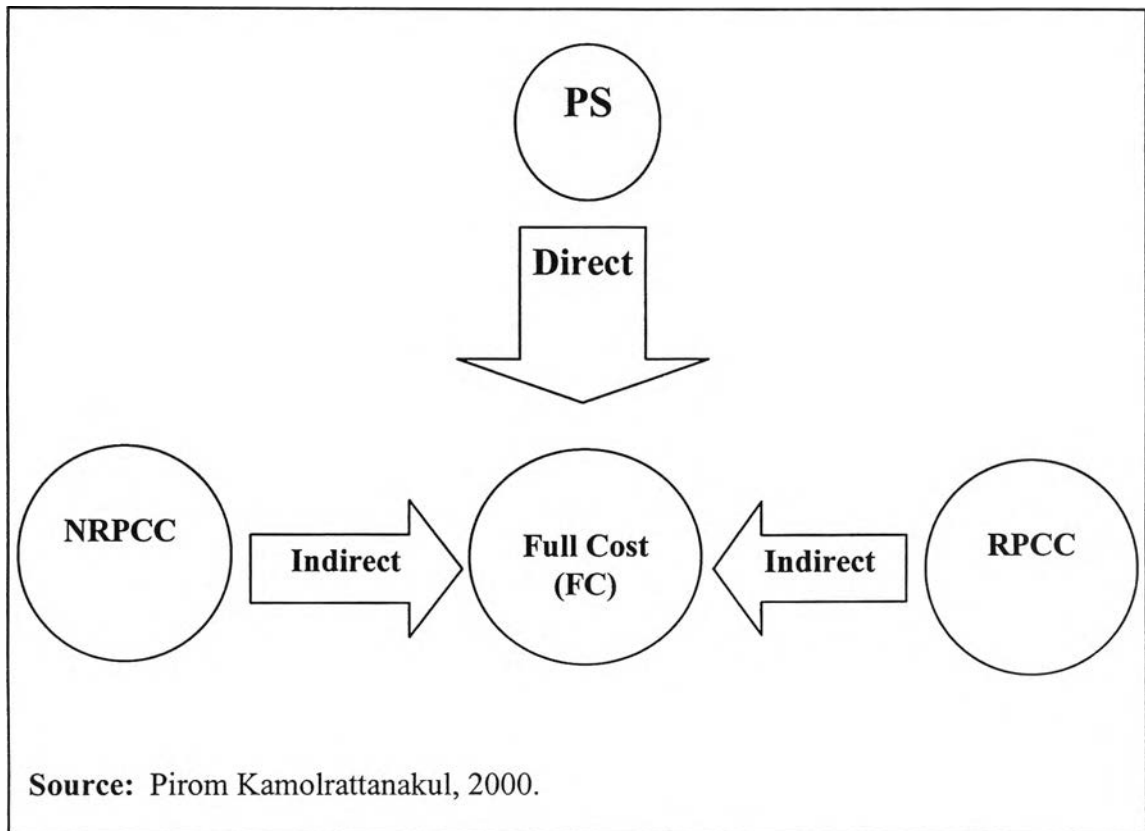


Figure 7: Full Cost Determination

After the entire cost of transient cost centers (TCC_s) are eventually allocated to the absorbing cost centers (ACC_s), the full cost of patient service area will be as follow:

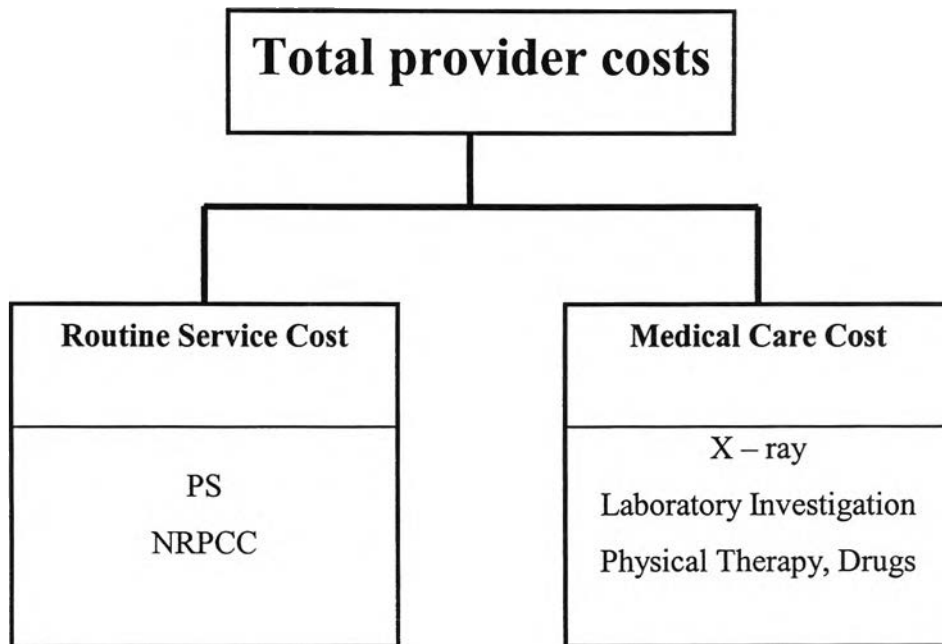
$$\begin{aligned}
 \text{Full Cost (PS)} &= \text{Direct Cost (DC)} + \text{Indirect Cost (IDC)} \\
 &= \text{DC (PS)} + \text{IDC (NRPCC)} + \text{IDC (RPCC)} \\
 &= \text{Total Direct Cost from Patient Service Area (PS)} + \text{Indirect} \\
 &\quad \text{Cost from Non-Revenue Producing Cost Center (NRPCC)} + \\
 &\quad \text{Indirect Cost of Revenue Producing Cost Center (RPCC)}
 \end{aligned}$$

Full cost of the patient service area will consist of 3 parts as following:

- Direct cost of patient service area = DC (PS)
- Indirect cost allocated from non-revenue producing cost center = IDC (NRPCC)
- Indirect cost allocated from revenue producing cost center = IDC (RPCC)

When considering the full cost of Patient Service Area in the public or state hospital, the full cost will include the building cost, personnel cost, office supplies cost, medical equipment cost and so on. This kind of cost will incur immediately when health service provided to the patients. However, it is the cost which not being charged directly to the patient. The patient will therefore not feel that they are charged (The cost incur but not charged directly to the patients). This cost can be also called the overhead cost. Normally, the overhead cost will be charged by the general private hospitals that are not subsidized by the government.

In case of the revenue producing cost centers, the cost charged to the patient is the direct cost. The medical care cost is the cost incurred when the patients are investigated, diagnosed or treated which depends on the seriousness of ailment, type of diseases and method of medical treatment.



Source: Pirom Kamolrattanakul, 2000.

Figure 8: Total provider Costs

5. Unit Cost Calculation

Unit cost is the comparison of the quantity of resource used and the final product or output. Unit cost is a tool to measure the efficiency of resource management, budget allocation, service fee defining, and the consideration to keep or cut-off the health service. (Anuwat Suppachutikul et al,1996).

Generally, unit cost analysis will be conducted in the period of time. It can be annually basis at the end of fiscal year. The wholly one-year cost analysis has a good point as the data record is more complete, not fluctuated due to the seasonal change. However, if there are any obstacles or limitation, the cost analysis can be conducted in the shorter period of time or less than one year. (Anuwat Suppachutikul et al, 1996).

$$\text{Unit cost of patient service} = \frac{\text{Full cost of patient service area}}{\text{Number of patient service unit}}$$

To calculate the unit cost of patient service area (PS) more accurately, the patient service area will be divided into out-patient and in-patient services cost center (Patcharanarumol, Walaiporn, Tisayaticom, Kanjana and Tangcharoensathien, Wiroj, 2000) by using the number of out-patient visits and the number of in-patient or patient day as a unit of service.

$$\text{Unit Cost of out-patient service} = \frac{\text{Full Cost of out-patient service}}{\text{Number of out-patient visits.}}$$

And

$$\text{Unit Cost of in-patient service} = \frac{\text{Full Cost of in-patient service}}{\text{Number of in-patient or patient day}}$$

Unit Cost (OPD)	=	$\frac{\text{Full Cost (PS)}}{\text{Number of Visits}}$
Unit Cost (IPD)	=	$\frac{\text{Full Cost (PS)}}{\text{Number of Patient Days}}$

Source: Pirom Kamolrattanakul, 2000.

Figure 9: Unit Cost Calculation

Review the Related Literatures

There are several researches about the unit cost analysis of out-patient and in-patient service which the researcher had reviewed as following:

Sukanlaya Kongsawatt (1991) studied the unit cost of out-patient service at Medical department of Chulalongkorn hospital in fiscal year 1990. It is the provider's perspective study. The cost center had been identified into three groups, which comprised the non-revenue producing cost center, revenue producing cost center and the patient service area. The study used the simultaneous equation method to allocate the cost. The finding shows that the proportion of labor cost, material cost and capital cost of Medical department in out-patient ward was 59: 28: 13 per cent. However, when allocating the cost by using the simultaneous equation method, the result shows the proportion of labor cost, material cost and capital cost was 10: 80: 10 per cent. The percentage of the service cost, which the costs charged to the patient and the cost can not be charged, were 64 and 36 respectively. The unit cost of out-patient service at Medical department of Chulalongkorn hospital was at Bht 253. When considering the unit cost of medical clinic, dermatological medical clinic, and Specialty Medical Clinic was at Bht 266 217 and 251 respectively.

Piriya Bussayaphanphong (1992) conducted the retrospective research to study the unit cost of out-patient service and emergency room of Chonburi hospital in fiscal year 1991 during October 1, 1990 to September 30, 1991. The cost center could be classified into four main groups that comprised primary cost, secondary cost, third level cost and absorbing cost. The study used the double step down method to allocate the

cost between the departments. The finding shows that the total cost of out-patient service was at Bht 32,998,226.28, Emergency service was at Bht 7,101,100.56, Emergency service during normal hour was at Bht 2,116,777.35 and Emergency service after normal hour was at Bht 4,984,323.21 respectively. The total cost of Medical was at Bht 9,411,468.67, followed by Obstetrics-Gynecology at Bht7,089,387.86 and Pediatrics at Bht 1,918,675.87 respectively. The clinic that had the highest total cost was Medical clinic at Bht 5,229,009.81, followed by Antenatal clinic at Bht 50,434.86. The average cost of out-patient service per visit was at Bht109.54. The average cost of Emergency service was at Bht 172.83 which comprised Emergency service during normal hour at Bht 225.84 and after normal hour at Bht157.16. The unit which had the highest average cost was Obstetrics-Gynecology (Bht 146.71 per visit), followed by Orthopedics (Bht146.14 per visit) and Pediatrics (Bht66 – 72 per visit) respectively.

Bawon Ngamsiri-udom & Thipaporn Sathiensakphong & Saranya Ngamsiri-udom (1997) conducted the prospective and descriptive research to study the unit cost of patient service of Mother and Children hospital in Chiangmai during June 1, 1994 to January 31, 1995. The research used the simultaneous equation method to allocate the cost between the departments. The finding illustrates the ratio of labor cost, material cost and depreciation cost of equipment and building was 6.3: 2.7: 1 The total cost was at Bht 36,915,876. The average cost of out-patient service per visit was at Bht 152.77. The Out-Patient Ward- Adult had the highest unit cost at Bht 244.31 whereas the Antenatal Clinic had the lowest cost at Bht 114.21. In case of the in-patient service, it found that the average cost of in-patient service per case was at Bht 3,569.68 and the cost per patient day was at Bht 992.22. The patient service unit which had the highest

unit cost per case and per patient day were the Private Section of Postnatal Ward at Bht 5,315.22 and Bht1,609.24 respectively. Obstetrics – Gynecology Ward had the lowest unit cost per case at Bht1,213.45 and Newborn Ward was at Bht 324.67 respectively.

Kannika Inpra (1996) studied the unit cost of out-patient service of Phrae hospital in fiscal year 1995. It was a retrospective study to find the cost from the provider perspective. The cost center had been classified into three main groups that consisted of non-revenue producing group, revenue producing group and patient service group. The study used the simultaneous equation method to allocate the cost. The finding shows that the average of unit cost of out-patient service was at Bht 151.80 per visit which comprised the cost which can be charged 73.60 per cent and the cost can not be charged 26.40 per cent.

Walaiporn Patcharanarumol (1997) conducted the retrospective research to study the unit cost of out-patient and inpatient service of Khon Khaen hospital in the fiscal year 1996. The hospital classified the cost center into four groups that consisted of non-revenue producing cost center, revenue producing cost center, patient service cost center and non-patient service cost center. The cost allocation method used in this study is Simultaneous equation method. The finding of the study indicated that the total cost of Khon Khaen hospital was at Bht 411,086,423. The proportion of labor cost, material cost and capital cost equals 48: 45: 7. The unit cost of out-patient service was at Bht 236 per visit and the unit cost of in-patient service was at Bht 1,242 per patient day. ICU-Surgery Ward had the highest unit cost at Bht 4,720 but the Gynecology Ward had the lowest unit cost at Bht 271.

Suwat Mahatnirankul et al, (1991) studied the unit cost of patient service of Suan Prung, Chiangmai province in fiscal year 1998 during October 1, 1997 to March 31, 1998. It was retrospective and provider's perspective study. The data gathered through the collecting form and report for labor cost, material cost, capital cost and labor allocation. The cost center had been designated into three groups which comprised the non-revenue producing cost center (NRPCC), revenue producing cost center (RPCC) and patient service area (PS). The cost had been distributed by using the simultaneous equation method. The finding shows that the unit cost per visit of out-patient service, dentistry, social work, psychology, stress free, rehabilitation and postal patient unit were Bht288.74, 197.34, 467.57, 1,045.59, 540.73, 928.08, and 290.24 respectively. The average cost of in-patient service was at Bht 12,982.18 per case or Bht 949.98 per patient day.

Kanjana Tisayaticom (2000) conducted the retrospective research to study the cost and unit cost of patient service of Trang hospital in fiscal year 1998. The cost center had been classified into four groups that comprised the non-revenue producing cost center, revenue producing cost center, patient service area and non-patient service area. The cost allocation used was the simultaneous equation method. The finding shows that the total direct cost of Trang hospital was at Bht 244,113,075.36 which the percentage of labor cost, material cost and capital cost were 54: 36: 10 respectively. The full cost of patient service was at Bht238,775,398.46. The cost of out-patient per visit was at Bht 205.68, Accident and Emergency Room at Bht 197.52, Dentistry at Bht 204.59 and Hemodialysis at Bht 5,717.84 respectively. For the unit cost of in-patient service, the average cost per case was at Bht 4,905.38 and the average cost per patient

day was at Bht1,125.18. The average cost of ICU-Surgery Ward was highest at Bht 28,783.70 whereas Obstetric Ward was least at Bht 3,136.87.

Daorook Sinthuwanich, et al, (2001) also conducted the retrospective research to elucidate the unit cost of patient service at Phra Pokklao hospital in fiscal year 2000. The cost center has been classified into four groups, which comprised the non-revenue producing cost center, revenue producing cost center, patient service area and non-patient service area. There were 76 different cost centers identified in total. The cost allocation between departments calculated by using the simultaneous equation method. The finding shows that the total cost of Phra Pokklao hospital was at Bht 624,927,871.51 which divided into the labor cost at Bht 315,769,710.96, material cost at Bht 238,945,469.97 and capital cost at Bht 70,212,690.58. The proportion of labor cost, material cost and capital cost was 4.5 :3.4: 1. The unit cost of out-patient service per visit was at Bht 841.37. The unit cost of in-patient service per case was at Bht15,185.68. The ratio of the unit cost of out-patient service and the in-patient service was 1: 18. The study of unit cost of out-patient service presents that the unit cost per visit of Hemodialysis was highest at Bht 2,580.92 and the Rehabilitative Medical was least at Bht 403.22. In case of the unit cost of in-patient service, the ICU Ward-Children got the highest cost at Bht 312,235.10 per case whereas the Pediatrics Ward No. 1 was least at Bht 8,128.41 per case. For the unit cost of in-patient service of Private Section Ward, the unit cost per case of Angkanawattana Private Section Ward was highest at Bht 230,051.91 whereas Theparat Private Section Ward (6th Fl) was least at Bht 14,459.20.

Panida Damaphong (2002) studied the cost calculation of Ban Paew hospital in fiscal year 2001 (October 1, 2000-July 31,2001) to find the unit cost of patient service. This research was the descriptive and retrospective study from the provider' perspective. The cost center could be classified into three main groups, which comprised the non-revenue producing cost center (NRPCC), revenue producing cost center and patient service area. The total direct cost consists of labor cost, material cost and capital cost was allocated from the non-revenue producing cost center and revenue producing cost center to the patient service area according to the appropriate allocation criteria. The study used the simultaneous equation method to allocate the cost between departments. The finding shows that the total cost of Ban Paew hospital was at Bht 106,212,792.34. The proportion of labor cost, material cost and capital cost was 47.04: 34.98: 17.98 per cent respectively. The labor cost of the patient service area and non-revenue producing cost center were highest at 56.02 per cent and 52.47 per cent respectively. The revenue producing cost center had the highest material cost at 39.03 per cent. The average cost of in-patient service per patient day was at Bht 1,268.98.

Woranuch Plubsawat et al, (2001) studied the unit cost of Phra Bhuddhalertla hospital in fiscal year 2000. The research was a retrospective study. The cost center had been classified into four main groups, which comprised the non-revenue producing cost center, revenue producing cost center, patient service area and non-patient service area. The study used the simultaneous equation method to allocate the cost between the departments. The finding presents the full cost of Phra Bhuddhalertla hospital was at Bht 238,765,809. The proportion of labor cost, material cost and capital cost was 49: 40: 11 The unit cost of out-patient service was at Bht 268 per visit which divided into the routine service cost (RSC) Bht125 per visit and medical care cost Bht 143 per visit.

The unit cost of in-patient service per case was at Bht 6,429 on average which comprised the routine service cost Bht 3,763 and medical care cost Bht 2,666 respectively. The in-patient service cost per patient day was at Bht 1,371 that comprised the routine service cost at Bht 803 per patient day and medical care cost at Bht 568 per patient day. The unit cost of in-patient service per case was 24 times of out-patient service per visit and the unit cost of in-patient service per patient day was 5 times of out-patient service per visit.

Payom Thanetrakul (2002) analyzed the cost and studied the unit cost of patient service of Thupthan hospital, Uthaitani province in fiscal year 2001 during October 1, 2001 to March 31, 2002. The cost center can be classified into three groups, which comprised the non-revenue producing cost center, revenue producing cost center and direct patient service cost center. The studied used the simultaneous equation method to allocate the cost between the departments. The finding shows that the operating cost of Thupthan hospital (6 month period) was at Bht 24,546,551.73, which consists of labor cost Bht12,140,724.49, material cost Bht9,438,149.14 and capital cost Bht 2,967,678.10 respectively. The proportion was 50: 38: 12 per cent respectively. The total cost per month was at Bht 4,091,091.96. The first three units which had the highest total cost were in-patient service of Karuna Building (Bht 766,483.11), followed by the out-patient service (Bht 716,725.08) and in-patient service of Metta Building and Delivery Room (Bht 662,7533.61) respectively. The lowest average cost came from the Acupuncture Clinic at Bht 110,101.91, followed by Thup Yai Pon Unit at Bht100, 732.03. The unit cost of out-patient service was at Bht 151.30 per visit, Accident and Emergency patient service was at Bht 176.03 per visit. The unit cost of in-patient service was at Bht 1,357.64 per patient day (excluding ICU) or at Bht

1,685.18 per patient day (including ICU). The unit cost of in-patient service per patient day descended from highest to lowest are belong to ICU ward (Bht 2,667.78), Metta Building (Bht 1,272.72), Muthita Building (Bht 1,108.26) and Karuna Building (Bht 783.60) respectively. The average unit cost of Dentistry was at Bht 226.90 per visit. The unit cost of Physiotherapy service was at Bht 523.56 per visit and the unit cost of Community Health Center was at Bht 295.45 per visit.

In conclusion, it can be seen from the above related studies that the cost classification and grouping was defined according to the function and true relation/association in providing service and support amongst the departments in the hospital. The cost centers can be classified into four main groups that comprise the non-revenue producing cost center, revenue producing cost center, patient service area and non-patient service. The study analyzed the total direct cost from labor cost, material cost and capital cost. The simultaneous equation method has been used in almost studies to calculate the cost since it is the most accurate and meticulous method. There was only the study of Piriya Bussayaphanphong used the double distribution method to calculate the cost. The main obstacle in conducting the study was the poor database system in every hospital. This caused the problem in cost analysis. Besides, from the hospital personnel viewpoint, the data gathering was considered as an additional burden for them as they actually had the high workload in their routine work. Furthermore, they did not recognize the importance of the linkage of database between each department. However, this study has solved the problem by elucidating its importance and explaining the study steps and data collecting process to every department before the research started.