CHAPTER 2

LITERATURE REVIEW

2.1 Cost

Definitions and Characteristics of Costs [3]

The measurement of cost is an extremely complicated issue. An appropriate measurement of cost for one analysis may be totally inappropriate of another.

The cost per patient represents the **average cost**. Average costs are the **full cost** of treating all patients divided by the number of patients. Full costs represent all costs associated with a **cost objective.**

A cost objective is any particular item for which we wish to know the cost. It may be a specific patient, a class of patients, a service, a department, or an entire organization. Before one can begin to measure cost, the cost objective must be defined.

Next we must decide if we are interested in **directed costs,** or both direct costs and **indirect costs** (or **overhead costs**). Direct costs are those that are clearly and directly associated with the cost objective. They are generally under the control of the manager who has overall responsibility for the cost objective. Other costs are indirect. The indirect costs consisted of an equitable share of indirect cost [4].

It is extremely important to define the cost objective carefully before trying to calculate the cost. There will be times when a user is concerned only with direct costs. In such cases, the definition of which costs have been considered to be direct in the analysis must be made explicit to avoid confusion.

Usually for the cost study, the direct cost comes from the labor cost, the material cost and capital cost [5].

- Labor cost is all expenditures spend for personnel's working and benefit such as salaries, wages and fringe benefits.

- Material cost is the cost of all materials and consumable supplied and other facilities [6].

- Capital cost is the depreciation cost of buildings and major movable equipment.

Full costs, however, include both direct costs and an allocated fair share of indirect costs. If the full costs are divided by the number of patients, the result is the average cost per patient.

Types of Costs: Fixed, Variable, and Marginal Costs, Opportunity Cost, Economic Cost and Accounting Cost

Full costs consist of both **fixed** and **variable costs**. Fixed costs are those that do not vary in total as the number of patients vary. Variable costs are those that vary in direct proportion with patient volume.

The definitions for fixed and variable costs assume that we are considering some relevant range of activity. It is not likely to be true that a fixed cost would remain the same over extreme variations in activity. But rather that it will remain fixed over some expected possible range of activity (often referred to as the **relevant range**).

Opportunity costs are the measure of cost based on the value of the alternatives that are given up in order to use the resource as the organization has chosen. The notion of economic cost is derived from the opportunity cost concept. Economic cost is defined as the amount of money that would be required to obtain the use of a resource. The economic cost measure is somewhat more restricted in scope than the opportunity cost measure, but still requires us to measure what everyone else would have paid for each of the resources we use.

Accounting cost is the measure of cost based on the number of simplifications, such as an assumed useful life for a piece of equipment. We can never know exactly what part of the equipment has been consumed in the current year (unless we sell it at the end of the year). Therefore, we will never have a true accounting cost.

Cost Finding and Analysis as Management Tools

In both developing and industrialized countries, government hospitals are viewed as vital and necessary community resources that should be managed for the benefit of the community. As such, hospital management has a responsibility to the community-to provide health care services that the community needs, at an acceptable level of quality, and at the least possible cost. Cost finding allows departmental managers, hospital administrators, and policy makers to determine how well their institutions meet these public needs.

Cost finding or cost analysis [7] is the process of manipulating or rearranging the data or information in existing accounts in order to obtain the costs of services rendered by the hospital. Cost analysis is concerned with issues of choice related to production, exchange, and consumption. As the financial management techniques, it helps to furnish the necessary data for making intelligent decisions concerning operations and infrastructure investments. If structured accurately. Cost data can provide information on operational performance by cost center. This information can be compared to budgeted performance expectations in order to identify problem areas that require immediate attention and provides a ready vehicle for the consideration of how best to use scarce resources for the production of health. This data gives management the material to evaluate and control a hospital's structure. Knowledge of costs (both unit and total) can assists in planning for future budgets (as an indicator of efficiency) and in apportioning costs to the patient care areas in order to comply with the reimbursement formulas to establish a schedule of charges for patient services. A hospital cannot set rates and charges which are realistically related to costs unless the cost finding system accurately allocates both direct and indirect costs to the appropriate cost center.

Prerequisites for Cost Finding [6]

There are five prerequisites that Berman, Weeks and Kukla[6] state for cost finding function is to be fulfilled and if it is to operate efficiently.

1. There should be an organization chart and a chart of account relating to it.

2. There should be an identification of all cost centers as either general service cost centers or as final cost centers to which all costs are ultimately assigned.

3. There should be an accurate accounting system capable of accumulating financial data by cost center.

4. There should be a comprehensive information system capable of collecting non financial data by cost center and by the total hospital providing : (a) the basis for distribution of costs from general service centers to final cost centers; and (baht) the basis for calculating unit cost by final cost center.

5. A methodology for cost analysis should be chosen that is most practicable for the hospital situation.

2.2 The Diagnosis Related Groups(DRG)
The Importance and Definition by DRGs [8] [9] [10] [11]

Patients treated in an acute-care facility can vary considerably in both the duration and intensity of services required to provide appropriate patient care. The relative amounts and types of hospital outputs utilized by individual patients are dependent on both the condition of the patient and the treatment process employed, and therapeutic characteristics of patients to the hospital outputs they utilize, a patient classification scheme can be developed which provides the framework for both the specification of hospital case mix and the measurement of the impact of case mix on hospital utilization and performance. The Diagnosis Related Groups represent an attempt to provide such a patient classification scheme. As currently defined, the DRGs provide a manageable number of patient classes that are exhaustive and mutually exclusive with respect to the types of patients seen in an acute-care setting. Further,

the DRGs provide patient classes that are clinically consistent and that have similar patterns of output utilization as measured by length of stay; beside, the DRGs can provide a framework for establishing the effects of case mix as well as for identifying diagnostic areas with potential problems. The goal of most comparative analyses is to isolate problem areas so that corrective measures can be initiated. If programs aimed at improving, the performance of the hospital health-care system are to be successful, managers and regulators must establish an; effective dialogue with those responsible for the delivery of services. The DRGs provide the first step in such a dialogue since problems defined in the context of DRGs are understandable from a clinical perspective.

The various actual and potential applications of the DRGs in the areas of utilization review, hospital budgeting and cost control, prospective reimbursement and regional planning emphasize the central role of the patients being treated. The programs responsible for these activities will share a common conceptual basis even though they are concerned with different aspects of the health care system. While the applications to date have been implemented to meet the immediate needs of the individual programs, future work will be directed toward exploring the potential of DRGs in achieving better integration and coordination of the different program goals and activities.

The Concept of Case Mix Complexity [9]

The concept of case mix complexity initially appears very straightforward. However, clinicians, administrators and regulators have often attached different meanings to the concept of case mix complexity depending on their backgrounds and purposes. The term case mix complexity has been used to refer to an interrelated but distinct set of patient attributes which include severity of Illness, prognosis, treatment difficulty, need for intervention and resource intensity. Each of these concepts has very precise meaning, which describes a particular aspect of a hospital's case mix.

Severity of Illness refers to the relative levels of loss of function and mortality that may be experienced by patients with a particular disease.

Prognosis refers to the probable outcome of an illness including the likelihood of improvement or deterioration in the severity of the illness, the likelihood for recurrence and the probable life span.

Treatment Difficulty refers to the patient management problems, which a particular illness presents to the health care provider. Such management problems are associated with illnesses without a clear pattern of symptoms, illnesses requiring sophisticated and technically difficult procedures and illnesses requiring close monitoring and supervision.

Need for Intervention relates to the consequences in terms of severity of illness that lack of immediate or continuing care would produce.

Resource Intensity refers to the relative volume and types of diagnostic, therapeutic and bed services used in the management of a particular illness.

Basic Characteristics of the DRGs Patient Classification Scheme [8] [9]

The DRGs were developed as a patient classification scheme consisting of classes of patients who were similar clinically and in terms of their consumption of hospital resources. The DRGs resulting from such a statistical approach, while similar in terms of resource intensity, would often contain patient classification scheme required that physician judgement, statistical analysis and verification with historical data be merged into a single process. It was necessary to be able to examine large amounts of historical data with statistical algorithms available for suggesting alternative ways of forming DRGs but to do so in such a way that physicians could review the results at each step to insure that the DRGs formed were clinically coherent. It was concluded that in order for the DRGs patient classification scheme to be practical and meaningful it should have the following characteristics:

1. The resource intensity of the patients in each patient's characteristics used in the definition of the DRGs should be limited to information routinely collected on hospital abstract systems.

2. There should be a manageable number of DRGs that encompass all patients seen on an inpatient basis. Each DRG should contain patients with a similar pattern of resource intensity.

3. Each DRG should contain patients who are similar from a clinical perspective (i.e. each class should be clinically coherent).

DRG must be similar on order to establish a relationship between the case mix of a hospital and the resources it consumes. Similar resource intensity means that the resources used are relatively consistent across the patients in each DRG. On other words, the definition of the DRG will not be so specific that every patient is identical but the level of variation is known and predictable. Thus, while the precise resource intensity of a particular patient cannot be predicted by knowing to which DRG he belongs, the average pattern of resource intensity of a group of patients in a DRG can be accurately predicted.

The Evolution of Diagnosis Related Groups (DRGs) [4]

The Diagnosis Related Groups (DRGs) are a patient classification scheme which was originally developed as a means of relating the type of patients a hospital treats (i.e., its casemix) to the costs incurred by hospitals. The design and development of the DRGs began in the late sixties at Yale University (Fetter, et al, 1980). The initial motivation for developing the DRGs was to create an effective framework for monitoring the utilization of services in a hospital setting. The first large-scale application of the DRGs was in the late 1970's in the state of New Jersey. The New Jersy State Department of Health used DRGs as the basis of a prospective payment system (PPS) in which hospitals were paid a fixed DRG specific amount for each patient treated. In 1983 Congress enacted a DRG based PPS for all Medicare

patients. Subsequent to the enactment of the Medicare PPS, a number of states and large payors implemented DRG based hospital PPS for non Medicare patients. In addition, DRGs have been used as the basis of global budget allocation and payment in several countries in Western and Eastern Europe as well as Australia.

The evolution of the DRGs and their use as the basic unit of payment in Medicare's hospital reimbursement system represent a recognition of the fundamental role which a hospital's casemix plays in determining its costs.

DRG System

DRG technology has experienced an evolutionary development process in which the later generations of DRG systems have incorporated the improvement s made by earlier generations. The five DRG systems that have been developed are:

- Medicare DRGs
- Refined DRGs (RDRGs)
- All Patient DRGs (AP-DRGs)
- Severity DRGs (SDRGs)
- All Patient Refined DRGs (APR-DRGs)

Each of these DRG systems were created to address specific limitations in the original DRGs.

Medicare DRGs: The initial DRG definitions developed at Yale were intended to describe all types of patients seen in an acute care hospital. Thus, the DRGs encompassed both the elderly patient population as well as the newborn, pediatric and adult populations. However, with the implementation of the Medicare prospective payment system in October, 1983, the responsibility for the maintenance and modification of the DRG definitions became the responsibility of the Health Care Financing Administration (HCFA). HCFA updates the Medicare DRGs on an annual basis. The focus of all DRG modifications instituted by HCFA subsequent to 1983 has been on problems relating primarily to the elderly population. Version 12.0 of the

Medicare DRGs has 492 DRGs and was effective October 1, 1995 and was used in this analysis.

Refined DRGs (RDRGs): During the mid 1980s the Health Care Financing Administration funded a project at Yale University to revise the use of complications and comorbidities (CCs) in the Medicare DRGs . In the Medicare DRGs a secondary diagnosis is considered a CC if it causes a significant increase in hospital resource use. For certain types of patients, a different Medicare DRG is assigned depending on whether or nor a CC is present. The Yale project mapped all secondary diagnoses that were considered a CC in the Medicare DRGs into 136 secondary diagnosis groups each of which was assigned a CC complexity level. For surgical patients each secondary diagnosis group was assigned to one of four CC complexity levels, (non-CC, moderate CC, major CC and Catastrophic CC). For medical patients each secondary diagnosis group was assigned to one of three CC complexity levels (non-CC, moderate or major CC and catastrophic CC). All age splits and CC splits in the Medicare DRGs were eliminated and replaced by the four subgroups for surgical patients, or the three subgroups for medical patients. The DRG system developed by the Yale project is referred to as Refined DRGs or RDRGs.

For medical patients in each MDC a separate DRG was created for early deaths primarily as a means of identifying patients admitted for terminal care. Early death DRGs were not created for surgical patients since patients admitted for terminal care would normally not have surgery performed. Early deaths were defined as patients who died within two days of admission. Thus, length stay as well as death was used to assign the RDRG.

All Patient DRGs (AP-DRGs): In 1987, the state of New York passed legislation instituting a DRG-based prospective payment system for all non-Medicare patients. The legislation included a requirement that the New York State Department of Health (NYDH) evaluate the applicability of the Medicare DRGs to a non-Medicare population. In particular, the legislation required that the DRGs be evaluated with respect to

neonates and patients with Human Immunodeficiency Virus (HIV) infections. The evaluation concluded that the Medicare DRGs were not adequate for a non-Medicare population. NYDH entered into an agreement with 3M Health Information Systems (3M HIS) to research and develop all necessary DRG modifications. The DRG definitions developed by NYDH and 3M HIS are referred to as the All Patient DRGs (AP-DRGs).

The AP-DRGs introduced many other changes to the Medicare DRGs. Some of these primarily affect pediatric patients while others affect patients of all ages. The pediatric modifications include some of the recommendations originally developed by the National Association of Children's Hospitals and Related Institutions (NACHRI) as well as other significant modifications. MDC 25 was added for patients with multiple trauma. In addition, significant modifications have been made for transplants, long term mechanical ventilation patients, cystic fibrosis, nutritional disorders, high risk obstetric care, acute leukemia, hemophilia and sickle cell anemia.

The AP-DRGs have been updated in January of every year since 1988. Version 12.0 of the AP-DRGs was effective January 1, 1995.

Severity DRGs (SDRGs): In 1993, HWA initiated a reevaluation of the use of complications and comorbidities within the Medicare DRGs (Federal Register, 1994). The DRG system developed by this reevaluation is referred to as the severity DRGs or SDRGs (sometimes also referred to as Severity Refined DRGs or SR-DRGs). The reevaluation excluded the DRGs associated with pregnancy, newborns and pediatric patients. The major CC list from the AP-DRGs was used to identify an initial list of major CCs. Using Medicare data the categorization of each secondary diagnosis as a non-CC, non major CC or a major CC was reevaluated.

In SDRGs, a patient is assigned to a subgroup corresponding to the highest level secondary diagnosis. Like RDRGs, multiple secondary diagnoses at a one level do not cause a patient to be assigned to a higher subgroup. The categorization of a diagnosis as non-CC, non major CC or major CC is uniform across the SDRGs and there are no modifications for specific SDRGs. HUA published the SDRGs in 1994, but

did not establish an implementation date. The SDRGs have not been updated by HUA since the original 1994 release.

All Patient Refined DRGs (APR-DRGs): The All Patient Refined DRGs (APRDRGs) further refine the basic AP-DRG structure by adding four subgroups. In subsequent updates of the APRDRGs the base AP-DRGs have been substantially modified. All age, CC and major CC distinctions in the AP-DRGs were eliminated and replaced by two sets of four subgroups. One set of subgroups addresses patient differences relating to severity of illness and the second set addresses risk of mortality. In APR-DRGs, severity of illness is defined as the extent of organ system loss of function or physiologic decompensation, while risk of mortality is the likelihood of dying. Since severity of illness and risk of mortality are distinct patient attributes, separate subgroups are assigned to a patient for severity of illness and risk of mortality. Thus, in the APRDRG system a patient is assigned three distinct descriptors.

- The base APR-DRG (e.g., APR-DRG 127 - Congestive Heart Failure)
- The severity of illness subgroup
- The risk of mortality subgroup

The four severity of illness subgroups and the four risks of mortality subgroups represent minor, moderate, major or extreme severity of illness or risk of mortality. The assignment of a patient to one of these four subgroups takes into consideration not only the specific secondary diagnoses but also the interaction between secondary diagnoses, age, principal diagnosis, and the presence of certain non-OR procedures. The assignment of a patient to a subgroup for each APRDRG is performed separately for severity of illness and risk of mortality.The APR-DRGs were a joint development of 3M HIS and NACHRI. The APR-DRGs encompass all the DRG modifications developed for the original PM-DRGs plus all subsequent NACHRI research. APRDRGs are updated every two years. Version 12.0 of the APR-DRGs was released in September of 1995.

Concept of DRGs Analysis [8] [11]

Since the DRGs form a classification of the patient population into classes with similar expected output utilization, they can provide a definition of the services provided by a hospital. As such, they allow the resources consumed and costs incurred to be related directly to the types of patients or case mix that the hospital treats. This is important in a hospital setting, where it is not management (i.e., administrators) but rather individual physicians who are responsible for allocation resources through various services and departments in order to provide effective patient care. To a large extent, physicians act independently of each other and are not generally aware of the overall financial implications of their individual decisions. If hospital cost control is to be attained, effective communication between the financial systems, of the hospital and its physicians must be achieved. By formulating the hospital budget in terms of patient classes with similar patterns of care, a direct linkage between the practices of individual physicians and the financial consequences for the hospital can be realized.

The goal, then, of a case mix accounting system is to provide a complete financial picture of the costs of treating specific types o patients, whose care is the basic service to a hospital. Under the traditional organizational structure of a hospital, there is no department whose responsibility is to insure that individual patients are financially well managed. Typically, the hospital's 2 accounting systems – financial and managerial – deal with patients in the aggregate and not on an individual basis. The financial system provides the basic financial description of the hospital in terms of the balance sheet, income statement and funds flow, while the managerial accounting system provides the financial information oriented at the department level (e.g. nursing, laboratory, medical records) for internal management purposes, Thus, hospital accounting systems have not provided the integrated picture of the financial consequences of the care delivered to individual patients that case mix accounting is designed to produce.

DRG Cost Model

The process of determining the cost of treating patients in each of the DRGs for an individual hospital or collection of hospitals is described elsewhere. In summary, the types of accounts in a hospital chart of accounts can be categorized into 6 distinct service areas: 1) outpatient accounts; 2) overhead accounts not related to patient care; 3) overhead accounts related to patient care; 4) Hotel and other general services accounts; 5) nursing accounts; 6) ancillary services accounts.

The DRGs currently encompass only the inpatient population; hospital outpatient costs are not included in the DRGs costs Overhead accounts are costs incurred by the hospital in its general operation but are either not related or only indirectly related to the provision of patient care. Depreciation and interest chares are examples of overhead costs that are not related to patient care and therefore are not normally included in the DRG costs. Other overhead accounts such as housekeeping or laundry are indirectly related to the provision of patient care and are included in the DRG cost. The definition of the overhead accounts that are considered as patient care-related versus non-patient-care-related can vary, depending on the goal of the case mix accounting system. For strictly internal management purposes it is reasonable to include as patient-care-related the various administrative services. However, if the case costs of a collection of hospitals are to be compared, then the administrative costs can vary greatly across hospitals for reasons other than case mix. The remaining 3 types of accounts are all directly related to patient care and with the addition of the outpatient account, are referred to as the final cost centers. The services associated with these accounts can be directly related to individual patients, allowing the costs to be apportioned to each patient.

The direct costs of each final cost center and the portions of the cost of patient-care-related overhead accounts allocated to each final cost center (as determined by a special algorithm) represent the total cost of providing the services associated with

each final cost center. An allocation statistic specific to each final cost center is used as the basis of apportioning the costs to the patients in each of the DRG. For example, the cost of nursing is allocated to patients based on a DRG-specific per diem nursing weight that was derived through a study of the amount of nursing time spent with patients in each DRG. While all of the allocation statistics possess some defects, they are designed to reflect more equitable the quantity of an institution's resources consumed by the patients in each DRG. The end result of the DRG cost of treating patients in each DRG.

Costing the DRGs [1]

Charas Suwanmala et al. stated that the Full cost calculation concept is applied in computing the DRG costs. Full cost of a DRG is a sum of all treatments' costs applied to the selected DRG. Full cost of a treatment is composed of direct and indirect cost.
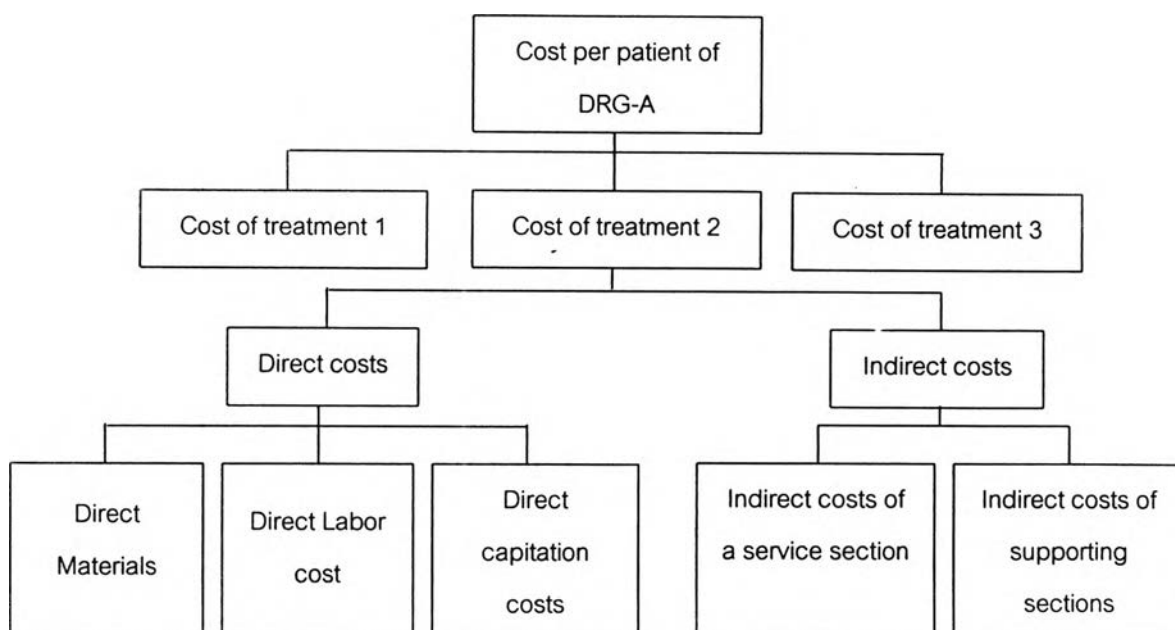
Figure 1: Combinations of DRG Full Cost

Costing DRG Methodology [1]

Direct Cost Estimation

    1. Determine the steps of treatment for the selected DRG.

    2. Determine the service departments.

    3. Determine the activities of each service (treatments) in a given service department.

    4. Tracing direct materials, direct labor, and direct overhead costs, that forgone due to the service delivery.

    5. Estimate costs of direct materials, direct labor, and direct overhead.

Indirect Cost Estimation

    1. Determine supporting departments and their activities.

    2. Estimate expenses incurred by an individual supporting department, the so-called " indirect cost".

3. Allocate indirect costs from supporting departments to the departments delivering the treatments.

4. Allocate the departmental indirect costs to individual treatments.

<u>Full Cost Estimation</u>

1. Calculate full costs of an individual treatment by summing up its direct and indirect costs.

2. Calculate full costs per patient of a DRG by summing up its related treatments' full costs.

2.3 Review of Related Literature

Charas Suwanmala et al. Studied costing the Diagnostic Related Group of Diseases (DRGs), A case study of Chulalongkorn Hospital in 1994. The cost of acute appendicitis was 7,819.25 baht per patient. Total average costs of appendicitis vary from 3,575 baht to 6,029 baht 8,257baht, and then jumping to 13,439 baht.