CHAPTER II

REVIEW OF LITERATURE

2.1. Basic Concept of DRGs as payment mechanism

DRGs prospective payment is a financing mechanism and method of regulation in which rates or levels of compensation are determined prior to the delivery of service and the hospital obtains the predetermined amount regardless of the actual cost that are incurred (Sorkin, 1992). On assumption that for the same type of treatment, the resources used should be the similar in every hospital. The prospective payment is claimed to provide hospitals with an incentive to contain costs.

Diagnosis related groups (DRGs) is a system that categorized patients into specific groups according to medical conditions. The classification is based on major patient's characteristic including main principle diagnosis, principle surgical procedures (if any), complications and comorbidities , age , and type of discharge. Other important associated factor that is use in classification is length of stay (LOS).

DRGs in Thailand were first introduced in 1993 for reimbursement of in-patients services under of the Protection for Motor Vehicle Accident Victims Act 1992 (Pannarunothai and Khunaratanapruk, 1997). Then it was implemented for the budgeting of the Low-Income Group Health scheme in 1995 and begins to use in some public hospitals in 1996. In 1998, the Health Insurance Office use DRGs payment method for reimbursement of high cost medical service with relative weights more than 2.5. Now under the Universal Coverage Health Insurance Scheme 2001, payment method for in-patient services between hospitals is based on DRGs.

In calculating the average cost for each DRGs in Thailand, studies are done in some sample groups of publics hospitals in order to obtain the unit cost for acute care in-patient services by allocation of all costs such as labor cost, material cost, capital cost to the final cost center which is in-patient department. Then another study was done in the same group of hospitals by collecting all individual in-patient records including charges per case and classify into similar groups by using the characteristics mention above by DRGs grouper software. Criteria in grouping are also from expert opinions, ICD-10 and ICD-9 CM. From these two studies, we can obtain the average charge per case of each hospital. Therefore the comparison of the unit cost per in-patient case and charges per case are set as cost-charge comparison ratio of the hospital. Adjustments from charges to cost in each individual record are adjusted by this cost-charge conversion ratio. Finally average costs of each DRG are then obtained by sum of total cost of all individual records of that DRG divided by total cases.

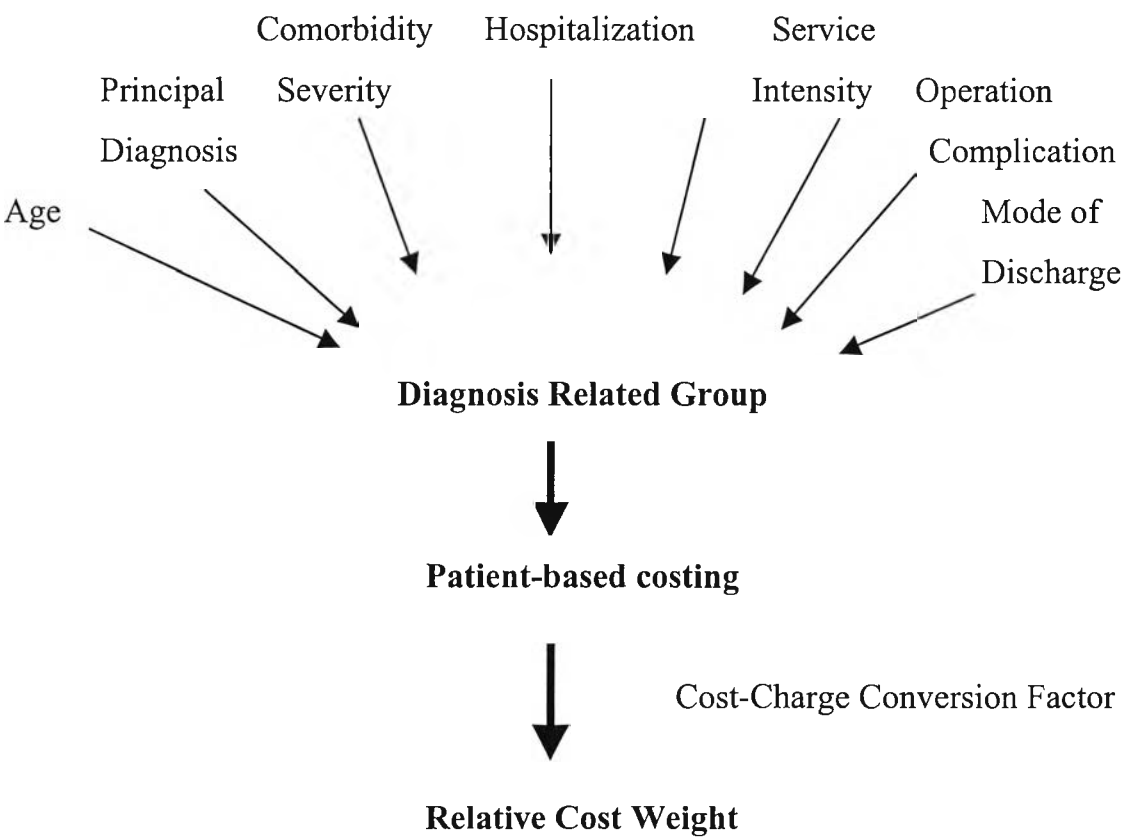
Relative weight (RW) for each DRGs reflects the average cost or average level of resources used for that in-patient service, then comparing the average cost means of each DRGs to the average cost for all patients. The weights are intended to account for cost variation between different types of treatments. More costly conditions are assigned higher DRGs weights. Relative weight could be calculated from the following formula.

$$RW = \frac{average\ costs\ of\ treatment\ for\ that\ DRG}{average\ costs\ of\ treatment\ for\ every\ DRGs}$$

The average standardized costs for each DRGs is calculated by summing the charges for all cases in the DRGs and dividing that amount by the number of cases classified in the DRGs. Statistical outliers are excluding from calculation for relative weight. There are many methods in trimming the outliers one method is

using only the data that are between quartile 1 and quartile 3 (from Nilsson and Erlo 1995, National casemix office 1991) or exclude cases that are outside three standard deviations of the average charge (Pannarunothai, 1998). Average cost could be calculated from arithmetic means or geometric means because the distributions of average costs are usually not standard normal distribution. For Health Care Financing Administration, the geometric mean was used instead of the arithmetic mean because the distribution of cases within each DRGs is skewed to the right. Use of the geometric means better enable the identification of unusually low and unusually high costs per cases.

Figure 2.1: Framework in calculating relative weight



(Pannarunothai , 1998)

Firstly, calculation of relative weights in Thailand was based on data of the Low-income Group Health Scheme. The base rate per relative cost weight (RW) was also originated from the payment of this scheme (Pannarunothai, 1998). The Health Insurance Office studied the full costs analysis of in-patient department in 9 provinces and founded that full costs (material cost, labor cost and capital cost) per RW were about 8,000-10,000 baht for each hospital. Material costs and the part of labor cost, which is not the salary, consist of 40% of the full costs. If operating costs were exclude from the full costs, the unit cost per one RW should be around 4,000 baht or 40% of full cost. Consequently is the reimbursement base rate per one relative weight of DRGs used for every hospital in the Ministry of Public Health under the Universal Coverage Health Insurance Scheme, since salary for hospital's personal were deducted at the central level already. For other hospitals, the operating costs were included in the re-imbursement rate, which is 10,000 baht per one relative weight of DRGs.

Since DRGs is a prospective payment method used to allocate budgets for hospitals. Different countries have different criteria in allocation of budgets. In Thailand, allocation of budget for Low-income Health Scheme (before implementing Universal Coverage Insurance scheme) used data of the relative weight from study of Pannarunothai (1998) and relative weight of out-patient service from Health Insurance Office to set model for allocation of budget to hospitals.

$$Budget = 13{,}290{,}178 + 130\,Pop + 34\,OPDRW + 550\,IPDRW$$

$$r^2 = 0.78137$$

Budget = Allocated budget

Pop = Low-income Health Scheme Population of Province

OPDRW = Relative weights of out-patient services

IPDRW = Relative weights of in-patient services

In Australia hospital in-patient funding policy in differs in different areas as stated in the Table 1.

Table 2.1: Australia Hospital In-patient Funding Policies, 2000-2001

Areas	Price for different hospital groups
New South Wales	▪ Fixed marginal activity component of 65% State-wide cost per case-mix weighted separation, applied across all peer hospital groups and all hospitals ▪ Variable infrastructure component reflecting underlying differences in cost between hospitals eg. Differences in cost due to location (such as higher patients transport costs in remote area)
Victoria	Payment varies for five hospital groups, adjusted for size
Queensland	▪ Prices based on four hospital groups (base payment price increases with size) ▪ Weight differ for different groups

Source: http://www.health.gov.au/casemix/hosp polic.pdf

Table 2.1: Australia Hospital In-patient Funding Policies, 2000-2001 (continue)

Areas	Price for different hospital groups
Western Australia	▪ Two groups for payments: Teaching or Non-Teaching (the latter, generally smaller, receive a lower payment) ▪ Access subsidy for rural and remote hospitals
South Australia	▪ Hospital specific "severity index" to cover additional days of stay not explained by DRG assignment applied to metropolitan, country regional and sub-regional hospitals ▪ Access subsidy for small hospitals
Tasmania	Casemix funding only applies to the state's three major hospitals. Model drives funding split.
Northern Territory	Price for each five public hospitals derived from national price with alterations to allow for remoteness factors.
Australian Capital Territory	Price vary according to hospital

Source: http://www.health.gov.au/casemix/hosp polic.pdf

In each area of Australia there are difference in criteria for budget allocation. For example, New South Wales Department of Health uses the following model for allocation.

$$R = a(N\Sigma P_I - 0.8Pr + O + H - I + G) + b(N\Sigma P_I) + cT$$

R = Allocated budget for each area

P_I = Population in each age group weighted with uses of DRGs resource in that area

N = Relative Need index

Pr = Activities in private hospital by DRGs weight

O = Labor activities minus delivery in private hospital

H = Treatment of high cost care

I = Activities between states

G = Net cross border service

T = Teaching and research hospital

a = constant for inpatient services

b = constant for non-inpatient services

c = constant for teaching and research hospital

In the United States of America, Health Care Financing Administration (HCFA) uses DRGs prospective payment for reimbursement of Medicare (Dalton, 2000). HCFA uses standardized charge to reduce different between data group by considering factors such as area wage level, indirect medical education, disproportionate share payment, hospital setting in urban or rural are and cost of living. DRGs payments are adjusted to take into consideration four factors, which are considered to reflect more, accurately the costs of services, provided by hospitals.

1.Application of a Wage Index

Salaries generally represent the largest component of hospital costs. Prevailing salary levels vary substantially among different areas of the country. Use of a single national or regional DRGs payment for all hospitals, without any consideration of prevailing wages, would severely penalize hospitals located in high-wage areas and unfairly benefit the hospital located in low-wage areas, which is defined as large urban, or other. Payment in high wage area is higher than low wage area.

2.Indirect Medical Education Costs

Teaching institutes are assumed to have higher costs than other institutions due to extra tests and procedures performed for teaching purposes and treatment of more serious cases. The DRGs payments for these hospitals are increased by percentage based on the ratio of interns and residents to hospital beds.

3.Cost Outliers

Medicare makes additional payment for cases with extremely high overall costs. The limits are established and must be met to qualify for " cost-outlier" payments. Cost outlier payments are not automatics; a hospital must make a specific request and must identify the actual costs associated with each outlier cases.

4.Disproportionate Share Payments

Disproportionate share hospitals are hospitals that treat a large percentage of low-income patients, including Medicaid and Medicare beneficiaries. Additional payments to the hospital are paid to account for the cost of treating this population.

In addition to the four factors discussed above, there are other factors considered in calculating DRGs payment depending on whether the hospital is considered a sole community hospital, a Medicare dependent rural hospital, or a regional referral hospital. Referral hospitals are reimbursed according to the payment rate for large urban area.

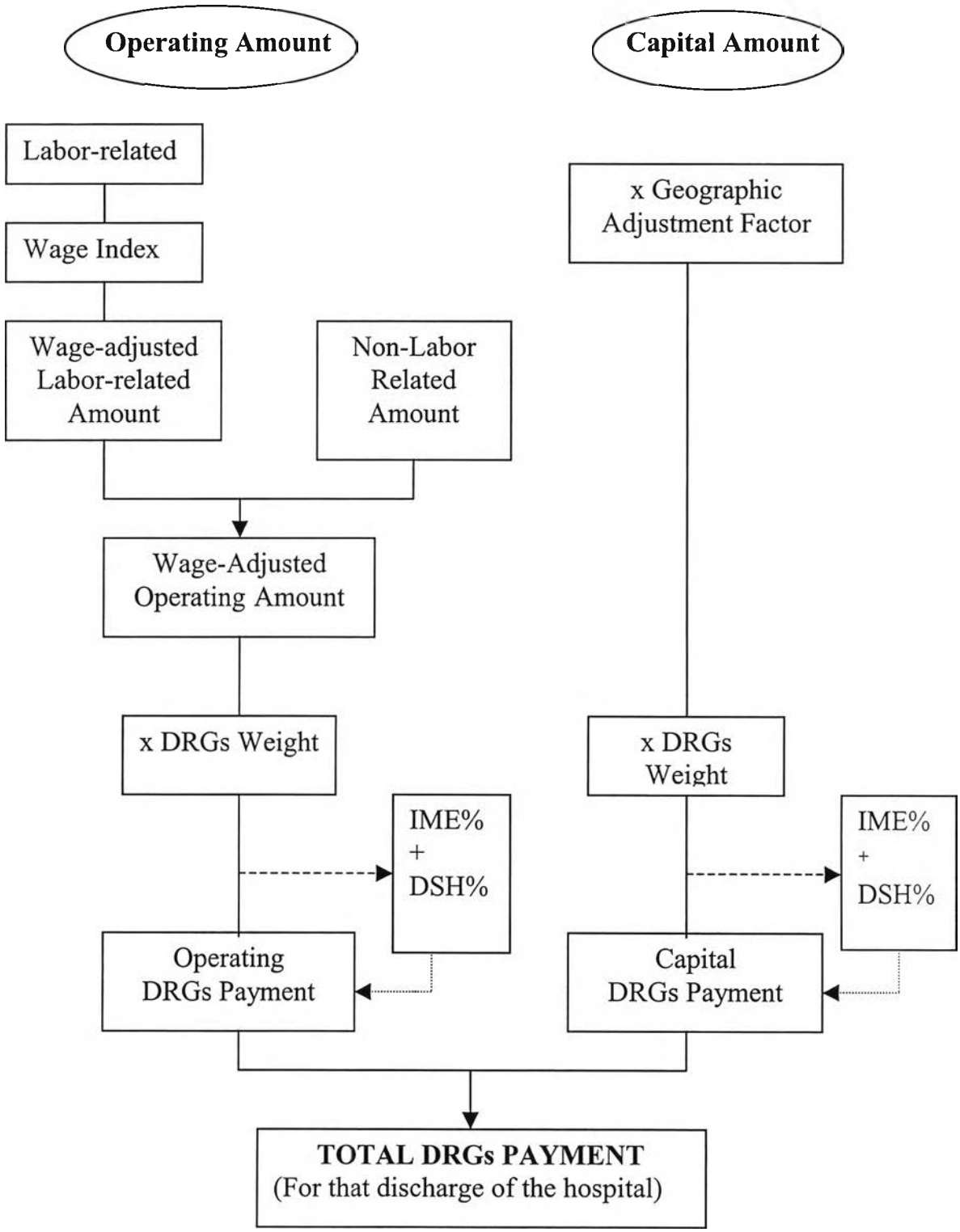
Most PPS are paid based on the sum of two-fixed amount per Medicare discharge, that are called the standardized payment amounts. Each case receives both an operating payment and a capital payment. The operating standardized amount is separately computed for hospitals located in large urban areas, and for those located in all other areas (i.e. smaller urban and rural combined).

Both the operating and the capital standardized payment amounts are multiplied by a resource weight according to the diagnosis-related groups (DRGs) that is assigned to each discharge. Other special adjustments are made to the standardized amounts for teaching hospitals (the indirect cost of medical education IME percent add-on) and hospitals serving a " disproportionate share " of indigent patients (the disproportionate share hospital DSH percent add-on).

The standardized amount for operating costs is itself made up of two components. One is considered " labor related ", and the other is " non-labor related ". The labor-related component is multiplied by the hospital wage index; the non-labor related component is not. The wage index ranges in value from about 0.70 to 1.30. It is intended to adjust for relative wage differences across different region of the country.

The Prospective Payment Assessment Commission (ProPAC) and Department of Health and Human Service are responsible to set and updating the DRGs rate. The process of updating payment rates would account for new medical technology, inflation, and increase productivity changes in case-mix index and other factors that affect the cost of providing care.

Figure 2.2: Framework for calculating DRGs payment for HCFA



Source: http://www.shepscenter.unc.edu

From the study of Chongsuviwatwong, Sujariyakul and Pannarunothai (2000) by analyzing impact on hospital revenues from the effect of DRGs payment if it was introduce. Data are from Low-income Health Scheme in-patients DRGs in 39 hospitals from community, general, regional and university hospitals. Expected revenue was computed from regression models using total hospital charges (the fees that hospital would have collected from patients if they were not exempted) as the dependent variables. Relative weight of each patient was the predictor variable of main interest. The level of hospital was used as an adjustment factor.

Four proposed models were presented as follows:

Model A: $R_A = a_A \times RW$

Model B: $R_B = a_B \times RW + Con_B$

Model C: $R_C = a_C \times RW + b_i \times Level_i + Con_{Ci}$

Model D: $R_D = a_D \times RW + b_i \times Level_i + c_i \times (Level_i \times RW) + Con_{Di}$

Model A is the original model where expected revenue is the product of the base rate and RW. Model B inserts the constant term indicating that each admission has an average fixed cost. Model C allows different fixed costs in different levels of hospitals. Model D allows different base rates as well as different average fixed costs for different levels of hospitals. The results from all models show that in regional hospitals, government hospitals in Bangkok and university hospitals, the revenues would be reduced. On the other hand, in community hospitals and general hospitals, the revenues would be increased. If the DRG payment based on Model A or Model B is used, there might be resistance from hospitals who lose (regional hospitals, government hospitals in Bangkok and university hospitals). Consequently, community hospitals and general hospitals would receive higher revenues. If Model C or Model D were used, all hospitals would have the expected revenue close to the actual charge. In other words, they would have a little net revenue gain or loss if the models were proposed.

2.2. Factors determining hospital cost

The focus of this study is the factors effecting on average total hospital charges for in-patient services, which implies to hospital costs.

Breyer (1987) reviewed many literatures and suggested a list of hospital and patient-related characteristics to used in hospital cost analysis:

- Capacity (bed size)
- Global indicators of hospital activity such as case flow, average occupancy rate or average length of stay
- Case-mix, measured by the proportion of patients in various diagnostic categories, defined by classification code
- Wage level of hospital employees
- Teaching status
- Indicators of hospital facilities and services
- Characteristics of the market for in-patient services with regional income level, physician density or hospital bed density

Santerre (1996) suggested that the determinants of hospital costs and utilization are these factors:

- Case mix
- Input prices
- Number of admitting physicians
- Occupancy rate
- Admission rate per 1000 population (Increase usage)
- Outpatients visits per 1000 population

Hospitals with more beds appear to have higher average cost. Larger hospitals typically serve a more expensive case-mix, have higher occupancy rates, and also higher average costs (Freidman and Pauly, 1981). Watts and Klastorin (1980) studied the impact of case-mix on hospital costs and founded that as average bed size increases, the average value of all case-mix measures increases.

Supachutikul (1996) analyzed the unit cost and related factors of 89 general and regional hospitals in Thailand by estimating unit cost model due to expenditure and unit cost model per service unit. The dependent variable is in-patient cost per case and independent variables are length of stay, case flow rate (occupancy per bed per year), regional hospital and death rate in hospital. The study found that unit cost for in-patient services in small hospitals (less than 200 beds) is higher than medium sized hospitals (200-600 beds) from high proportion of labor cost. Unit cost for in-patient services in regional hospitals (more than 600 beds) is significantly higher than small sized hospitals due to average length of stay.

In some circumstance, if a hospital becomes sufficiently large, the burden of administration may become so great that average cost would rise (Sorkins, 1992). If the size of hospitals were increased (with constant utilization rates), their geographic service area would expand and consequently average travel costs (for both doctors and patients) would raise. Two hospitals that produce the same range of services may have different average cost because they produce different proportion of these services or a different range of services associated with a different case mix. Moreover, large hospital may have more patients that are seriously ill. Then, unless difference in patient health status are considered the observed relationship between cost and size is that larger hospitals have higher per unit cost.

Capacity utilization is a measure of the intensity with which hospital capacity is used. Therefore, it could be proxy by the ratio of hospital output per period to hospital capacity (Faher, Fung and Harper, 2000). This ratio is also

known as the 'Case Flow Rate' (CFR). For a given hospital capacity, the relationship between average cost and the case flow rate is hypothesized to be quadratic. At low case flow rate, increases in capacity utilization are expected to lower short-run average cost as the fixed costs of hospital plant and administration are spread over larger output of treatment services. At higher levels of capacity utilization, however, further increases in the case flow rate are expected to raise average cost as the more intense used of fixed capacity begins to crowd existing facilities and raise average variable costs at a faster rate than average fixed costs decline. The standard measure of case flow rate is the number of cases per bed per year.

Wage and salaries are a significant component of a hospital's operating expenses. Pannarunothai and Kongsawatt (2001) studied in-patient unit cost for 17 community hospitals, 3 general hospitals, and 3 regional hospitals found that material cost and labor cost is account for 39% of total cost in community hospitals, 57% in general hospitals, and 70% of total cost in regional hospitals. The recurrent costs per relative weight are different in each level of hospitals also. While average relative weights for each level of hospital are 0.58 in community hospitals, 0.66 in general hospitals and 0.91 in regional hospitals.

Hospitals case-mix or DRGs index refers to the varieties of illness that are treated in the hospital. Case-mix index is generated by dividing the severity-weighted sum of hospital admissions, in which DRGs cost are measures of illness severity weighted by total number of admissions. Watts and Klastorin (1980) used a cross sectional sample of 315 short-term general hospitals in the United States of America, to compare the ability of various measures of case-mix to explain the variation in average cost per admission per hospital. The study uses 10 cases-mix variables and proxy variables, including the number of beds in the institution. The study found that as average bed size increases, the average value of all case-mix measures increase. Difference in the average value of case-mix variables also was

หอสมุดกลาง สำนักงานวิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

examined for hospitals in urban and rural area, case-mix variables appear consistent and significant between rural and urban but the basic service appears equally in urban and rural hospitals. Four element variables counted the number of facilities and services in each four services categories (basic service, quality-enhancing services and complex services) and the weight sum of a number of facilities and services reported by the hospital. The study was able to explain 70% of the inter-hospitals variation, due to four service categories.

Pettengil and Vertrees (1982) estimated a hospital cost function, relating the Medicare average cost per case, to a set of independent variables including the Medicare case-mix index. The empirical evaluation methodology was adopted to assess the validity of the index. The evaluation suggested that 20 percent of the samples did not provide enough cases, for a reliable estimate of the hospital Medicare case-mix index value. For the remaining 80 percent of the sampled hospital, the Medicare case-mix index was a powerful predictor, explaining about 30 percent of the variation in Medicare average cost per case.

In hospital industry, the most commonly used measures of cost per unit of output are total cost per day and total cost per admission. Among the health-specific factors, changes in the intensity of medical treatment have been the single most important source of expenditure growth. Advances in medical technology have increased hospital costs (Sorkins, 1992). Unlike firms in other industries that can reduce costs by substituting capital for labor, the utilization of new capital equipment by hospitals often requires they employ more skilled personnel to operate the new equipment. The results are an increase not only in the average cost of capital equipment and labor but also in the number of full time equivalent employee per patient day. Numbers of admitting physicians also contribute to higher average cost per out, especially if that hospital has many board certified physicians. Hospital tends to have more highly technology equipment for services of more sophisticate care provide by these physicians.

Improvement in medical technology tends to increase cost and improved quality induces consumers to pay more for hospital care. Hence, the observed increase in the cost of care might be attributable more to improvements in quality than inefficient operation, suggesting that an assessment of efficiency and valid comparison of costs requires more homogenous measures of output. Change in per-diem costs can be distributes among four components

1. More personnel per patient day
2. Higher wage rates
3. Increase use of non-labor inputs per patient day
4. Higher price for non-labor inputs

Hospital total admissions are one of the measures of hospital's output. High admission rate may indicate high outputs but does not mean high degree in severity case-mix. Admission rate is a factor that may related to cost of in-patient services, hospital that tends to admit patients easily will have high total relative weight than hospital that does not admit easily but leads to higher cost of service also. Referral rate of hospital may indicate the capacity of that hospital in intensity of providing complicate health care services. Therefore, both factors may have some influence to the average cost of output.

In the United States of America, heavily populated or urbanized areas tend to serve mainly indigent and low income patients which lead to " bad debt ". As mention earlier in this chapter both Medicare and Medicaid pay additional "disproportionate share" (DSH) payment to hospital with large proportion of low-income patients. Medicare DSH payments are intended to compensate hospitals for the higher costs of treating low-income patients, including additional resources needed because such patients may be more severely ill or have a great burden of illness. For example, because of inadequate primary care on average and their

treatment should require more resources per admission, even if in the same diagnosis related group. Medicaid provides DSH payments to compensate hospitals for the "special needs" of low-income patients.

Kominski and Long (1996) estimated differences in Prospective Payment System adjusted cost and outlier-adjusted length of stay for low-income patients relative to matching non-low-income cases from the same hospital in 85 high-volume DRGs and founded that low-income Medicare do not have costlier hospital stays, although their stay are longer 2.5%. They conclude that disproportionate share payments are not justified on grounds of higher treatment costs.

It has long been recognized that teaching hospitals have higher costs per case than do non-teaching hospitals (Sloan, Feldman and Steinwald, 1983). Researcher have attempted to determine, whether the higher costs of teaching hospitals are due to the cost of medical education or other factors with severity of the hospital case-load. There were mixed results in the empirical studies conducted in the United States of America. Some studies suggest that medical education increase the cost of hospital care for similar group of patients, through increase numbers of diagnostic tests. When resources were used to weight case-mix measurement (DRGs), teaching hospitals were found to have more serious case mix (Goldfarb and Coffey, 1987). Other studies found that teaching and non-teaching hospital cost difference were reduced significantly, when hospital case-mix measures were included (Watts and Klastorin, 1980). The Health Care Financing Administration (HCFA) used regression analysis to develop a basis on which to pay for level of teaching activity under prospective payment system.

Sloan et al (1983) use data from 5,000 hospitals, and employing a double-log functional form, HCFA regressed the average cost per case on the case-mix index (the more complex, on average, a hospital's cases, the higher its case mix), nurses wages, number of beds, three dummy variables for the size of the metropolitan area, and the intern and resident to beds ratio (IR). For each increase

of 0.1 in the ratio of intern and residents to beds, teaching hospitals received an add-on of 11.58% over and over what was received by hospitals with no interns and residents.

Since DRGs payment method is based on historical data, one of the biggest problems with these data is that they are influenced by change in price levels-namely inflation (Finker, 1994). To make data useful for estimating future cost, it is necessary to adjust, or index the historical information of inflation. The consumer price index (CPI) indicates the general rate of inflation for consumer purchases. Price indices are used as a basis for adjusting various financial measures for inflation over times. Therefore DRGs rates should be adjusted each year based on market basket index. Also consumer price index differences in the areas of which hospital is located may have some effect on input prices.

From the previous reviews, many factors may contribute to variations in average cost or average charge of providing in-patients services in different hospitals. The factors that used by HCFA for re-imbursement criteria are wage-index, case-mix index, geographic factors, teaching status and percent of disproportionate share. While the factors used in Australia are somewhat the same but have some more focus on relative need index, population in each age group and some activities in hospital. Others factors suggested are capacity of hospital, case flow rate, number of admitting physician, admission rate and outpatients visit. This study will focus on some more other factors that may have effect on average charge such as high medical technology, income per capita and cost of living index etc. Further investigation should be taken to figure out which factors are significantly related and reflects the charge of in-patients service based on DRGs.