UNIVERSITY OF ALBERTA

AN INTEGRATED CASE MIX ANALYSIS OF THE GOVERNMENT OF ALBERTA INPATIENT ACUTE CARE FUNDING FORMULA

by

KAUL J.B. ©

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ABSTRACT

The Acute Care Funding Project is an undertaking by the Government of Alberta to restructure the mechanism by which acute care hospitals are funded. To date only the inpatient component of the project has been implemented. Hospitals, since 1989, have been funded for their inpatient portion of the budget, in accordance with a funding formula derived by the Case Mix Institute of Queens University, Ontario. A lack of any coherent documentation explaining the infrastructure of this formula has left hospitals in a void. They have been unable to critique the formula's redistribution of dollars between hospitals that have complex organizational cultures and that vary vastly in size, location, case mix of patients treated e.t.c.. Preparing annual budgets knowing that the formula may affect each subsequent years funding radically has made planning an uncertain and risky task.

The University of Alberta Hospitals have in conjunction with the Mechanical Engineering Department of the University of Alberta, funded a study attempting to recreate the precise mechanism by which funding is redistributed. In addition, a case mix group analysis was done to examine specific areas of concern that the hospital has with the funding formula, the internal affects of physician practice and variable resource utilization between patients.

Through a greater understanding of the formula and its strengths and weaknesses, hospitals will be able to react quickly to funding adjustments and ensure that quality patient care is provided at all times.

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I THE ACUTE CARE FUNDING PROJECT

1. Introduction

1.1 Purpose

The purpose of this study was twofold. First, to simulate the Case Mix Institute Inpatient Acute Care Funding Formula for Alberta. In so doing, the methodology used to calculate the Hospital Performance Index (HPI) was developed, and applied to recreate the HPI for the University of Alberta Hospitals. Second, to undertake a detailed study of eleven selected diagnosis related groups. The results of this study were used to assess the adequacy of the diagnosis related group classification system to explain variability in patient resource utilization and to list areas of concern such as the ICD-9 coding, length of stay as an appropriate cost proxy, etc. Through studying the eleven diagnosis related groups an appropriate protocol was also established such that similar studies can be undertaken on a continual basis.

1.2 Background Information

The Acute Care Funding Project was undertaken in December 1988 to respond to the various funding reports and studies conducted over the last decade, which consistently observed that the existing hospital funding system needs change. To date, only the Inpatient component of this project has been implemented. The remaining components that are still in the blueprint phase, include:

Outpatient services, fixed facility costs (Facility Support), shared services, research and educational activities and new or special programs.

Given the enormous importance of changing the hospital funding system, not just in terms of redistributing dollars between hospitals but in terms of the system's impact on public goals, the acute care funding project should be subject to careful scrutiny. If hospitals, and indirectly the public, are to buy into a system one should insist that one knows a good deal about the system, there should be as few grey areas as possible.

1.2.1 Inpatient Services

Prior to 1988, hospital funding was based on the labour, supplies and services used to provide patient care and other services. Now, however, funding is based specifically on the actual services provided for patients requiring care, (examples include hip replacements, myocardial infarction and so on). All of the costs related to each distinct service or Case Mix Group (CMG) are combined into a service rate. Within each case mix group, this service or funding rate has differing levels reflecting variations in patient severity of illness and resource utilization. An important point is that the funding for inpatient services is only for the medical or surgical treatment procedure costs. Additional costs, such as the facility support costs, are funded separately.

1.2.2 Outpatient Services

Once the outpatient or ambulatory care component of the Acute Care Funding Project has been implemented, it will similarly allocate funding based upon the types of services provided. Outpatient services have been outlined as incorporating emergency, day surgery, clinics, diagnostic and therapeutic services[1]. A customized funding mechanism will be established for each area.

1.2.3 Facility Support

Facility differences in size, design, building systems and equipment, age and location will influence the overall resource consumption rates between hospitals. The influence of facility factors, however, has not yet been studied, and only when comprehensive and consistent financial and statistical data are available will facility support be incorporated into the funding mechanism.

1.2.4 Other Funding Elements

Shared services will also be funded separately under the funding project. Such services will include, for example, laboratory and laundry services provided by one hospital to another, or between hospitals and other publicly funded organizations. Hospitals, if permitted to provide services to non-publicly funded agencies, will account for these costs separately and allow for such private sector costs as overhead and taxes.

Two further funding elements are research and education costs. These elements include direct costs, such as the schools of nursing, and indirect costs, which are less readily identifiable, and incurred by having medical interns and residents.

The last funding element in the model, New or Special programs, separates the operational costs of specialized hospital research (separate from that funded through the Alberta Heritage Medical Research Foundation).

1.2.5 Role Statement

All the services of the funding elements operating within each hospital have been described in a document prepared by each hospital using a standard format. This document or **Role Statement** articulates the types and volumes of services currently provided. The objective of the role statement is to promote a sharing of information between hospitals, thus revealing gaps in services and areas of duplication. They are also being used to develop short-term goals and long-term system objectives. The result is a form of contract, whereby Alberta government payments to the hospitals will be based on the services each provides.

1.2.6 Information Requirements

Regardless of intensive research, hospital and government commitment, and prior planning, the Acute Care Funding Project's successful implementation is dependent upon a comprehensive, consistent and timely information system. The data required must include financial, statistical and clinical information.

Financial and statistical data will be provided by each hospital following the Management Information System (MIS) framework. MIS is a Canadian undertaking involving the hospital associations and government and it is presently in the process of being implemented in all Alberta acute care hospitals.

Clinical data for inpatient discharges are now reported by all Alberta acute care hospitals using the International Classification of Diseases version nine with clinical modification[a] (ICD-9-CM). The Health and Medical Records Institute (HMRI) of

Ontario assist hospitals by verifying data and by producing comparative utilization reports. In addition to submitting inpatient discharge data to HMRI, acute care hospitals also submit a monthly update, containing all patient abstract data, to Alberta Health. In this way, Alberta Health is in a position to calculate inpatient funding for all hospitals by November for the previous fiscal year (April 1 to March 31). A system which captures outpatient clinical data accurately is also being developed.

Traditionally, only financial data have been audited. In the long term, however, since the funding mechanism relies on the accuracy of the statistical and clinical data a mechanism must be developed to ensure that this information is also reliable and consistent across hospitals.

1.2.7 Project Organizational Structure

As outlined in Figure 1.1 the line of authority for each of the components is decentralized. However, the health minister (presently Nancy Betkowski) and Steering Committee retain responsibility for the overall policy direction.

Steering Committee

The Steering Committee Membership consists of representatives from the Alberta Hospital Association (AHA), the Alberta Medical Association (AMA), the Alberta Association of Registered Nurses (AARN), the Council of Teaching Hospitals of Alberta (COTHA) and Alberta Health.

Working Committees

The working committees have been established drawing members from various

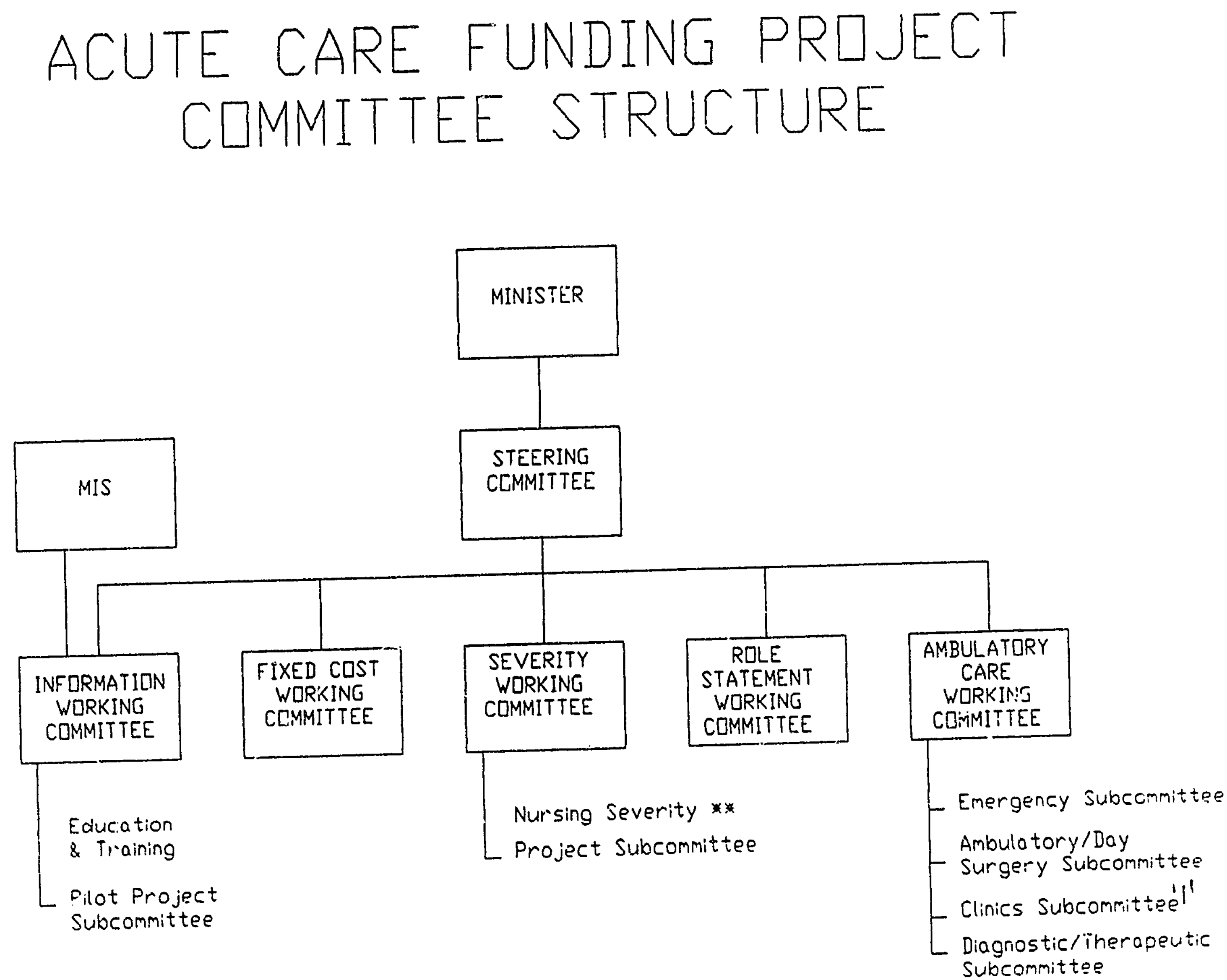


Figure 1.1 Organizational Structure of the Project

disciplines representing project hospitals and government. The funding aspects addressed by the working committees include inpatient services, outpatient (ambulatory) services, facility support (fixed/variable costs), hospital role statements and inter-hospital comparative information requirements. Each working committee has established objectives and a work plan which includes reporting recommendations back to hospitals and government.

Project Hospitals

At the outset, it was decided that in order to make the project manageable, it would focus on the 29 largest acute care hospitals in Alberta. This group as outlined in table 1.1, includes those Alberta hospitals with 60 or more acute care beds. Whether additional hospitals should be included in the funding framework is presently being assessed by Alberta Health.

1.2.8 The Official Mandate

Before proceeding, one must have a clear understanding of the underlying principles or **Funding Issues** that were recognized by the steering committee and sought to be solved through the implementation of the new funding framework throughout Alberta. The six funding issues as proposed in the initial mandate were as follows:

1. **Fairness and Equity:** Current policies, standards and funding guidelines do not always provide a fair and equitable allocation of available resources.

2. **Severity of Patient Illness:** Patients with a similar illness often experience different levels of illness severity, and these variations which consume differing amounts

Table 1-1 Acute Care Hospitals Within Funding Framework

ALBERTA ACUTE CARE HOSPITAL	BEDS
CARDSTON	60
DRUMHELLER	70
W.J. CADZOW - LAC LA BICHE	72
IMMACULATE, WESTLOCK	80
STURGEON, ST. ALBERT	100
BROOKS	70
PEACE RIVER	71
HIGH PRAIRIE	75
MEDICINE HAT REGIONAL	290
RED DEER REGIONAL	349
CALGARY DISTRICT (2 sites)	795
FOOTHILLS	705
HIGH RIVER	65
MISERICORDIA	540
WETASKIWIN	135
ST. JOSEPH'S, VEGREVILLE	70
QE II GRANDE PRAIRIE	238
SALVATION ARMY, GRACE	82
BONNYVILLE	65
ST. MARY'S, CAMROSE	117
LETHBRIDGE REGIONAL	264
CAMSELL	335
ROYAL ALEXANDRA	932
ST. MICHAEL'S LETHBRIDGE	202
LEDUC	68
EDMONTON GREY NUNS	519
UNIVERSITY OF ALBERTA	979
CALGARY GENERAL (2 sites)	918
FORT MCMURRAY	142

of resources, are not recognized in the current funding system.

3. **Separating Inpatient from Outpatient Services:** The trend toward increased outpatient treatment suggests inpatient and outpatient services should be separately recognized and funded.

4. **Policy Direction:** Clear, consistent hospital service policies from government, both short and long term, are needed.

5. **Incentives:** Hospitals need positive incentives to improve productivity while providing quality patient care in an era of expanding technology and restricted resources.

6. **Inter - hospital payments:** The current system, focusing on individual hospitals, restricts opportunities for hospitals to share expertise and services for improved productivity and better use of available resources.

1.3 Methodology And Scope

The inpatient component of the acute care funding project (i.e. the inpatient acute care funding formula) has been in place as of the fiscal year 1988-1989. The first part of this paper will focus on each component within this funding model. Each component will be examined so that ultimately the formula, as it is presently being calculated, can be recreated. The ability of Alberta Acute Care Hospitals to recreate the funding model, has to date been unsuccessful. This is mainly due to the lack of information released by the Case Mix Institute of Ontario (the architects of the funding model) describing the specific mechanisms involved in calculating the formula and also due to the widespread ignorance as to the size of the impact that the formula will have on funding to all acute care hospitals in Alberta. Recognizing the global impact on funding, that this formula will have, and the need to be able to set forthcoming budgets with some level of certainty as to how many funding dollars can be expected, has spurred the University of Alberta Hospitals in the effort to recreate the funding model as soon as possible. The second part of this paper will address specific services (case mix groups-CMGs) offered within the University of Alberta Hospitals. In all, 11 case mix groups were selected for study. A cost analysis was undertaken for a random sample of 30 patients within each CMG. The cost analysis captures only the resource utilization for the medical or surgical procedures that each of the patients underwent. In this way, the data exposes specific areas of concern that the University of Alberta has, captures a best demonstrated cost for each of the case mix groups and provides for a protocol that can be repeated in order to react quickly to the funding formula.

2. Patient Classification Systems

2.1 The Evolution of Case Mix as a Basis for Hospital Payment

The measurement of case mix, the number and types of patients or diseases treated by a health care provider, is conceptually distinct from questions of payment for services. However, the roots of current case mix measurement lie in the development of hospital payment systems and the analysis of hospital costs that underlies that development.

Shortly after the introduction of Medicare's "reasonable cost"[2] reimbursement in 1966, policy makers and hospital administrators alike recognized the potentially inflationary incentives of cost-based systems, in which hospitals could increase revenues by increasing their costs[3]. With the intent of limiting the increase in health care costs, work began on the development of alternative methods of payment. The requisite process of collecting data on hospital costs quickly revealed that costs vary greatly between hospitals, even those located in the same community. This variation reflects, in part, the diversity among institutions. It is mostly due to differences in the scope of services provided and in the size of teaching programs. In order to develop equitable payment methods, a more appropriate way to account for the differences in hospital characteristics and costs was needed.

Efforts in the late 1960's and early 1970's focused on the development of a prospective payment system by using such characteristics as bed size, location, average length of stay, teaching status, staffing patterns and the array of services provided[4][5][6].

However, as this analysis progressed, it became increasingly evident that although these characteristics were significant the most important differences among hospitals were in the kinds of cases they treated. Focusing on the mix of patients treated, rather than hospital characteristics, provides a more sensitive measure of the unique characteristics of any given institution and helps account for the substantial variations in costs among hospitals[7][8].

2.2 Systems of Measuring Case Mix - Patient Classification Systems

The main patient classification system, used for measuring specific services or case mix, in the United States is Diagnosis Related Groups (DRGs). In Canada it is Case Mix Groups (CMGs). Other systems of measuring case mix and the severity of illness have also evolved. These systems are not widely in use and are therefore, addressed only briefly.

2.2.1 The DRG Classification System

DRGs were developed in the early 1980's, by Fetter et al at Yale University[9], in an academic effort to test new methods of computerized classification techniques, however, developers quickly recognized their potential utility for financial management and rate setting. DRGs gained considerable support from the United States federal government operating under a 1972 congressional mandate to develop new reimbursement systems. As a result, the development of DRGs and DRG based payment systems moved so quickly that the intellectual infrastructure of DRGs still remains rather underdeveloped. Literature is also comparatively scanty and many important issues are still not very well understood.

The DRG classification system was developed and shaped by one fundamental constraint and two sets of basic trade-offs:

ONE FUNDAMENTAL CONSTRAINT

1) Developers made a commitment to develop and maintain a classification system employing data routinely collected and reported by hospitals, as defined in the uniform hospital discharge data set (UHDDS)[33], with diagnostic information coded according to the ninth revision of the international classification of diseases (ICD-9)-CM[9].

TWO BASIC TRADE-OFFS

1) Developers tried to strike a balance between the precision of individual DRGs and the need to keep the total number of classes (groups defining a specific diagnosis) within reasonable limits.

2) The system must be plausible to physicians and surgeons.

2.2.2 A Description of DRGs as an Inpatient Reimbursement System

The purpose of DRGs as an inpatient reimbursement system is to relate the demographic, diagnostic and therapeutic characteristics of patients to the service they receive. Cases are thereby differentiable by only those variables related to the condition of the patient (i.e. age, primary diagnosis) and treatment process (i.e. surgical) that affect his/her utilization of the hospital's resources.

The DRG classification system uses primarily ICD-9-CM diagnosis and procedure codes to create groups of patients homogeneous with respect to resource consumption. The assignment of a DRG to a patient is also based on information about the patient's age, sex and discharge status (i.e. Early Death). Co-morbid (Pre-existing) conditions and complications, as secondary diagnoses, also influence assignment.

Hospital discharge abstracts generally contain all the data necessary to determine a patient's DRG. Patients are initially assigned to a Major Diagnostic Category (MDC). There are 27 MDCs representing the major organ systems (see Table 2.1). The subsequent split to a DRG is then based upon the above stated criteria and also whether the patient underwent a medical or surgical procedure.

There are presently 477 DRGs. The implementation of prospective payment for hospital Medicare patients in the United States using DRGs has profoundly influenced the revision of DRGs and the development of all other patient classification systems. Because of the DRG-based hospital reimbursement, the groups are revised regularly in order to maintain their clinical relevance. An example would be the inclusion of a group to classify Aids patients.

In summary then, the goals of the DRG reimbursement system were to develop the following clinically coherent groups based on consumption of resources:

1) Homogeneous medical categories with similar case management processes for all patients within a given category.

2) Classes defined in terms of data, readily available from a hospital's patient discharge abstract database.

Table 2-1 Major Diagnostic Categories

MAJOR DIAGNOSTIC CATEGORY NUMBER	MAJOR DIAGNOSTIC CATEGORY DESCRIPTION
01	Diseases and Disorders of the Nervous System
02	Diseases and Disorders of the Eye
03	Diseases and Disorders of the Ear, Nose and Throat
04	Diseases and Disorders of the Respiratory System
05	Diseases and Disorders of the Circulatory System
06	Diseases and Disorders of the Digestive System
07	Diseases and Disorders of the Hepatobiliary System and Pancreas
08	Diseases and Disorders of the Musculoskeletal System and Connective Tissue
09	Diseases and Disorders of Skin, Subcutaneous Tissue and Breast
10	Endocrine, Nutritional and Metabolic Diseases and Disorders
11	Diseases and Disorders of the Kidney and Urinary Tract
12	Diseases and Disorders of the Male Reproductive System
13	Diseases and Disorders of the Female Reproductive System
14	Pregnancy and Childbirth
15	Newborns and Neonates with Conditions Originating in Perinatal Period
16	Diseases & D. of Blood and Blood-Forming Organs & Immunological Disorders
17	Lymphoma, Leukaemia or Unspecified Site Neoplasms
18	Multisystemic or Unspecified Site Neoplasms
19	Mental Diseases and Disorders
20	Alcohol/Drug Use and Alcohol/Drug Induced Organic Mental Disorders
21	Injury, Poisoning and Toxic Effects of Drugs
22	Burns
23	Other Reasons for Hospitalization
24	HIV Infections
25	Multiple Significant Trauma
98	Unrelated O.R. Procedures
99	Ungroupable Data

3) Mutually exclusive classifications with a manageable number of classes.

4) Similar length of stay and total resource use of patients within any class.

2.3 Canadian Case Mix Groups (CMGs)

In 1983 the Hospital Medical Records Institute (HMRI) introduced a Canadian version of the DRG classification system for resource management applications by the Hospital Medical Records Institute. It contained a number of similarities to the American DRG system in addition to several unique features. CMG like the DRG system, utilizes the diagnosis and procedure codes as well as age ,sex, and discharge status to assign patients to a group (Figure 2.1 and Figure 2.2). In addition, the HMRI system originally composed of 23 Major Clinical Categories (MCCs corresponding to MDCs in the DRG framework). As of April 1990, however, these were expanded to 27 categories resulting in the present number of 553 case mix groups. Gaps have been built into the CMG system to allow for future expansion such that the numbers assigned to the CMGs differ from those of their DRG counterparts.

It should be made clear at this stage, that although the Case Mix Group Classification system is utilized by many Canadian hospitals for purposes such as resource management, control of variations in drug utilization by physician and patient type, inter-hospital comparisons of services e.t.c, the funding formula in Alberta uses the U.S. DRG based classification system in categorizing patients and all subsequent calculations. The Case Mix Institute, in developing the funding model, chose the DRG based system due to the large database of patient related information that was readily available at that time and likewise the lack of equivalent information on the CMG Canada wide database. As the CMG based system develops, however, many questions arise as to whether a switch from the U.S. based DRG system to the Canadian based CMG system will eventually be necessary. These issues are dealt with in more detail in chapter five.

2.4 The Three Basic Differences between U.S. DRGs and Canadian CMGs)

CMGs are assigned for use with the ICD-9 (International Classification of Disease) coding convention rather than the ICD-9-CM currently used by DRGs. Clinical Modification (-CM) involves the use of an extra digit for certain diagnoses and procedures to further specify the disease classification.

2) Assignment to a CMG is based on the 'Most Responsible Diagnosis'. This describes the condition which consumes the most hospital resources during a specific patient length of stay. It can therefore, be a condition which is acquired or detected only after admission. DRGs are assigned on the basis of the 'Principal Diagnosis' which is the condition for which the patient was admitted.

3) Only co-morbid or secondary conditions which are actively managed during the hospital stay are included from the discharge abstract for CMG assignment. For example, a diabetic who is hospitalised for another condition would only be coded for diabetes as a co-morbid condition if that disease required active medical management during that particular hospitalisation. DRGs do not segregate co-morbid conditions in this manner, but rather have a restricted list of co-morbid conditions. Therefore, the

existence of diabetes as a co-morbid condition is not considered as a co-morbid condition in the DRG system whether or not it was actively managed dur g the hospitalisation[10]. The implication of this discrepancy between the two systems, means that, all acute care hospitals in Alberta will receive funding only for the principal diagnosis treated and a restrictive list of co-morbid conditions. Any co-morbid conditions that are also treated but that fall outside of the restrictive DRG list of secondary conditions will not be recognized and thus the hospital will receive no funding for the resources consumed in such treatment procedures. A patient, therefore, admitted for a heart transplant who also has active medical treatment for a co-morbid diabetic condition, during any given hospitalization, will only be funded for the transplant procedure. The repercussions that this has on the equitable distribution of global funding dollars will undoubtedly be larger for institutions such as the UAH which treat approximately 30,000 inpatients per year.

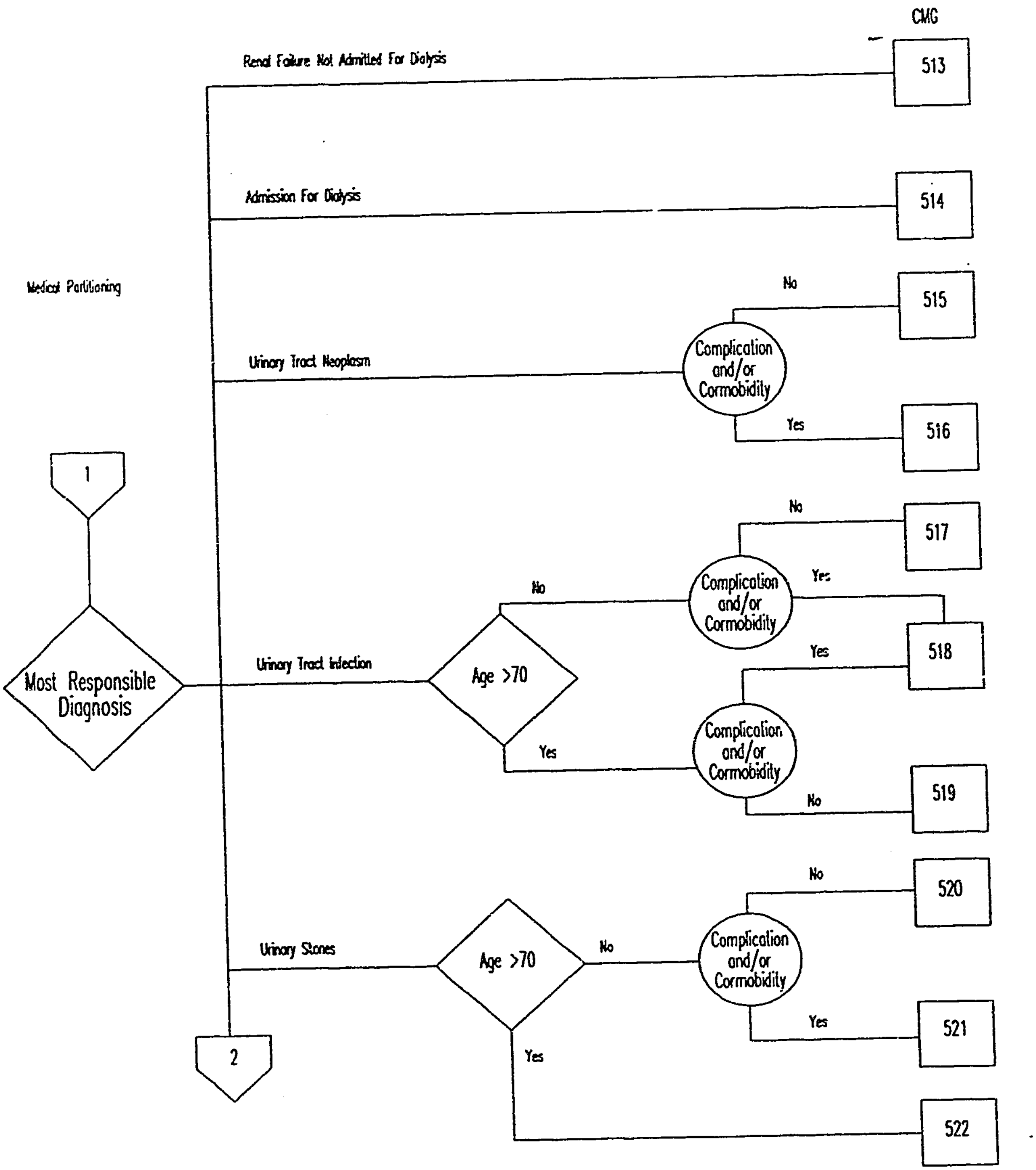


Figure 2.1 Assignment of a Patient to a Medical Case Mix Group

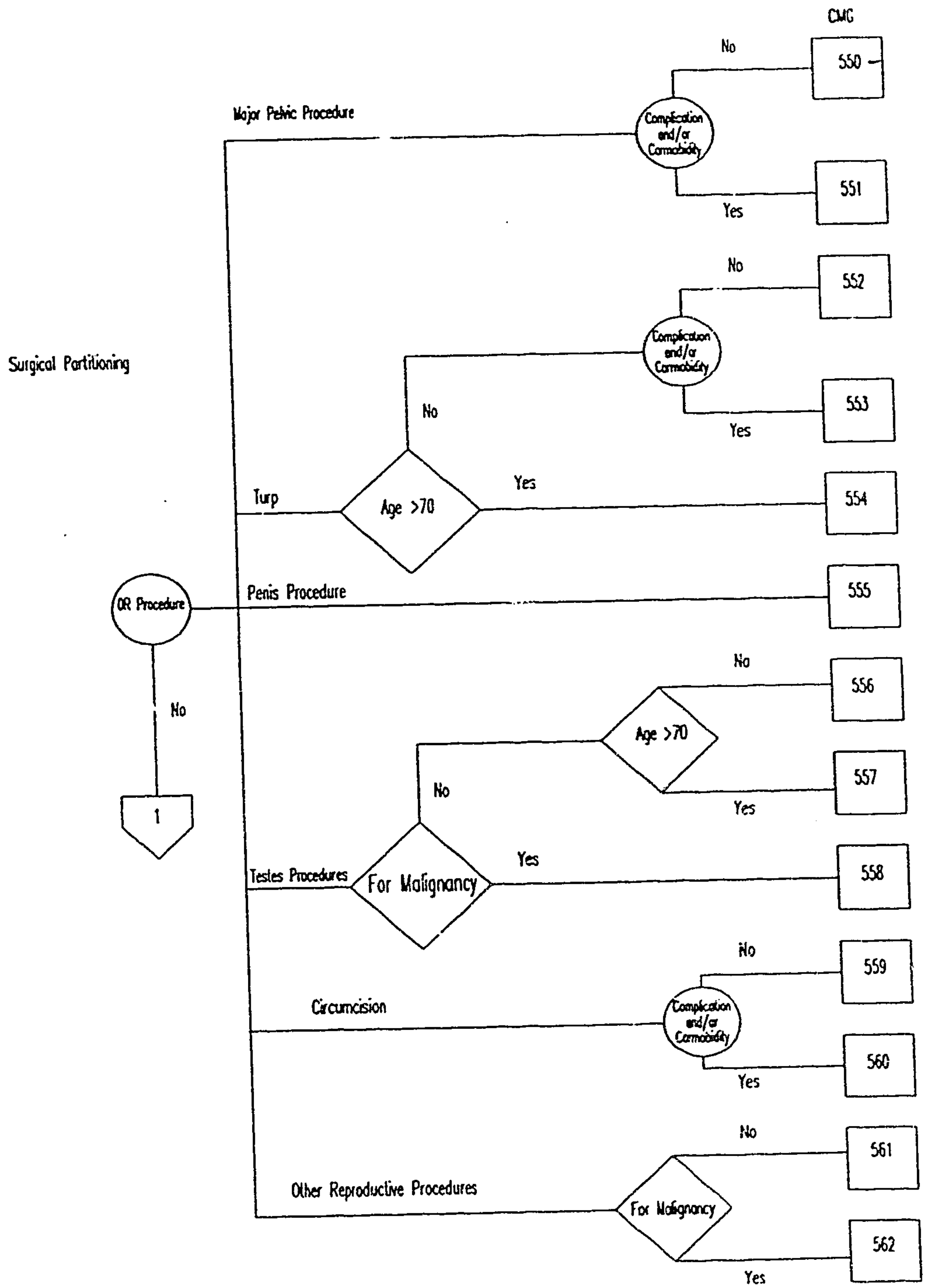


Figure 2.2 Assignment of a Patient to a Surgical Case Mix Group

2.5 Other Patient Classification Systems

Several alternative classification systems are present throughout North America. A brief description of some of these alternatives is presented.

2.5.1 Patient Management Categories

Patient Management Categories (PMCs) were developed by W. Young et al, for Blue Cross of Western Pennsylvania[11]. PMCs differ from other classification systems in that the patient groups are defined on the basis of common diagnostic and treatment strategy. The treatment strategy for each PMC is made explicit and cost weights are provided. The assignment process is based on both ICD-9-CM diagnosis and procedure codes. Early results from relatively limited data bases show that PMCs explain roughly the same percentage of variance in resource utilization as DRGs[12].

2.5.2 Disease Staging (Systemetrics)

Disease Staging was introduced by Gonella[13][14] in the mid 1970's. It was intended as an educational aid to describe diseases not patients and is based on a search of the medical record. It is a complete classification system containing a basic grouping device, the Diagnostic Category (akin to a DRG), which is overlaid with a severity score which defines progression of the disease through to death.

Disease Staging has progressed in its development along two lines. It was originally intended to assign severity within a disease based on clinical indicators. This requires a manual search for the record which may be cumbersome and impractical.

Clinical Staging was not originally developed to predict resource use. However, early research evidence suggests that the ability of this system to predict resource consumption may be relatively high[15][16][17]. Clinical Staging is slowly being automated using this information and operating as a chart based severity system. However, Systemetrics (a consulting agency based in Illinois) has also developed automated Coded Staging software[18]. This uses ICD-9-CM diagnosis and procedure codes to assign a patient first to a Diagnostic Category and then to the Disease Stage. There is evidence to suggest good correspondence between the clinical and coded versions of Disease Staging[19]. One of the limitations of Disease Staging has been that it assigns a severity for each independent disease process but has been unable to incorporate this information into an overall severity measure.

2.5.3 Acute Physiology and Chronic Health Evaluation (APACHE II)

APACHE II is a disease severity classification system that uses basic physiologic principles to stratify patients prognostically by risk of death[20]. Developed by Knaus et al at George Washington University Medical Centre, its specific goal is to describe groups of intensive care unit (ICU) patients and evaluate the efficacy of their care. APACHE II operates on the premise that the wide variety of physiologic measurements routinely obtained on ICU patients contain precise information on the Patient's acute severity of illness.

The twelve physiologic variables collected reflect derangement across all the vital organ systems. The variables include vital signs (heart rate, mean blood pressure, respiratory rate, and temperature), variables derived from routine venous blood tests (haematocrit and white blood cell count, serum potassium, serum sodium and serum creatinine), and two variables derived from arterial blood gas tests (serum pH and paO2).

Although APACHE II was designed for use in intensive care units, the developers of the method believe that it can also be used appropriately for other hospital inpatients as well. No research has yet been completed, however, on the applicability of APACHE II for non-ICU patients.

2.5.4 Computerized Severity Index (CSI)

Computerized Severity Index is a system developed by Susan Horn et al at John Hopkins University[21]. It is a menu driven system with a resident set of ICD-9-CM codes as the basic grouper. Each of the approximately 400 codes has an attached matrix which assigns severity of the principal diagnosis on the basis of the value of findings from a set of relevant clinical criteria. Unrelated comorbid conditions are similarly assigned severity levels. A series of algorithms then reduces the severity levels of the principal and comorbid diagnosis into a single severity score. In its current state CSI does not incorporate procedures. Although developed with reimbursement in mind, CSI explicitly attempts to measure illness severity and not resource intensity[22].

There is much confusion as to the distinction between clinical classification systems and resource intensity classification systems. The distinction must be clarified since the Acute Care Funding Formula Applies the DRG system, which is resource based. The following example will illustrate the difference ;

A patient admitted and classified as an Early Death (Death within two days of admission) will be listed as the highest severity patient type in the clinical system. However, in a resource intensity classification system the same patient type will be deemed to have utilized a small amount of resources and is thus classified as a low severity patient. The importance of this distinction is thus clear and should be remembered whenever the Acute Care Funding Project is referenced.

2.5.5 Medisgroups (Mediqual)

Medisgroup from Mediqual has been extensively used as a severity system. Its chief uses are as a quality of care instrument[23]. It was not intended for use as a reimbursement instrument. Medisgroup is purely generic in its construction and it assigns severity in the same fashion irrespective of principal diagnosis or DRG. Initially Medisgroup required some 500 clinical variables but this has been reduced to approximately 225. Comorbidity is explicitly considered via abnormal results in multiple organ systems. Algorithms are used to combine morbidities into a single severity level much like CSI. Both CSI and Medisgroups, although not directly applicable to reimbursement, are of particular interest when considering quality of care and hospital management. Their prime focus lies in detecting unexpected morbidity.

2.5.6 Acuity Index Method (Iameter)

The Acuity Index Method (AIM) is a severity of illness classification system which assesses quality of care and cost efficiency of individual hospitals and physicians. It has been developed by Iameter, a private company which was founded in 1983 by Dr. Peter Farley and Dr. William Mohlenbrock to provide decision support systems for health care professionals. AIM utilizes DRG methodology and is entirely dependent on information contained in the Uniform Hospital Discharge Data Set (UHDDS) or the Uniform Billing (UB-82) document. The goal of the AIM algorithm is to explain or account for variation in length of stay and total charges within each DRG[24]. The ICD-9-CM diagnosis and procedure codes on the discharge abstract and the resultant DRG assignment are the fundamental elements used by AIM.

3. The Inpatient Acute Care Funding Formula for Alberta

3.1 Overview of The Inpatient Acute Care Funding Formula

3.1.1 The Hospital Performance Index

Each hospital is assigned a hospital performance index (HPI) which depends upon its own hospital performance measure (HPM) in relation to the average HPM of all hospitals which are included in the provincial analysis. This HPI has been "normalized"[b] such that the average of all hospitals equals 100. An HPI of 100 means a hospital has performed at the provincial average. An index above 100 means it has performed better than the provincial average and one below 100 means it has performed below average. The higher the value of this ratio, the more favourable is a hospital's "performance" deemed to be and the more favourable will be its funding adjustment.

3.1.2 The Hospital Performance Measure

The hospital performance measure is an indicator used to reflect a hospital's actual performance. It is a result of two statistical measures which may bear a greater or lesser relationship to actual performance. The two measures are those of Predicted Cost and Actual Cost Per Discharge (detailed discussion to follow). The HPM is the ratio of Predicted Cost to Actual Cost per Discharge. The higher the ratio (that is, the greater is predicted cost relative to actual cost), the more favourable is a hospital's 'performance' deemed to be, and the more favourable will be its funding adjustment. Thus, a relatively high HPM will translate into a high HPI (assuming all other hospitals'

HPMs remain the same) and a favourable funding adjustment. Worth noting is that the HPM is that component of the HPI over which hospitals can have some influence. This will become apparent as the formula is clarified

3.1.3 The Funding Adjustment

Each hospital's maximum funding adjustment for Alberta is the HPI multiplied by an Inpatient Funding Base. This base is predicated on the amount of government transfers to the hospitals (the global budget). It is equal to the total estimated hospital inpatient costs, for that portion of costs which are government funded. Thus, if these estimated costs are $100 million and the hospital's HPI is 110, the total maximum funding adjustment will be $10 million. Actual adjustments may be less than this, if deemed so by Alberta Health. For example, the HPI may be increased in order to prevent closures of hospitals that are allocated an HPI of 70 and thus stand to lose 30% of their annual budget. Similarly, Alberta Health can reduce the maximum funding adjustment for hospitals with HPI's above 100. The reduction in maximum funding adjustments are then redistributed among hospitals witnessing severe hardship. Many of the smaller rural acute care hospitals have received additional funding in this way.

3.2 The Formula

We are now in a position to examine the formula as it is applied to calculate each hospital's HPM. The basic formula is quite complex but more easily understood when dissected into three components (see Figure 3.1). An example calculation is also included in chapter 4 to help clarify further, each components role in developing the overall HPM.

Figure 3.1 Equation for the Hospital Performance Measure

1. Basic Unadjusted Severity Predicted Cost Per Discharge (SPC)
   $SPC = [SUM(N.Y.\ SIW * ALOSprov_i * C_i)] / [Total\ Discharges]$

2. Hospital Bedsize and Teachingness Adjustment Factor (HAF)
   $HAF = e^{[(0.000426(Bk-B) + 0.00428(Tk-T)]}$

3. Actual Inpatient Cost Per Discharge (ACPC)
   $ACPC = \{SUM[Activity(inpatient)_j / Activity(total)_j]^* Activity\ Cost_j\} / [Total\ Discharges]$

4. Hospital Performance Measure (HPM)
   HPM = [(SPC)(HAF) / (ACPC)]

5. Hospital Performance Index (HPI)

   HPI = (HPM for Hospital) / (Average HPM for all hospitals in funding project)

LEGEND:

N.Y. SIW - New York Cost Index Per Day for associated RGN group

$ALOS_{prov}$ - Alberta Average Length of Stay for associated RGN group

i - Specific RGN group

C_i - Number of discharges in RGN group

Bk - Number of rated beds for hospital

B - Provincial Average Number of Beds

Tk - "Teachingness Factor":Residents and Interns per 100 beds-for Hospital

T - "Teachingness Factor":Residents and Interns per 100 beds-for Province

$Activity_j$ - Number of units of each activity in Evans-Barer Formula

Activity $Cost_j$ - Total cost of each activity centre

RGN - Resource Grouper Number (outlined on page 31)

The three components include: **1. Basic (unadjusted) Severity Predicted Costs per Discharge, 2. Bed size and 'Teachingness' Adjustment Factors** and **3. Actual Inpatient Cost per Discharge.** The former two components (1 and 2) when multiplied make up the Predicted Cost Index. The Predicted Cost Index is then divided by component 3, the Actual Inpatient Cost per Discharge to give the Hospital Performance Measure. Each component is outlined in the proceeding sections. The formula, and thus all three components, were developed by the Case Mix Institute of Ontario[d] and adopted by the government of Alberta in an effort to curb burgeoning health care costs, make the allocation of funding dollars between hospitals more equitable and promote more efficient treatment of patients.

3.3 Basic Unadjusted Severity Predicted Cost (Component 1)

Basic Unadjusted Severity Predicted Cost / Discharge = SPC

SPC =[SUM(N.Y. SIW * ALOSprov)$_i$ * C$_i$] / [Total Discharges]

Basic Predicted Costs, in Alberta acute care hospitals, are the sum of all "case weighted" discharges in the hospital, divided by the total number of discharges in the hospital. Thus, each discharge is weighted by a relative number in accordance with the class in which it falls. A severity classification system (developed at Yale University for use in the Alberta funding model) is used to categorize all discharges, called the **"Refinement Grouper Number"** (RGN). There are approximately 1100 such classes of cases. Each RGN group is assigned a relative weight, which was designed by the

Case Mix Institute to approximate the relative amount of resources used by that case. When all Discharges in the hospital are so weighted, a basic predicted cost is developed. An explanation of the RGN severity index classification system follows.

3.3.1 Severity of Illness

Severity of illness measurement systems were developed in an attempt to improve payment and quality of care assessment across hospitals. Funding was provided initially by the Health Care Financing Administration (HCFA), of America, for research into severity of illness measurement systems and their proposed usage, causing more systems to be developed. Some of these systems were intended to replace the DRG system, while others were created to explain variation in resource use or quality of care within certain hospital units.

There are many existing severity of illness rating systems. At this time, no one system is considered to be superior to the others. Acute Physiology and Chronic Health Evaluation (Apache, ApacheII, Apache IIB), outlined earlier, draws patient data directly from the patient's chart and uses comprehensive physiological data such as heart rate, temperature and so on. While chart based systems are more specific than abstract based systems, they require more labour to gather data and to-date have tended to be used only in specialized areas like Intensive Care Units. Other severity systems in use include Severity of Illness Index (SOII), Medicare Mortality Prediction System (MMPS), Computerized Severity Index (CSI), Disease Staging, Q-Scale, Patient Management Categories (PMC), Medisgroup and the DRG Refinement Grouper Number system, (RGN).

3.3.2 Refined Grouper Number (RGN) Classification System

The refined grouper number is a refinement of the DRG (Diagnosis Related Group) system. It was developed by Robert B. Fetter and colleagues at Yale University in 1989 under a cooperative agreement between the Health Care Financing Administration (HCFA) and Yale University. A similar cooperative effort resulted in the development of the original DRG system.

The DRG Refinement Grouper System is an abstract-based system predicated upon patient discharge data. In general, an abstract based system which uses only ICD-9-CM diagnosis and procedure codes, contained in the standard discharge abstract, is better at predicting cost than a chart-based system such as APACHE II or CSI, which use clinical data straight from the patient medical record, and which would be better at predicting clinical outcome. One drawback, however, of the DRG refinement Grouper System software is the lack of guarantees that it will keep pace with new developments (i.e as new diseases are found and treatment procedures are changed) in the DRGs and ICD-9-CM coding. A proprietary severity system would be much better in this respect, but of course would be much more expensive.

The DRG system is composed of 477 different groups of cases. The RGN system is an offshoot of the DRG system. It is called a "severity system" because it attempts to further refine the DRG classification to include indicators of severity. The objective of such refinements, through the use of severity indicators, is to better explain differences in resource use than do basic diagnosis differences. The indicators used in this case are the types of additional diagnoses. To develop an RGN (also called a

Refined Diagnosis Related Group-RDRG) a computer program, developed by Karen Schneider et al of the Health Systems Management Group - Yale University, groups DRGs into similar groupings called **Adjacent Diagnosis Related Groups (ADRG)** and then takes patient cases in each one of the ADRGs and assigns them to specific Resource Grouper Numbers. The assignment from ADRGs to RGNs is done on the basis of additional diagnoses codes. This procedure is now explained in more detail.

Under the DRG Refinement Grouper System patients are first assigned to one of the twenty seven major diagnosis categories (e.g. MDC 04-Diseases and Disorders of the Respiratory System), based on their principal diagnostic code. Patients who have had a temporary tracheostomy (a non-operating room procedure) or an early death (death within two days of admission) are not considered further in the classification process and instead are assigned directly to an RGN or severity rating. All patients, except newborns and neonates (MDC 15) are then assigned to an Adjacent DRG (ADRG). Major Diagnostic Category 15 has been modified under the DRG Refinement Grouper System and a new set of Adjacent DRGs based on birth weight has been developed. Patients are differentiated with respect to classes of additional diagnoses and Comorbidities and Complications (CCs) that are disease and procedure specific. Adjacent DRGs share the same list of principal diagnoses as the DRGs prior to the point where age splits and complications and comorbidities are factored into the 477 DRG assignments. Age splits and comorbidities and complication listings equal approximately 3,000 diagnoses codes. Under the DRG Refinement Grouper System these codes are eliminated from consideration and replaced by specific combinations of secondary diagnoses in the assignment of an RGN or severity rating. (See Figure 3.2)

Refinement classes have been established for medical and surgical ADRGs. Medical DRGs are assigned to three classes: Zero for baseline/Minor CCs (Comorbidities and/or Complications), one for Moderate CCs and two for Major CCs. Surgical DRGs are assigned to the same three classes as well as to a fourth class for catastrophic CCs. **Each class represents a different level of resource utilization for a given category of principal diagnoses or surgical procedures.** Zero representing the lowest level of resource utilization and four the highest. The highest class found among these secondary diagnoses is considered the patient's Refinement Class.

The computer application developed at Yale University utilizes the variables (Major Diagnoses Category, Patient Age, Principal Diagnosis, Comorbidities and/or Complications) and organizes them into an algorithm which is a sort of map that leads one through a series of criteria to the final classification. The Software application is described in detail in the Appendix.

An example of RGN groups which are offshoots of the DRG group are shown in Table 3-1.

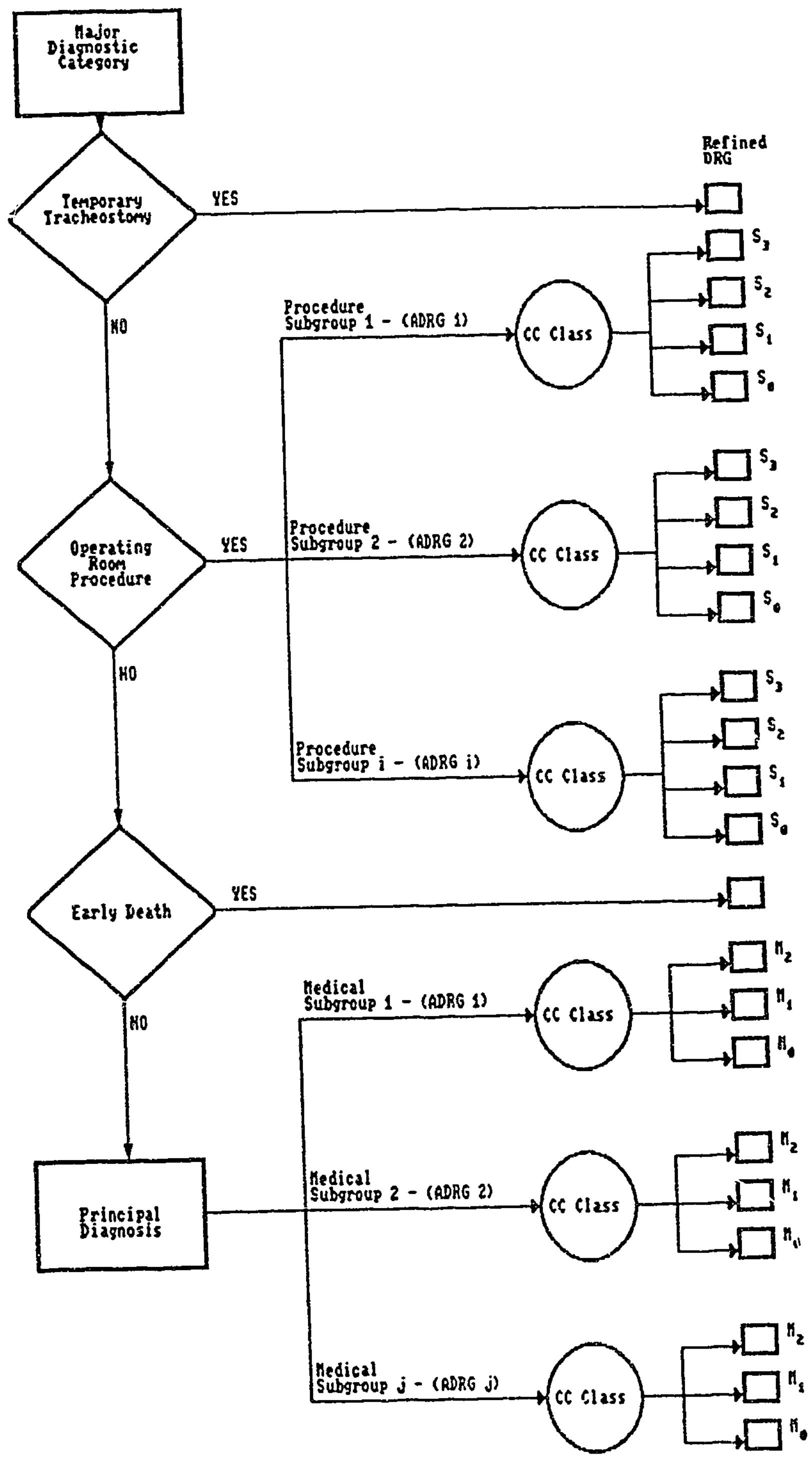


Figure 3.2 Structure Of The Refined DRG Classification with Medical and Surgical Classes of Additional Diagnoses

Table 3-1 Sample Refined Group

DRG Number	SEVERITY Number	RGN Number	RGN Description
001	0	0010	Craniotomy except for Trauma with no cc
001	1	0011	Craniotomy except for Trauma with class C cc
001	2	0012	Craniotomy except for Trauma with class B cc
001	3	0013	Craniotomy except for Trauma with class A cc

3.3.3 RGN Weights

Relative Weights are numbers which attempt to approximate the relative amount of resources which go into the treatment of different cases. Since they are relative, it is their magnitude in relation to each other that is of prime importance. Thus, according to the CMG weighting system a normal delivery has a weight (called a Resource Intensity Weight-RIW) of 0.75 and a bone marrow transplant has a weight of 19. This means that the normal delivery is deemed to use about three quarters of the resources of a typical case (normalized to have a weight of 1.00), while the bone marrow is deemed to use 19 times the resources of a typical case. A 'typical case' is defined as a patient consuming the average amount of resources as compared to the average of a sample of Alberta Discharges. Obviously this average will change annually, and so, the average or typical case is recalculated each year.

Based on a sample of Alberta discharges, a " provincial average length of stay" was also developed for all cases within each RGN group. The sample used excludes days of care which exceeded some predetermined standard (termed outliers as defined in the funding formula). Thus, each RGN had a specific provincial average length of stay. In order to obtain an appropriate "cost per day " for each group a relative "cost per day" weight was needed. The Case Mix Institute used data from a New York Hospital sample for 1985. This sample used relative "service intensity weights" (SIWs) for a day of care in New York. It should be noted that these weights are relative with an average overall value of 1.00. The rationale for using such an index is twofold. Firstly, relative weights are not available in Canada, because Canadian hospitals do not presently have sufficient information on costs or charges on a case-type basis. Secondly, as long as the relative costs of treating each disease are the same in New York as in Alberta (this assumption is used by the ACFP), then the relative weights will be a reasonable approximation to actual Alberta weights. Data is not currently available to verify this assumption. A sample of RGN weights per case, for each RGN group, is shown in Table 3-2.

Table 3-2 RGN Severity Weights

RGN Number	Severity Weight**	RGN Description
0010	27.29439	Craniotomy except for Trauma with no cc
0011	28.91693	Craniotomy except for Trauma with class C cc
0012	37.95697	Craniotomy except for Trauma with class B cc
0013	49.54257	Craniotomy except for Trauma with class A cc

****It should be noted that the severity weights are the product of the inlier average length of stay for the RGN and the SIW (per day). These weights are province-wide weights, and so are applied to all hospitals.**

3.3.4 Basic (Unadjusted) Severity Predicted Cost

A hospital's basic severity predicted costs, then, are the (RGN) weighted costs. That is, each discharge in the hospital is classified according to its RGN and the number of discharges in each RGN is added up. The total number of discharges in each RGN is then multiplied by the provincial RGN weight (severity weight) relevant to that RGN. The sum total (of the RGN weights multiplied by the number of discharges in that RGN category) is divided by the total discharges to get an average weighted cost per discharge for the hospital.

This concludes the presentation of the first variable in the HPI, the measure of Basic Unadjusted Severity Predicted Costs. This measure is adjusted as follows.

3.4 Hospital Adjustments to the Basic Predicted Cost (Component 2)

Hospital Adjustment Factors = HAF = $e^{[(0.000426(Bk-B) + 0.00428(Tk-T)]}$

There are two adjustment factors, for bedsize and teachingness. These two factors are multiplicative, that is, the overall adjustment factor is the product of the two. Each factor will be examined and its general order of magnitude illustrated.

3.4.1 The Bedsize Adjustment Factor

The bedsize adjustment factor is e to the power of [0.000426 * (Bk-B)][b][34] where Bk is the number of rated beds in each hospital and B is the average number of rated beds in all hospitals (Provincial Average). The basic formula is multiplied by this factor, which is based on rated beds, rather than beds in use, (Setup beds). In Table 3-3, several adjustment factors which are related to beds are presented. Given a basic cost factor, the meaning of this adjustment factor is that the cost measure, (the basic unadjusted severity predicted cost per discharge) must be multiplied by the factor. A hospital, therefore, with a bedsize of 300 will have a bedsize adjustment factor of 1.00555 (assuming the provincial average number of beds to be 287). This factor is substantial and simple calculations show that an increase in rated beds by 100 results in a 4.4% increase in predicted cost per case. Obviously, this is to the benefit of larger institutions (in terms of rated beds) whose calculated predicted cost per case will be increased proportionately when adjustment for the bed size factor is incorporated. The assumption, therefore, behind this adjustment, is that diseconomies of scale exist in hospitals. The more beds a hospital has the larger the marginal cost for operating each additional bed will be.

3.4.2 The Teachingness Factor

The second adjustment to the predicted cost is based upon the teachingness factor. It is also multiplied by the basic cost factor. This variable is written as e to the power of [0.00482 * (Tk-T)][h][34]. The variable, T, used to measure teachingness represents the number of residents and interns per 100 beds. The variable Tk is the value for each hospital while T is the provincial average. The size of this adjustment factor for various values of T, is also shown in Table 3-3. For example, a hospital with 5 residents per 100 beds will have an adjustment factor of 1.00978. It should be noted that this adjustment factor is generally much smaller in magnitude than the bedsize factor. The teachingness factor is incorporated to recognize additional costs that teaching hospitals, such as the University of Alberta Hospitals, incur in maintaining a base of medical residents and interns.

Table 3-3 Hospital Adjustment Factors

Hospital	Beds	Interns & Residents/100	Bedsize Adjustment	Teachingness Adjustment	Both Adjustments
1	100	0	0.92343	0.98574	0.91026
2	200	2	0.96362	0.99529	0.95908
3(AVG*)	287	2.98	1.00000	1.00000	1.00000
4	300	5	1.00555	1.00978	1.01538
5	400	6	1.04932	1.01466	1.06470

*This hospital has both the provincial average number of beds and Int. & Res. /100 beds.

3.5 Actual Inpatient Costs (Component 3)

Actual Inpatient Cost Per Discharge = ACPC

$$ACPC = \{SUM[Activity(inpatient)_j / Activity(total)_j] * Activity\ Cost_j\} / [Total\ Discharges]$$

The "Evans-Barer" model of cost allocation, based on total costs by activity centre as reported on the Statistics Canada HS-1 form, is used to determine total inpatient costs. According to this model, total hospital costs by activity centre are gathered as in Table 3-4.

Table 3-4 Calculation of Inpatient Component of Budget

Department (Activity Centre)	Total Costs	Tot Activity	Outpt. Units	Ratio	Outpt. Cost
Diagnostic Rad. (Salary)	5000000	2000	600	0.3	1500000
Therapeutic Rad. (Salary)	1000000	100	50	0.5	500000
EEG (Salary)	300000	500	500	1.0	300000
TOTAL	6300000				2300000
Total Inpatient Budget is	4000000 or 63.5%				
Actual Average Cost/Case is	4000000/1000**	=$4000			

**(Assume Total Hospital Discharges =1000)

An important point worth noting is that the individual ratios that this model allocates to different activity centres will vary as in the above table. The hospital's overall allocation of total costs between inpatient and outpatient costs will thus be determined by the sum of these individual allocations. A detailed exposition of the specific methodology used and ratios developed in the Evans Barer model has been included in the appendix.

3.5.1 Inpatient Cost Per Discharge

Total inpatient costs for the hospital are divided by the number of total discharges in the hospital to obtain the average inpatient cost per discharge. For the data outlined in Table 3-4, inpatient costs are $4,000,000 for 1000 cases, or $4,000 per case.

3.6 Raising Your Hospital Performance Index

3.6.1 The Hospital Performance Index and Measure

The Hospital Performance Index (HPI) is the ratio of each hospitals Hospital's (HPM) to the average of all HPMs for all hospitals within the funding project. To raise its HPI, a hospital must therefore concentrate on its HPM. Of course, raising one's HPM will offer no guarantee that one's HPI will increase. One can become more "efficient", but if other hospitals become even more efficient, then your hospital's HPI will in fact fall. Notwithstanding this point, the following are the possible effects of various HPM-raising strategies.

3.6.2 Shortening the Length of Stay

Shortening length of stay will cut the costs of existing cases, since the marginal cost of the reduced days will be saved. Provided that the cost savings are used to increase the number of cases carried out, (assuming there is always a waiting list of inpatients) this will raise the HPM. In order to decide which cases to target, an analysis can be done which will weight excessive stay cases. The analysis should use RGN weights and RGN data, rather than the more available CMG data, so that consistency with the acute care funding formula is maintained. (N.B. Case Mix Groups are not used in the funding formula). In addition, the weights allocated to CMGs are so different from the RGN severity weights used in the funding formula that the results will likely be considerably distorted.

3.6.3 Shifting Costs from High to Low Inpatient Areas

Each activity area has associated with it, an inpatient to total units of activity ratio as determined by the Evans-Barer model. The institution's overall inpatient actual costs are determined by the sum of the allocations in each activity centre (Table 3-4). Since these allocations depend upon activity centre data the inpatient to total activity ratios will vary by centre. There is, therefore, a real benefit from shifting expenditures from high-inpatient to low-inpatient areas, as this will vary the overall ratio. This, it should be noted, can be done quite legitimately through reorganizing hospital activities. Indeed, the inpatient to total activity ratios vary considerably, now, by hospital and much of this variation is in fact due to the manner in which the hospitals are internally organized (the accounting systems in place and methods of financial reporting). Hence the variance is due to the different reporting mechanisms set up to accommodate an array of organizational infrastructures rather than differences in actual costs. It should be noted, however, that if at some future date the outpatient component of the project is implemented, then this may no longer be an effective method of lowering "actual costs".

3.6.4 Taking More (Less) Complex Cases

A hospital can shift its case load to more complex cases. If these cases have higher weights, then the numerator in the HPM formula (Predicted Cost) will increase.

However, these cases cost more to treat and so the denominator will increase as well. Therefore, this is not a sure and fast way to raise the HPM. Whether the HPM will increase will depend upon the specific RGN group in which the more complex cases fall. Since it is currently difficult to target, before admission, which RGN cases are "high weight" cases according to the RGN classification, this is a risky strategy. A corollary of this analysis is that, if one cuts out less severe cases, there is no assurance whatsoever that the HPM will increase. Implementing such a strategy to increase a hospital's HPM would therefore warrant caution.

3.6.5 Closing Beds and Taking Fewer Patients

The Strategy of closing beds will result in lower actual costs, which by itself would raise the HPM (since it lowers the denominator in the HPM equation). However, this also lowers the total number of weighted cases, and so it depends on where the cuts are made as to how the HPM will be affected. It is quite possible to close beds and cut costs only to find that the predicted costs have fallen more than actual costs, resulting in a fall in the HPM. Again this strategy would also warrant caution given the uncertainty of the outcomes.

In conclusion, strategies such as lowering length of stay and reallocating costs to high volume outpatient centres will directly impact on the HPM (though not necessarily on the HPI. Other strategies, such as not treating the less severe patients or closing beds down, may not work to raise the HPM. They are more risky and have to be implemented with more data.

4. Calculating the Hospital Performance Index

4.1 Sample Hospital

Having dissected the Hospital Performance Index into its constituent parts and having developed the methodology behind each one, the entire process will now be illustrated through the use of a sample hospital case scenario. The data presented is fictitious and represents an imaginary hospital within the Acute Care Funding Project. However, the methodology is precise and represents the actual mechanisms by which the Hospital Performance Index is calculated.

Example Calculation of the HPI for a Sample Hospital

Table 4-1 Patient Data Requirement for Sample Hospital

DESCRIPTION	RGN #	RGN WEIGHT	# OF CASES	RGN WEIGHT CASES
TONSILLECTOMY NO CC	0590	2.81029	1000	2810.29
CHOLY WITH CDE NO CC	1950	11.73659	1000	11736.59
VAG. DELIVERY NO CC	3740	7.04807	1000	7048.07
MAJOR HEAD & NECK PROC. NO CC	0490	11.91347	1000	11913.47
BRONCHITIS & ASTHMA NO CC	0960	4.14306	1000	4143.06
CRANIOT. EX TRAUM NO CC	0010	27.29439	1000	27294.39
ANGINA PECTORIS NO CC	1400	4.53319	1000	4533.19
GI OBSTRUCTION WT NO CC	1800	3.67340	1000	3673.40
MED BACK PROB WT NO CC	2430	4.29195	1000	4291.95
DEGENERATIVE NERVE SYSTEM WT NO CC DISORDER NO CC	120	18.97506	1000	18975.06
		TOTAL:	10,000	96,419.47

Statistics for Sample Hospital

TOTAL HOSPITAL BUDGET = $ 46,153,846 (90/91 FISCAL YEAR)

INPATIENT PORTION OF BUDGET (EVANS BARER) =(65%) * TOTAL BUDGET
=(0.65) * (46,153,846)
=30,000,000

BEDS = 100 (BK)

OF INTERNS & RESIDENTS = 5 (TK)

Statistics for Provincial Average

BEDS = 287 (B)

OF INTERNS & RESIDENTS = 2.98 (T)

STEP 1 To Calculate the Hospital Adjustment Factors (HAF)

BK =100(RATED BEDS FOR THE SAMPLE HOSPITAL)

B = 287(AVERAGE RATED BEDS FOR ALL HOSP IN THE FUNDING PROJECT)

TK = 5(RATIO OF INTERNS & RESIDENTS PER 100 BEDS IN SAMPLE HOSP)

T = 2.98(AVG. RATIO OF INTERNS & RESIDENTS PER 100 BEDS FOR ALL HOSPITALS IN THE FUNDING PROJECT)

HAF = EXP {(0.000426 * (BK-B)) + (0.00482 * (TK-T))}

HAF = EXP {(0.000426 * (100-287)) + (0.00482 * (2.87-5))}

HAF = 0.9324631926

STEP 2 To Calculate Severity Predicted Cost (SPC)

THE EQUATION TAKES THE FORM:

SPC = [SUM(SIW * ALOS FOR THE RGN) * DISCHARGES IN THE RGN]
TOTAL HOSPITAL DISCHARGES

SPC = 96,419.47 / 10,000

SPC = 9.641947

STEP 3 To Calculate the Overall Predicted Cost Per Case (OPCPC)

OPCPC = (SEVERITY PREDICTED COST) * (HOSPITAL ADJUSTMENT FACTOR)

OPCPC = (SPC) * (HAF)

OPCPC = 9.64197 * 0.93246319

OPCPC = 8.99076076

STEP 4 To Calculate the Actual Cost Per Case (ACPC)

ACPC = [(TOTAL EXPENSE) * (INPATIENT PORTION OF EXPENSE)]
TOTAL INPATIENT DISCHARGES

ACPC = [(46,153,846) * (0.65)] / 10,000

ACPC = 3,000

STEP 5 To Calculate the HPM

HPM = (OVERALL PREDICTED COST PER CASE)/ (ACTUAL COST PER CASE)

HPM = (SPC)(HAF) / (ACPC)

HPM = 8.99076076 / 3,000

HPM = 0.00299692

STEP 6 To Calculate the Hospital Performance Index (HPI)

HPI =(HPM / AVERAGE HPM FOR ALL HOSPITALS COVERED BY THE FUNDING PROJECT **(assume this value is 0.00250664)**

HPI = [(0.00299692) / (0.00250664)] * 100

HPI = 119.55 (ROUNDED TO 120)

4.2 University of Alberta Hospitals

Having developed the components used in calculating the Hospital Performance Index (from information gathered in reports etc. from CMI), the formula was applied to actual data for the University of Alberta Hospitals (Table 4-2, Table 4-3). Initially the formula was applied to 1989/1990 fiscal year data. This fiscal years HPI was known to be 105 and hence the result of 105.07 verified that the methodology applied was correct. Having verified that the methodology used to calculate the HPI was correct a simulation of the HPI for the fiscal year 1990/1991 was carried out.

Table 4-2 Calculation of 1989/90 HPI for the University of Alberta Hospitals

Hospital	UAH
Rated Beds of Hospital	979
Number of Interns and Residents	190.50
Interns and Residents / 100 Beds	19.45863126
Provincial Average Beds for Hospitals	289.93103448
Provincial Average Interns & Residents / 100 Beds	2.93641908
Severity Predicted Cost	8.4155
Hospital Adjustment Factor	1.453631
Overall Predicted Cost Per Case	12.2330
Inpatient Budget ($)	146685980
Estimated Total Budget ($)	236000000
% of Budget Which is Inpatient	62.16
Number of Cases (Upon Which SPC is Based)	31604
Average Cost Per Case	4641.37
Hospital HPM	0.00263564
Provincial Average HPM	0.00250660
Hospital HPI	105.07

Table 4-3 Simulation of 1990/91 HPI for the University of Alberta Hospitals

Hospital	UAH
Rated Beds of Hospital	979
Number of Interns and Residents	190.50
Interns and Residents / 100 Beds	19.45863126
Provincial Average Beds for Hospitals	289.93103448
Provincial Average Interns & Residents / 100 Beds	2.93641908
Severity Predicted Cost	7.7400
Hospital Adjustment Factor	1.452346
Overall Predicted Cost Per Case	11.2412
Inpatient Budget ($)	144519923
Estimated Total Budget ($)	259228562
% of Budget Which is Inpatient	55.75
Number of Cases (Upon Which SPC is Based)	29643
Average Cost Per Case	4875.35
Hospital HPM	0.00230571
Provincial Average HPM	0.00250660
Hospital HPI	91.99

The assumptions made in this calculation were that the provincial average figures for beds and students and interns had not changed from the previous year. In addition, it was assumed that the provincial average HPM remained at the previous years level. These assumptions had to be made as the required figures are not available until the following year (January 1992), when the official HPI figures are released by Alberta Health. It must be noted that the simulation was done with the older 2.3 version of the RGN grouper software. Errors are therefore anticipated where this older version would not account for subsequent revisions made to the ICD-9-CM coding system and DRG classification system.

5. Critique of the Inpatient Acute Care Funding Formula

Having developed the Inpatient Acute Care Funding Formula (from information gathered in reports from CMI), there are specific areas of concern that have not been addressed in any of the accompanying literature by either Alberta Health or the Case Mix Institute. The first area of concern pertains to the measure of severity of illness.

5.1 The Severity Measure

There are a number of severity Index measures which have recently been introduced[c]. It is necessary to know a lot more about these indexes, their relative properties and biases, before one can assess their appropriateness as reimbursement tools. In this regard, there is scarce literature on resource grouper numbers or possible alternatives. This factor alone must raise serious questions about the adoption of one system, with many unknown properties, in relation to other systems. Unless, and until, such comparisons appear and are subject to considerable public scrutiny, it would appear foolhardy to "blindly" follow an RGN based severity system. Given the enormous impact on hospital funding that such a system could have, vital questions remain unanswered: On what grounds is RGN the best? What tests have been performed? No valid justification has been presented.

A further point worth noting is that the RGN system is based on Diagnosis Related Groups (DRGs) - a U.S. classification system. In Canada, the diagnosis classification system is the case mix grouping (CMG), developed by the Hospital Medical Records Institute (HMRI) of Ontario and initially based on DRGs, but designed to account for Canadian coding practices (HMRI 1990). It was formerly possible to directly map CMGs onto DRGs but with the development of the most recent version of CMGs - called CMG 1990, this is no longer possible. This may create an anomaly in the use of an American based classification system using Canadian standards. The issue is not addressed in the basic documentation to the Acute Care Funding Program.

5.2 The Costs in Each Cell

There are tremendous difficulties with the way in which costs in each cell have been calculated. In each cell the cost is the service intensity weight (New York cost per day for the RGN) times length of stay for the cell. When one moves up the severity scale within a diagnosis related group (moving to higher resource grouper numbers) the Length of stay presumably increases. If this is so, the marginal cost for successive days might be lower than for the first few days of an admission. This would offset the previous cost-severity factor. To what extent, if any, is simply unknown. Given the size of severity adjustments, however, the price of even a small discrepancy could mean large sums of money redistributed between hospitals contrary to the funding issue of " Fairness and Equity " raised earlier.

5.3 Teaching Hospital Adjustments

The severity predicted cost for all cases is adjusted for the " Teachingness " and Bed Size of a hospital. The teaching hospital adjustment is based on a cost regression analysis. The study on which it is based developed a regression relating average operating costs to three variables - hospital bedsize, number of interns and residents per 100 beds (Teachingness) and average severity. The sample included 169 hospitals across Canada. There are numerous questions raised with regard to the variables used. These questions are now addressed.

(1) BED SIZE FACTOR

Of all the important variables relating to hospital costs, Bedsize is one of the most contentious. The basic premise for the use of this adjustment factor is that diseconomies of scale exist -the larger a hospital, in terms of active beds, the larger the marginal cost of operating one additional bed. This adjustment factor is obviously to the advantage of larger acute care hospitals in that the predicted cost is corrected accordingly. Whether economies, constant returns or diseconomies of scale exist has never been ascertained and remains an issue of debate amongst economists. Again, nowhere in the acute care documentation is this acknowledged by the Case Mix Institute[d].

(2) AVERAGE SEVERITY

The Case Mix institute does not identify what severity measure was used.

(3) TEACHINGNESS FACTOR

The measure of teachingness currently used in the HPM formula, that is, the number of interns and residents per 100 beds, is not a good measure of postgraduate medical education in teaching hospitals. Interns and residents are not attached to any one single hospital, for the most part, and so the number reported in the HS-1[e] has little meaning. Further, the amount of resources used by residents will vary according to the type of residency. For these reasons, Ontario has rejected the approach taken in Alberta in the HPI formula[29]. The role of indirect costs of medical education, it would appear requires a much closer examination.

Important as the discrepancies in these three variables are, equally important are the omissions of certain variables that it would appear should have a place in the predicted cost adjustment.

(1) REGIONAL FACTORS

Input prices and funding levels will vary by region and location. This is a critical variable, not considered in the development of the teaching hospital adjustment, which potentially explains a significant portion of the variation in costs.

(2) SPECIALTY MIX

With regard to teaching hospitals, there is a mix for types of residents (e.g. surgical, family practice, radiology e.t.c.). This "Specialty Mix" will have a significant impact on teaching costs, yet it is totally ignored by the Case Mix Institute.

The omitted factors are particularly important when the results are being used in a funding setting. Biases can result in inappropriate funding to a specific hospital.

5.4 Actual Cost

Let us now examine the actual allocated cost which appears in the denominator of the HPM calculation. These are not actual costs in any sense, but a sum of allocations of costs of separate activity centres[7] (an activity centre is a department that supplies resources for the treatment of patients). It is possible to manipulate this figure, and thus change one's HPM, by moving costs among activity centres. Indeed, it was just this ability of hospitals to manipulate an allocation formula whose weights differed between departments that forced the Medicare program in the United States to disband its formula and move to a different (per DRG patient) payment system[33]. Alberta has not taken advantage of the Medicare experience. More importantly, even if hospitals did not deliberately reallocate costs among centres, the present allocation among centres depends upon how hospitals are organized. That is, the manner in which a hospital is organized will affect its reporting, and hence its measure of "actual" cost. This would imply that the HPM's measure of actual cost does not measure true actual inpatient cost, but is influenced by a mixture of cost levels and organizational structures.

5.5 Outlier Costs

Outliers by definition refer to extreme case types that have excessive lengths of stay. The costs associated with all outliers are excluded from the case counts in the HPM formula, while outlier costs are included in the inpatient component of the budget figure used in the HPM formula. This potentially will cause significant material errors especially for hospitals treating a larger case load, by volume, of outlier cases. Such hospitals will therefore not have a severity predicted cost (in the HPI calculation) that truly reflects their resource utilization. Clearly, this treatment of extreme case types runs counter to the objectives raised in the initial mandate, that is, to recognize differing amounts of consumed resources as per the level of severity of patients treated.

5.6 ICD-9 Coding

The International classification of Diseases - Ninth revision, is used to code patients under the case mix group classification system. Studies undertaken at the University of Alberta Hospitals have shown that such a patient classification system is unable to account for variations in resource usage[8] when applied to specific case mix groups such as pediatrics and psychiatry among others. These specific case mix groups have been shown to exhibit variations in resource usage, due to the very nature of the patients and treatment procedures, that the conventional DRG framework cannot account for[35]. Although several studies in the U.S. have led to revised DRG frameworks no attempt has been made to apply these revisions to the present coding practice. Given the importance of the coding mechanism, especially within a funding setting, to adequately separate patients with differing diagnoses and hence levels of resource utilization, it would appear that this is one "grey area" that leaves many questions unanswered.

5.7 Summary - The Global Effect

Having discussed the specifics with regard to the acute care funding project, some attention must also be given to the global repercussions of implementing such a performance based system. The attention that hospitals have inevitably paid to their, and other hospitals', HPIs, in an effort to sustain future funding, has created a competitive environment. The creation of such an environment is contrary to the "incentives" pursued by the initial setting up of the funding project where planning, cooperation and improved productivity were sought. In addition, it is hoped that the effect on quality of health care will not be adversely affected by such an environment, as hospitals continue to pursue higher and higher Hospital Performance Indexes.

Lastly, the HPI is a "relative" index whose average value is equal to 100. It is continually being normalized. This means that no matter how efficient hospitals become, the index will continue to be normalized, and there will be an equal number of winners and losers. This will soon become discouraging to a hospital which improves its formula, perhaps significantly, only to find that other hospitals' performance index have increased even more. The fairness of such a formula is certainly questionable.

II SELECTED CASE MIX ANALYSIS

6. Introduction

6.1 Overview

The Acute Care Funding Formula is presently in its fourth year of implementation. Since the formula was formally set in motion, hospitals have been subject to an annual redistribution of inpatient funding dollars. These hospitals have inevitably joined the race to become more "efficient", reduce patient lengths of stay (hospitalization) and thus maximize each subsequent years provincial funding. Somewhat lost in this race, has been the funding formula itself. No studies have been formally undertaken by any hospitals, to date, in order to gather specific data and thus measure to what extent the formula is meeting the set of criteria as expressed in the initial mandate.

The second part of this study is a formal undertaking by the University of Alberta Hospitals in a joint collaboration with the Mechanical Engineering department of the University of Alberta to rectify this situation. In order to assess specific components of the formula, on a continual basis, the funding framework and any subsequent changes can be methodically assessed as to their appropriateness in targeting adjustments to global funding. In addition, hospitals by recreating the Hospital Performance Index are able to better react in, for instance, assigning budgets, evaluating new prog.ams and priorizing the modernization of existing medical technology. The protocol established in the proceeding study will also enable the University of Alberta Hospitals to evaluate its present operations. Such an internal evaluation into specific processes (such as drug

...ion, patient lengths of stay by diagnostic group/department and case mix specific services) will enable the hospital to react effectively to improve the quality of care provided while maintaining a focus on maximizing funding. Lastly, another benefit of internal evaluation is that it enables a hospital to propose changes (within the existing funding framework) to Alberta Health on the basis of factual data. Equitable changes to the funding mechanism will, after all, benefit all Alberta Acute Care Hospitals and patients by ensuring quality health care is appropriately reimbursed.

The study undertaken involves two phases:

1) The data collection phase

2) The evaluation and implementation phase.

6.2 Hypothesis Test

A statistical test was conducted to determine the accuracy of the thirty samples selected for study within each case mix group. The independent variable tested for each case was patient length of stay, (Assume length of Stay = Function[cost]). It was found, through developing the Null Hypothesis, that the samples chosen were representative of the sample population given a 95% confidence level, (+/- 5% error). The exception was CMG 505, Normal delivery without complications, where sample length of stay differs from published UAH data. This is assumed due to the hospital practice of excluding outliers from their data set. The UAH classifies outliers as any length of stay larger than thirty days. Sorting the data set revealed eighty three of four thousand and twenty nine records to have stays larger than ninety days.

7. Phase 1 : Data Collection

7.1 DRG Selection

The first step in this phase of the study involved the determination of eleven diagnosis related groups (DRGs) to use as the basis of all subsequent analysis. The criteria for selection was to determine which DRGs were "critical" for the University of Alberta Hospitals (UAH). By critical, what is meant is, those DRGs that have the greatest impact on the UAH's Hospital Performance Index (HPI). A DRGs impact on the HPI is determined by two main factors: The Resource Intensity Weight (RIW-a measure of the DRGs resource consumption) of that DRG and the total volume of patients that the UAH treat in a fiscal year for the same DRG. Having identified these factors, a list of DRGs was generated using the product of these two variables as the selection criteria. The next step was to identify which of the eleven DRGs was a "winner" or a "loser". A winner is classified as a DRG that contributes to a positive funding adjustment and likewise a "loser" is classified as one that contributes to a negative funding adjustment. The winners, according to this definition, are therefore recognized as efficient cost effective groups by the funding formula and vice-versa for the losers. The purpose of this split is to be able to learn what specific process differences, if any, are being recognised positively by the funding formula. The split of winners and losers were based upon Average Lengths of Stay. Given the present funding formula, DRGs that have an average length of stay (Hospital Specific) less than the provincial average length of stay will receive additional reimbursement. These DRGs, then, are recognized as winners and similarly those DRGs with an average length of stay larger than the provincial average length of stay are recognized as losers. The DRGs chosen along with the selection criteria are outlined in Figure 7.1 and Figure 7.2.

7.2 Patient Resource Consumption Profile

The University of Alberta Hospitals have developed a resident database which is called Patient Resource Consumption Profile (PRCP). The PRCP project was developed as the means by which key patient-specific information contained in the Hospitals' computer system is rolled together, supplemented with cost/activity data and made available to decision-makers as required. The end result of the project will be an automated blend of information about a patient's diagnosis, operative procedure, location, physician, radiology and lab orders, nursing workload, length of stay, etc. (Figure 7.3).

The project began in 1988/89 with funding assistance from the Department of Health. At completion it will include radiology, nursing, pharmacy, operating room, rehabilitation and laboratory medicine information which is combined with patient demographic, transfer, discharge, operative procedure and diagnostic information. To date all the components are in place with the exception of pharmacy (Drug Costs). In addition, information relating to patient classification is also available. This information, however, is on a case mix group (CMG) basis and no DRG specifics are available. All patient information in Alberta acute care hospitals is stored on a case mix group basis. Certainly, if the funding formula continues to utilize diagnosis related groups as the patient classification system of choice, Alberta hospitals will need to consider storing patient related information in a compatible format.

CMG # (DRG #)	UAHLOS	PLOS	RIW * PT. VOLUME
595 (430)	35.5	20.3	492,558 (3.6%)
143 (109)	9.5	9.4	366,444 (2.7%)
502 (370)	9.2	7.2	237,825 (1.74%)
001 (001)	23.5	21.2	169,090 (1.23%)
100 (075)	25.1	17.0	168,498 (1.23%)
140 (105)	16.4	15.7	92,701 (0.67%)

Description of DRGs

595 --- PSYCHOSES

143 --- OTH. CARD THORACIC PROC. - NO PUMP

502 --- C-SECTION

001 --- CRANIOTOMY, AGE > 18 EXC TRAUMA

100 --- MAJOR CHEST PROCEDURES

140 --- CARD VALV PR W PUMP, NO CATH

** **UAHLOS - University of Alberta Length of Stay for DRG**

** **PLOS - Provincial Average Length of stay for DRG**

** **RIW - Resource Intensity Weight for DRG**

Figure 7. List of Losers

CMG # (DRG #)	UAHLOS	PLOS	RIW * PT. VOLUME
505 (373)	4.1	4.4	2,827,062 (20.63%)
49 (039)	2.1	3.4	663,680 (4.84%)
142 (107)	10.9	12.8	342,095 (2.5%)
446 (336)	8.5	10.2	213,486 (1.56%)
193 (148)	19.9	20.8	207,208 (1.51)

Description of DRGs

505 --- VAGINAL DELIVERY WITHOUT CC

49 --- LENS PROCEDURES

142 --- CORONARY BYPASS, NO CARD CATH

446 --- TURP, AGE > 70

193 --- MAJOR BOWEL PROC, AGE > 70 /CC

** **UAHLOS - University of Alberta Length of Stay for DRG**

** **PLOS - Provincial Average Length of stay for DRG**

** **RIW - Resource Intensity Weight for DRG**

Figure 7.2 List of Winners

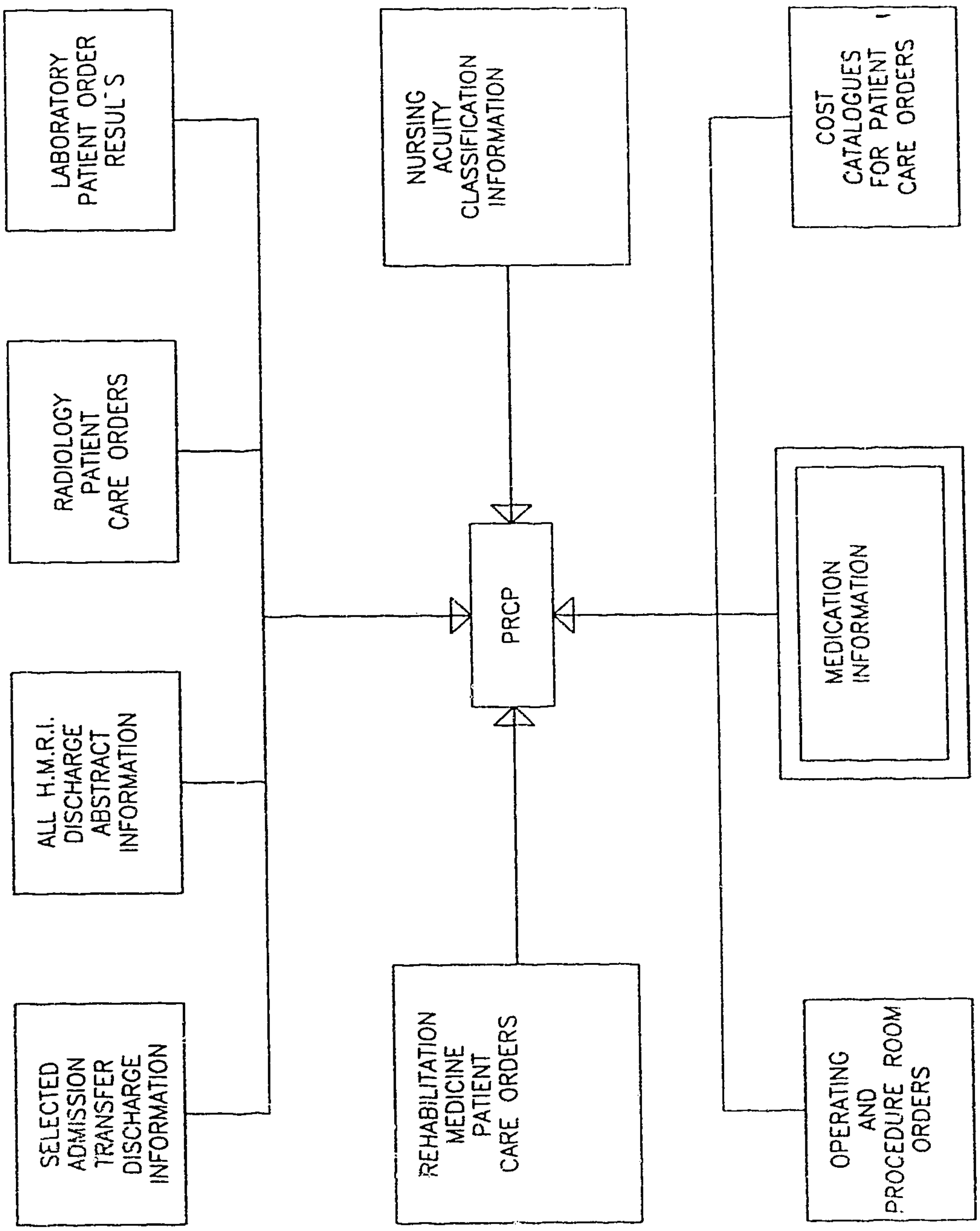


Figure 7.3 The PRCP Database

7.3 Patient Selection

Having selected the DRGs, the next step was to decide on an appropriate time frame to base the study on and the sample size of patients to be evaluated. The time frame chosen was from March 31, 1989 to April 1, 1990. A sample size of thirty patients for each of the eleven DRGs was chosen. The screening process for these patients involved the following procedures:

a) The DRGs chosen were analyzed and the corresponding CMGs chosen. Having identified the specific case mix groups a random sample size of thirty patients were selected (for each CMG) using the PRCP database. A random number was generated and the corresponding patient in the HMRI list was chosen. For each patient the identification number and admission and discharge dates was noted. All information on the hospital PRCP database, relating to each patient, could thus be accessed using the patient's identification number and admission and discharge dates.

b) Each sample patient was then matched using the Hospital Medical Records Institute's (HMRI) database. This information was made available to the author and contained the UAH entire patient database, for the fiscal year 89/90, in a DRG specific format. Of the thirty patients chosen, for each classification group, it was found that many patients were classified under totally different groups for the DRG and CMG classification systems. This was expected, given the inherent difference in the two systems (i.e. DRGs use the ICD-9-CM coding with Clinical Modification and CMGs use the ICD-9 coding without). In order to maintain a homogeneous group, only patients classified in the same Diagnosis Related Group and Case Mix Group were selected.

Patients selected that were not classified in the same DRG and CMG groups were rejected. Any future cross reference between the two systems would thus be valid.

7.4 Patient Costing

Using the PRCP database, a complete costing was done for the following categories: Rehabilitation, Nursing Care, Radiology, Laboratory and operating costs. The Drugs and IV (IntraVenous Drugs) costs were not available from the database and so each patient's chart was manually pulled, the total drug utilization evaluated and each drug costed. In this way a total per patient cost was obtained for all of the categories listed above.

Each of the categories was manually checked against the patient discharge abstract for accuracy. Discrepancies were found in several cases and corrected accordingly. The author recognizes that errors will undoubtedly occur in the abstract data completed by the University of Alberta Hospitals, however, in the absence of any other reference, an assumption had to be made as to the accuracy of this data.

8. Phase 2 : Evaluation and Implementation

8.1 Areas of Concern

The analysis reported in this paper will concentrate on only three of the eleven Diagnosis Related Groups evaluated. These DRGs are listed below:

1) DRG 373 - Normal Delivery Without Complication and/or Comorbidity

2) DRG 430 - Psychoses

3) DRG 049 - Lens Procedures

The Diagnosis Related Groups not reported in this paper revealed identical areas of concern as the three groups listed. This substantiates concerns that a problem exists in the funding formula, the classification and coding of patients and internal processes that exist within the hospital.

Following is an exposition of the results and analysis of the three DRGs, normal delivery, psychoses and lens procedures.

8.2 Results and Evaluation of DRG 373 - Normal Delivery Without Complication and/or Comorbidity

All 30 patients evaluated for this DRG were categorized as zero (Minor) level severity cases. Their resource utilization per day are therefore assumed to be the same under the RGN Grouper classification system. Figure 8.4 captures the total cost summary for the entire sample size. Patient number one has the longest length of stay, (106 days) and subsequent patients have progressively decreasing lengths of stay with patient

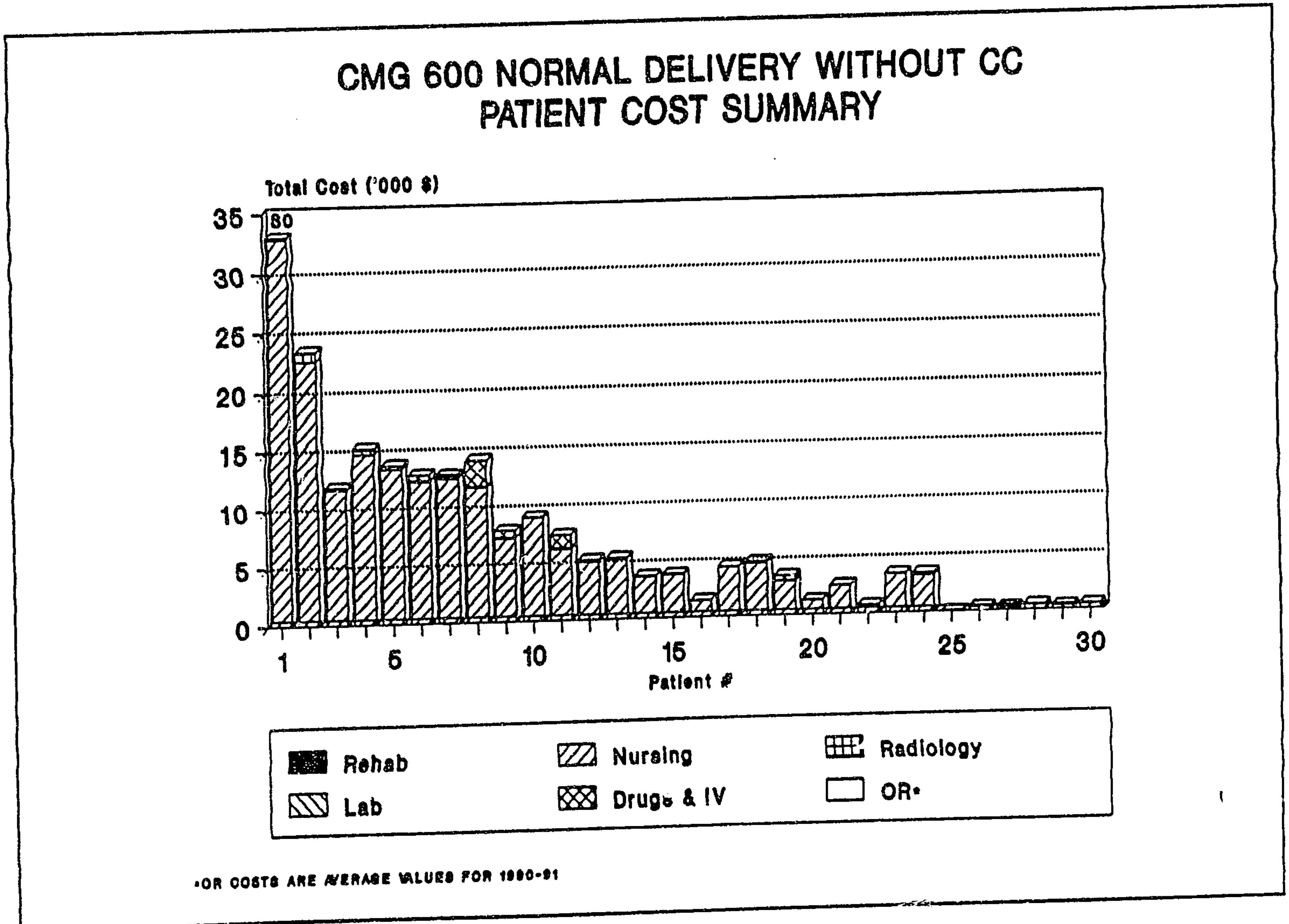


Figure 8.4 TOTAL COST SUMMARY

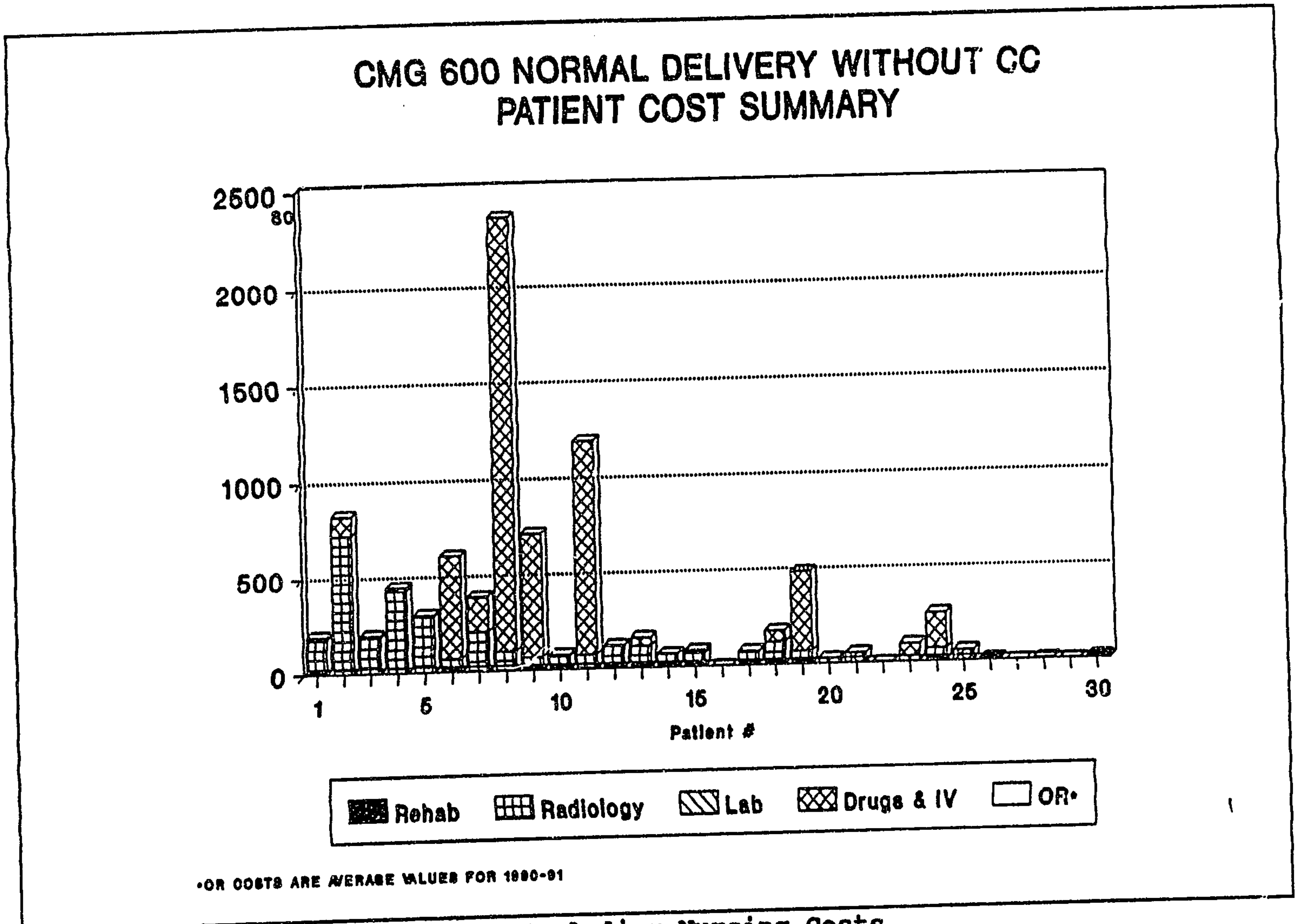


Figure 8.5 Total Cost Summary Excluding Nursing Costs

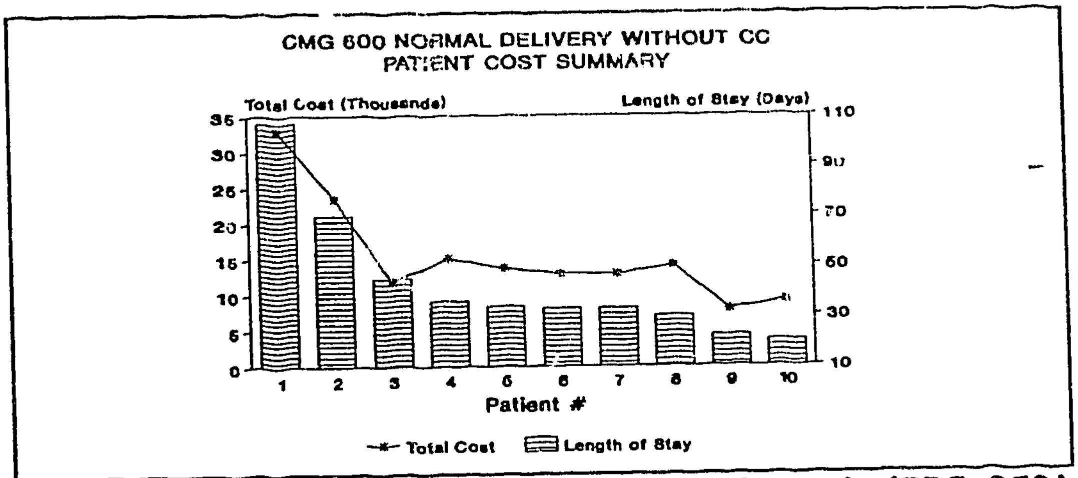


Figure 8.6 Length of Stay vs. Total Cost (DRG-373)

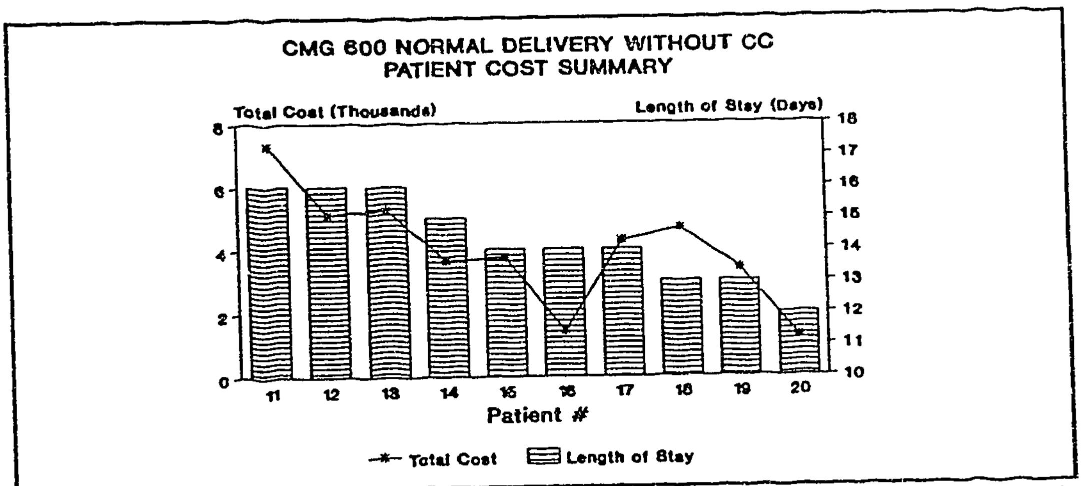


Figure 8.7 Length of Stay vs. Total Cost (DRG-373)

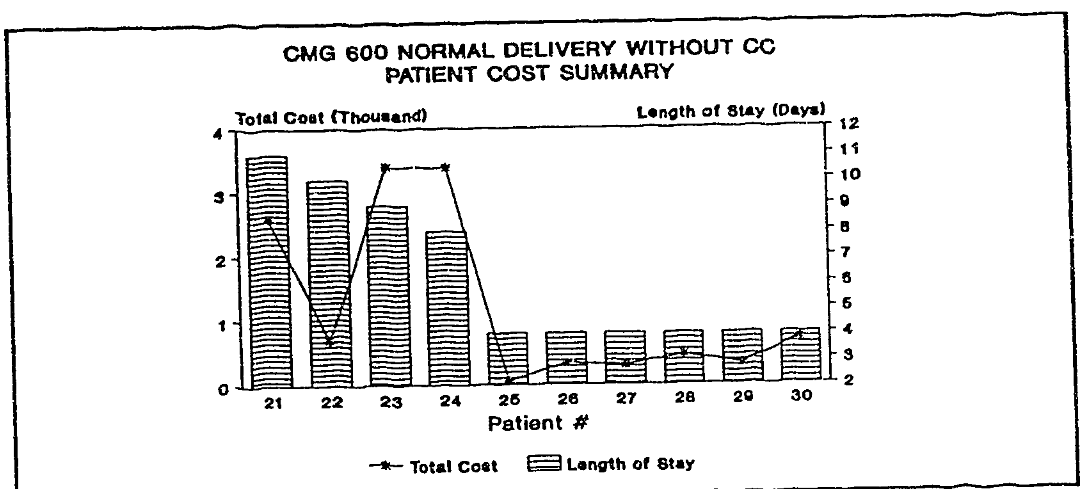


Figure 8.8 Length of Stay vs. Total Cost (DRG-373)

number 30 having the shortest length of stay, (4 days). The components contributing to the total patient costs are outlined, and as expected, nursing costs account for a substantial portion. For the UAH, nursing costs account for approximately 65% of total inpatient costs.

8.2.1 Drug Utilization

When nursing costs are extracted from the total patient costs (Figure 8.5) the remaining components do not exhibit any consistency. Of particular concern are the drug utilization levels for patients classified under the same severity class. As can be seen, the drugs administered vary in total cost from only a few dollars to $2,200. This variation could be due to one of two reasons. Either the patients exhibiting excessive drug consumption levels have been incorrectly classified as a" Normal Delivery without complication" or physician practice must be examined at the University of Alberta Hospitals. If the former is applicable, the criticism that a DRG based classification system applied to Canadian practices and standards is not appropriate, is certainly substantiated. If however, the problem lies in Physician practice, an internal evaluation will have to be conducted in order to assess appropriate levels of drug utilization for patients within this DRG. Having developed a standardized process for drug utilization, large variations in drug utilization can be easily tracked on a Physician specific basis and corrective action taken as necessary. It has been found through previous studies conducted at the University of Alberta Hospitals[32], that when data pertaining to patient treatment is presented to the relevant physicians they themselves take the action necessary to standardize treatment procedures and hence reduce procedural variations across patients to a minimum. In order to ascertain whether one or both of the reasons is causing the large variation in drug utilization, the data collected for each of the patients has been submitted to the Medical Quality Council. Both physicians that treated the patients and the Medical Records Department will also be given copies of the data so that treatment procedures can be evaluated for all the cost components. It is hoped that such a patient specific evaluation will reveal the extent to which either Physician practice or the DRG patient classification system are responsible for the disparities witnessed.

8.2.2 The Cost Weights

The funding formula's use of the New York Cost per day (or Service Intensity Weight) as a surrogate of cost underlies a critical assumption, that the total resource consumption for a patient within a given DRG increases constantly as the length of stay increases. Given the importance of this assumption in calculating the Severity Predicted Cost, any discrepancy would have vital implications in determining whether the present redistribution of dollars is equitable.

Figures 8.6, 8.7, 8.8 would tend to substantiate concerns that such an assumption is not valid. As can be seen, resource consumption (total cost) variations are generally independent of length of stay. Of particular interest were patients numbering 25 through to 30 (Figure 8.8). These five patients are classified under the same DRG. They have also been assigned to the same severity class by the RGN severity system and have identical lengths of stay. For all intensive purposes, these five patients should have undergone the same treatment procedures. The successively increasing costs, such that patient numbers 25 and 30 have a total cost difference of $800 can, therefore, not be explained by the present funding mechanisms. Data pertaining to this area of concern have been submitted to the Technical Committee responsible for recommending improvements (of the present funding formula) to Alberta Health.

8.2.3 Length of Stay

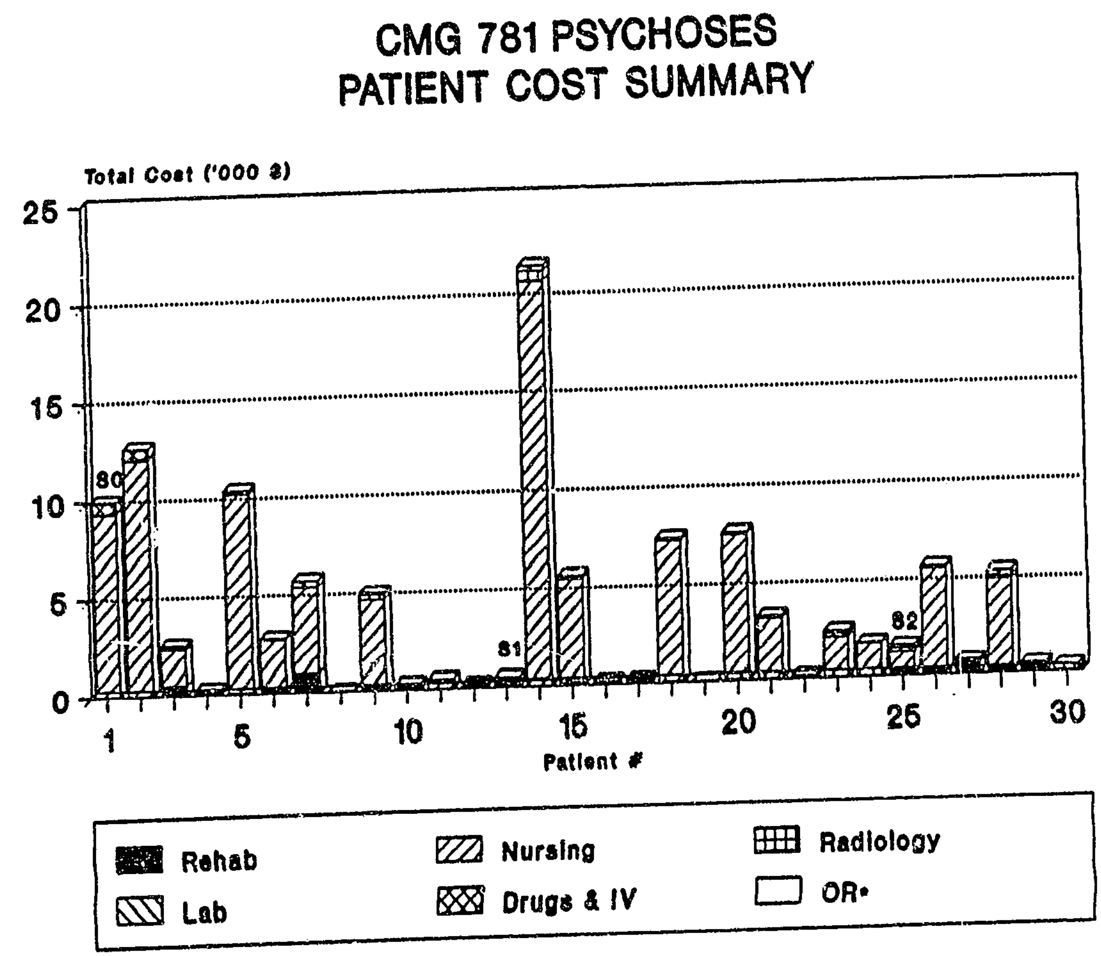
The accuracy of a patient's assignment to a Diagnosis Related Group and subsequently to a Resource Grouper Number will depend on how accurately the patient discharge abstract is completed by the physician and on how the presently used International Classification of Diseases (Ninth revision with clinical modification) codes the primary and secondary diagnoses of a patient. With this in mind, one's attention is drawn to patient numbers 1 through to 8. The present use of the outliers' adjustment in the formula has drawn attention away from a serious problem. Outliers, termed as patients with excessive lengths of stay, are not included in the case count to calculate the severity predicted cost but are, however, included in the calculation of inpatient expenditures. Institutions treating a larger case mix of high severity patients such as the University of Alberta Hospitals will thus be adversely affected in terms of funding received for such patients. This point made, the more serious problem of why such patients are being quite obviously incorrectly classified, is not being addressed. Whether patient number one, for instance, is classified as an outlier or not should not be the primary concern. The mere fact that a patient with a length of stay of 106 days has been assigned to a DRG representing Normal deliveries without complications illustrates a much deeper problem. An evaluation of the accuracy of patient discharge abstracts must be undertaken by Alberta Health in order to ascertain the root cause of the problem. If at a later stage, the ICD-9 coding system is also found wanting, appropriate measures should be taken. The use of outliers to simply disregard patients not fitting the assignment process is a short term solution to a problem that will most certainly increase as the average population age and likewise severity increases.

8.3 Results and Evaluation of DRG 430 - Psychoses and DRG 049 - Lens Procedures

Results from the analysis of these two Diagnosis Related Groups revealed the same areas of concern as listed for DRG 373 - Normal Delivery without complication and/or comorbidity (Figures 8.9 to 8.18). For Psychoses patients rehabilitation, radiology and drug utilization levels all show variations in total costs that are inconsistent with both increases in severity and length of stay. The same procedure of data evaluation was used for these DRGs and all others not presented in this paper. The data was presented to the relevant physicians and departments (i.e. Medical Records) so that an internal evaluation could be undertaken.

8.3.1 The RGN Severity System

The RGN Severity Classification System, used in the funding formula, purports to categorize patients into one of four levels (S0, S1, S2, S4) of severity. It thus, attempts to separate cases into severity classes that have homogeneous resource



*OR COSTS ARE AVERAGE VALUES FOR 1990-91

Figure 8.9 Total Cost Summary

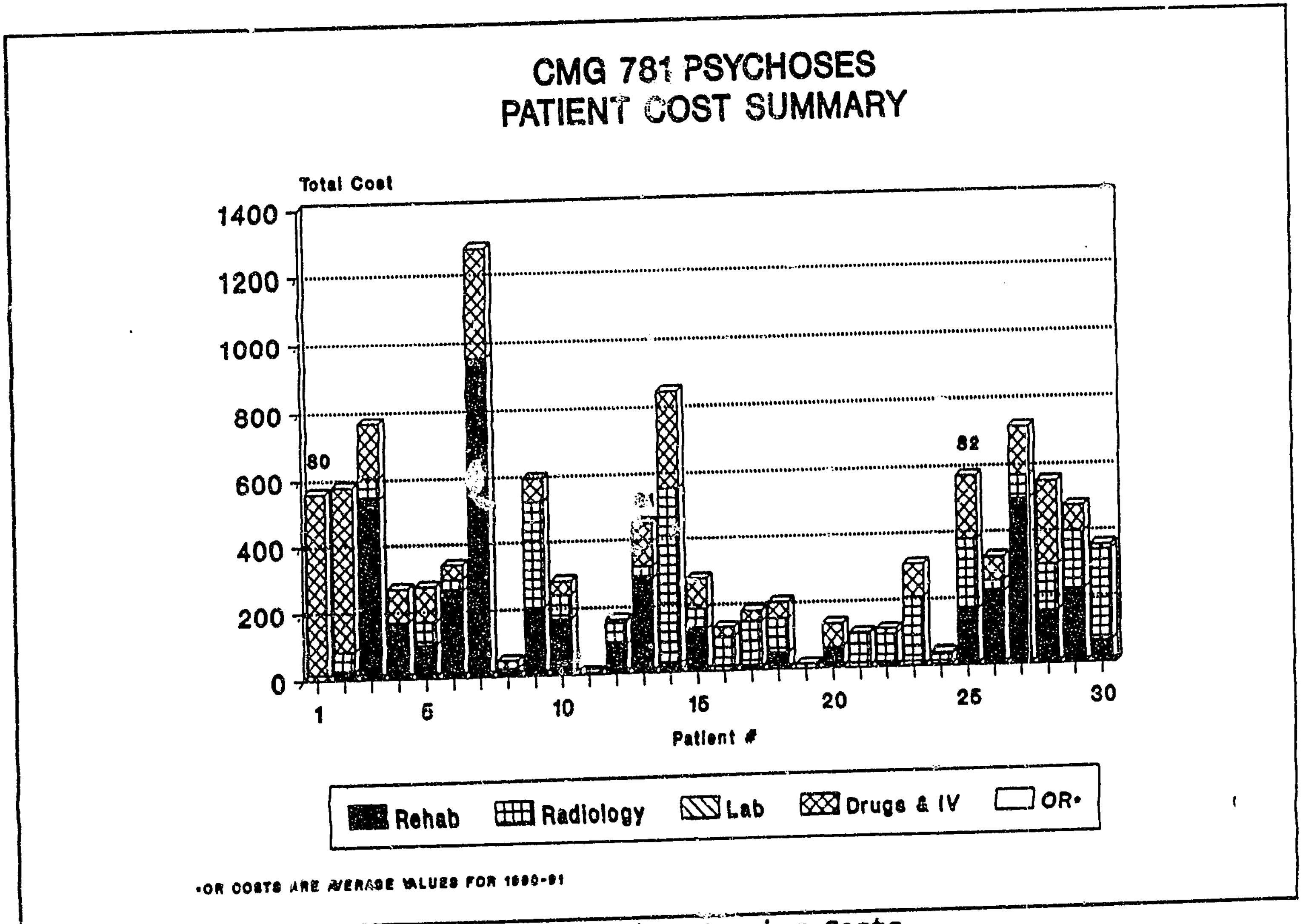


Figure 8.10 Total Cost Summary Excluding Nursing Costs

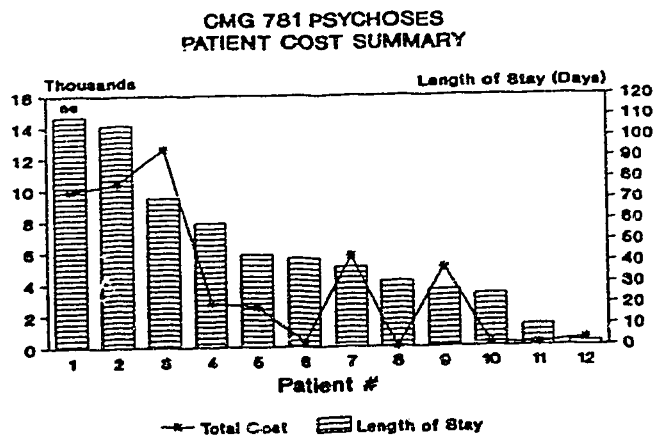


Figure 8.11 Length of Stay vs. Total Cost (DRG-430)

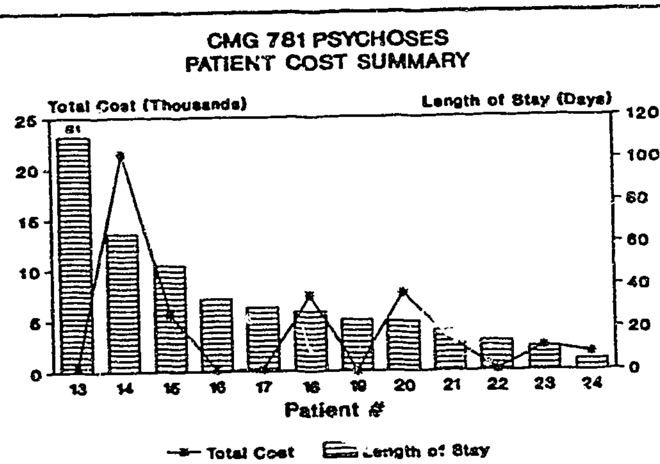


Figure 8.12 Length of Stay vs. Total Cost (DRG-430)

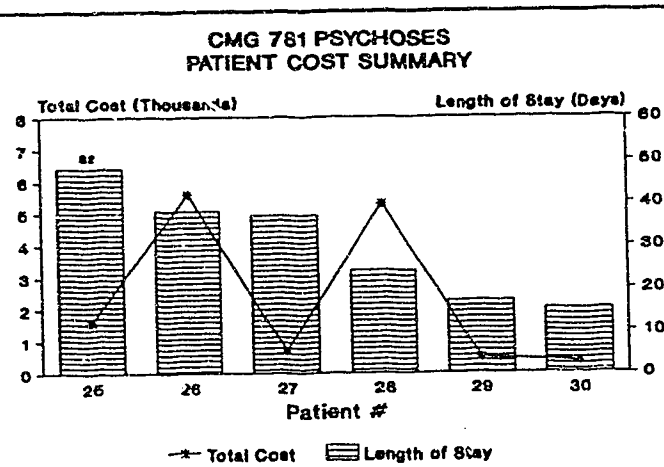


Figure 8.13 Length of Stay vs. Total Cost (DRG-430)

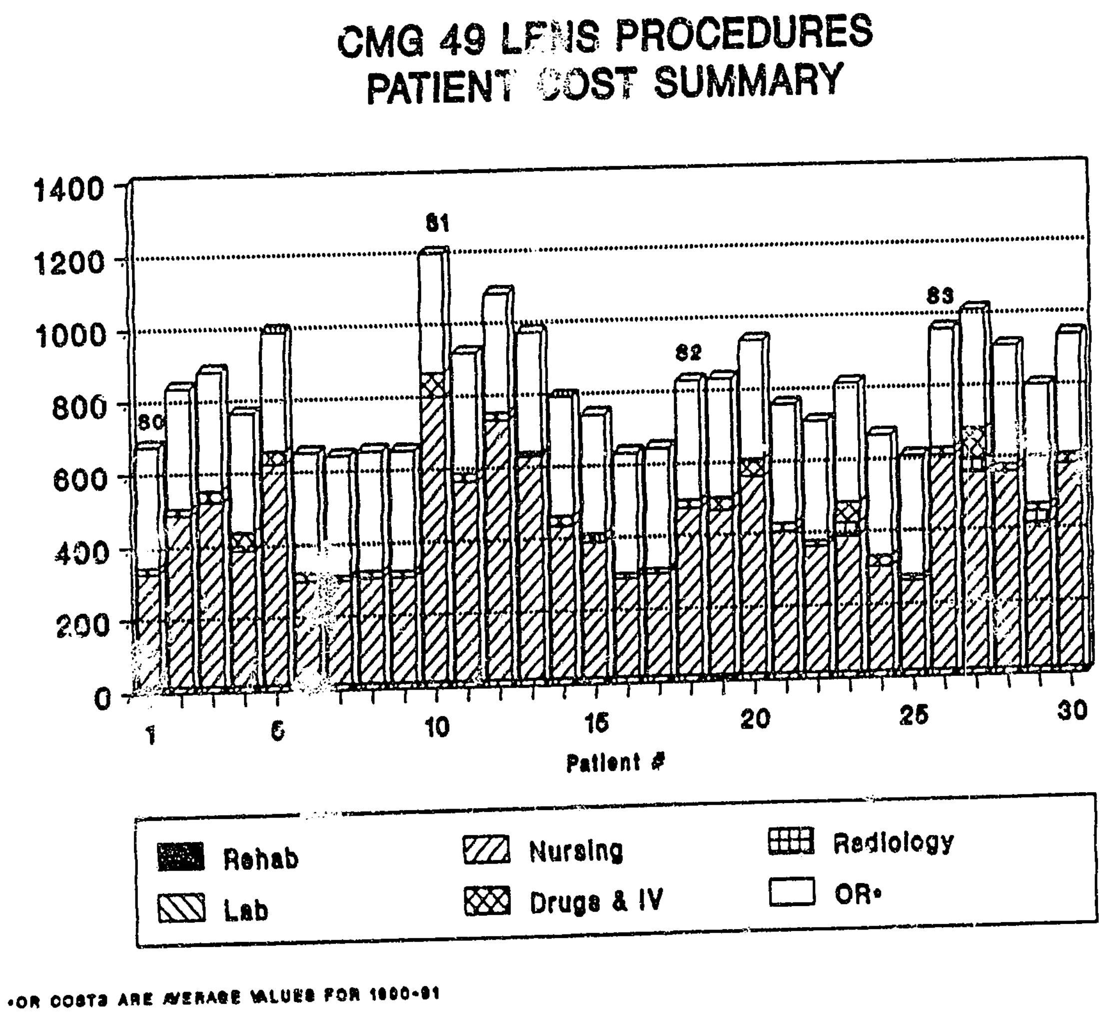


Figure 8.14 Total Cost Summary

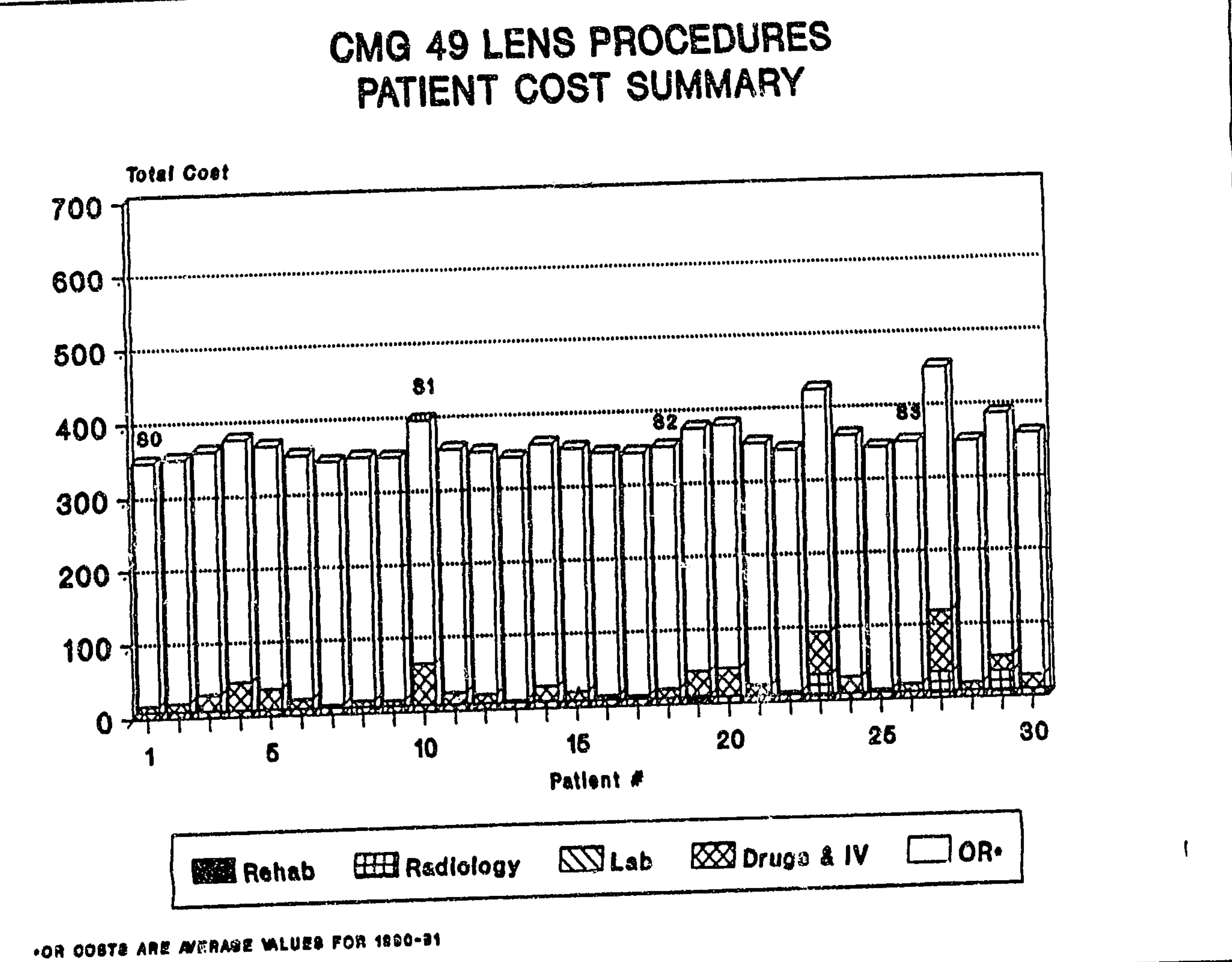


Figure 8.15 Total Cost Summary Excluding Nursing Costs

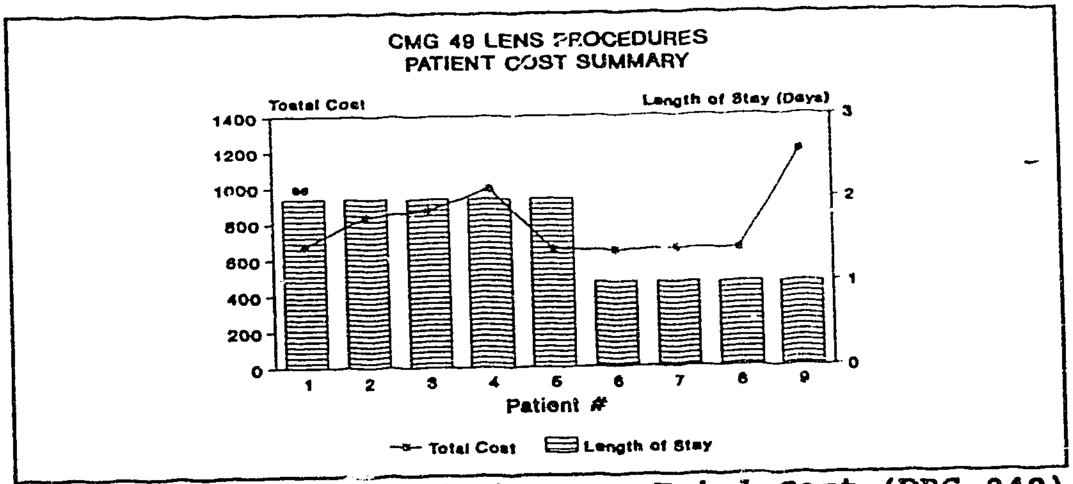


Figure 8.16 Length of Stay vs. Total Cost (DRG-049)

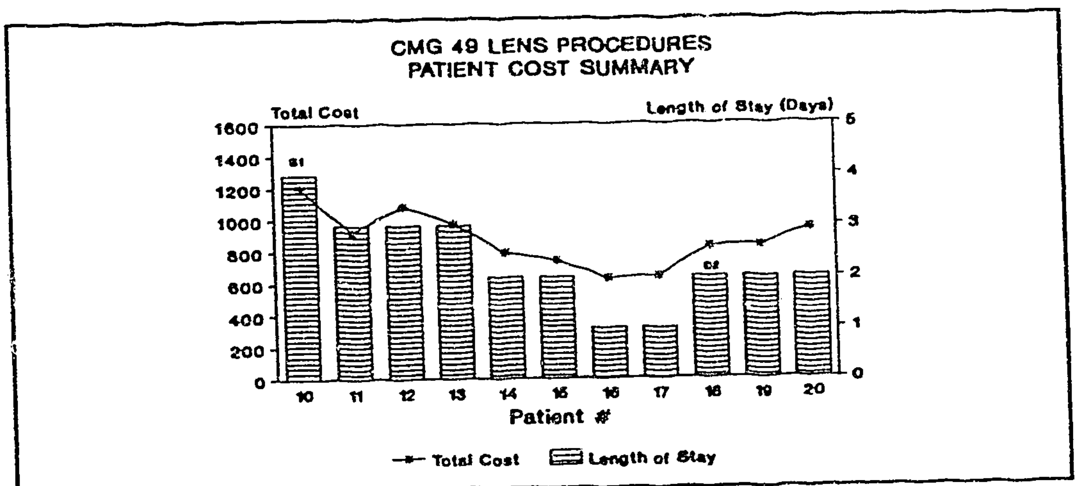


Figure 8.16 Length of Stay vs. Total Cost (DRG-049)

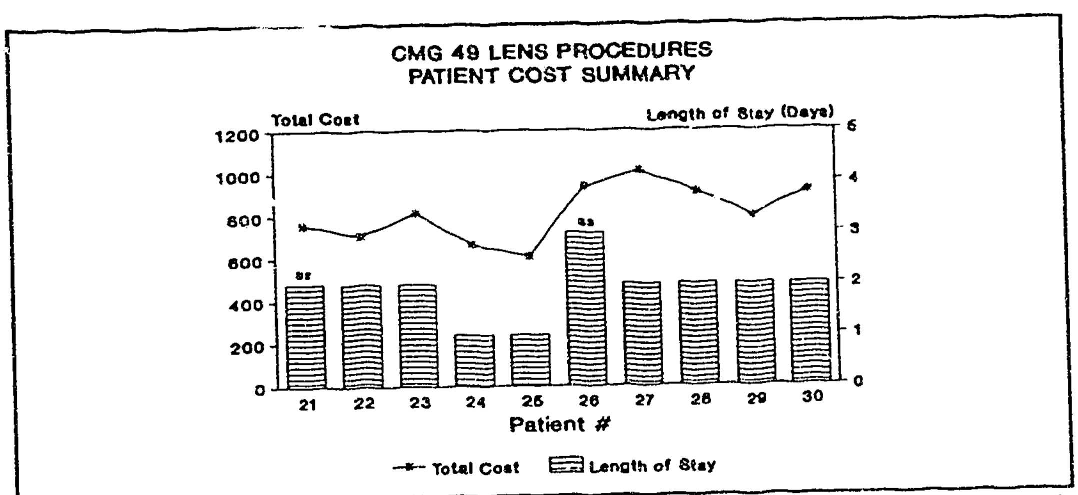


Figure 8.18 Length of Stay vs. Total Cost (DRG-049)

consumption patterns within a severity class and increasing resource consumption rates for successively higher classes. Figures 8.9 and 8.14 show that, on the contrary, there appears to be no such relationship either between severity classes or within a given severity class. Psychoses patients showed no consistency within severity classes and similarly across different classes.

Lens procedure cases was the only DRG studied that exhibited consistently average total costs within severity classes. However, when progressively higher classes of severity were analyzed an increase in resource consumption (total cost) was not evident. Rather, when nursing costs were extracted (Figure 8.15) the average total cost for increasing levels of severity ranged from $360 to $366. This result and similar results for all the other DRGs studied would tend to substantiate the claim that the RGN severity system is not adequately categorizing patients into homogeneous (as far as resource consumption is concerned) severity classes. Tests need to be undertaken to evaluate the necessary refinements to this system. The adoption of an alternative system that better accounts for variations in severity and resource consumption for acute care patients in Alberta should also not be discounted.

9. Conclusion

The purpose of this two part study was to (1) develop the Inpatient Acute Care Funding Formula for Alberta (from information gathered in reports from CMI) such that the Hospital Performance Index (HPI) can be recreated for the University of Alberta Hospitals using actual patient data and (2) to undertake a case mix analysis of selected Diagnosis Related Groups such that specific areas of concern within the presently used formula can be illustrated and an appropriate protocol developed for future studies.

The analysis of the Acute Care Funding Formula was successful. Each component of the formula was assessed and the HPI for 1989/1990 was recreated. In addition, the HPI for 1990/1991, which is due to be released in the beginning of 1992, was [illegible]. In addition, areas of concern within the present methodology were revealed and assessed. A case mix analysis was undertaken to assess these areas of concern. Results proved positive, clearly highlighting the changes that will be required to be made to the funding formula such that the redistribution of funding dollars are equitable and the funding issues outlined in the initial mandate are being met.

Although many areas for improvement remain, within the Inpatient Funding Formula, the implementation of the Acute Care Funding Project has had one overwhelmingly beneficial affect. It has acted as a catalyst in forcing health care providers, administrators and policy makers to realize that a constantly increasing funding budget is not the answer to burgeoning health care costs. Much wastage exists in the system and unless and until these issues are tackled, the next century will surely be a time of increased hardship for all Acute Care hospitals in Alberta.

FOOTNOTES

[a] The International Classification of Diseases with Clinical Modification (Ninth Version), developed in the U.S., is a list of approximately 10,000 known diseases. It is presently being used in Alberta to code the diagnoses of patients.

[b] "Normalized" is a statistical technique that puts all individual results onto a standard scale (such as +/- 1.00) which makes comparison easy.

[c] In addition to the refined DRG/RGN (Yale University), a number of severity systems have been developed and most use abstracted data. Some systems like Acute Physiology and Chronic Health Evaluation (APACHE II) draw patient data directly from the patient's chart and use more comprehensive physiological data such as heart rate , temperature and so on. While chart based systems are more specific than abstract systems, they require more labour to gather data and to date have tended to be used only in specialized areas such as Intensive Care Units.

[d] The Case Mix Institute: Queens University, Kingston , Ontario, are responsible for establishing the framework of the Acute Care Funding Project.

[e] Total costs by activity centre per fiscal year are reported annually on the statistics Canada HS-1 form.

[f] At the University of British Columbia Robert Evans and Morris Barer developed a method of separating the costs of inpatient services. All operating costs are considered so the resulting estimate of actual inpatient costs include both patient treatment costs and a portion of the facility support costs. The model uses data supplied by hospitals on the annual federal report HS-1.

[g] A study was undertaken by the University of Alberta Hospitals in conjunction with the mechanical engineering department to look into ten specific case mix groups. Results indicated that the ICD-9 coding system was inadequate in classifying patients - especially when variance in resource utilization was examined.

[h] The coefficients in this adjustment procedure are derived from a regression analysis performed on 169 Canadian hospitals in which the logarithm of average cost per case was regressed on average severity, number of beds and the number of interns and residents per 100 beds.

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APPENDIX A

A DETAILED EXAMINATION OF THE EVANS-BARER MODEL FOR CALCULATING THE INPATIENT PROPORTION OF TOTAL HOSPITAL EXPENSES

Detailed Calculation of Inpatient and Non-Inpatient Expenditure Proportions

PART 1 : NON-INPATIENT ACTIVITY AREAS

Expenditure for gross salaries and wages and supplies and other expenses are allocated into inpatient and non-inpatient components. Some activities are considered entirely non-inpatient such as special research, emergency, home care, social work, ambulance (excluding motor transport), education costs and other expenses under diagnostic and therapeutic. The following cells **(page/line/column)** from Statistics Canada's Annual Return of the Health Care Facilities, Part One (HS-1), are allocated directly to non-inpatient gross salaries and wages and expense.

ANNUAL CELLS

Non-inpatient Activity Area	Gross Salaries and Wages (PP/LLL/CC)	Supplies (PP/LLL/CC)
Special Research (Res)	1200302 + 1200303	1200304
Emergency (Emerg)	1000102 + 1000103	1000104
Home Care (HC)	1001702 + 1001703	1001704
Social Work	1001802 + 1001803	1001804
Ambulance (Amb)	1001902 + 1001903	1001904
Education	1100702 + 1100703 +1100704	1100705
Diagnostic & Therapeutic (Other Expenses)	1002102 + 1002103	1002104

*** note that the (page/line /column) for each component refers to the corresponding cell to be found in the annual HS-1 form.**

PART 2 : ACTIVITY AREAS SHARED BY INPATIENTS AND OUTPATIENTS

A number of departments have both inpatient and outpatient activities. Non-inpatient expenditure is estimated and the assumption made that expenditure follows the same inpatient/outpatient distribution as utilization. The following areas are considered in this section. Laboratory, Radiology, ECG, EEG, Nuclear Medicine, Respiratory Therapy, Other Therapy, Special Clinics, Day/Night Programs, dietetics and laundry and linen. Utilization weights vary between activity centres and include standard units, number of visits and number of tests or examinations. Dietetic's expenses are based on inpatient/non-inpatient meal days and laundry and linen expenses are based on kilograms of laundry done for own hospital (inpatient) and laundry done for others (non-inpatient). The non-inpatient expenditure share is estimated below for each activity area.

LEGEND

nonipsw - non-inpatient share of salaries and wages.

nonipsoe - non-inpatient share of supplies and other expenses

nonipur - non-inpatient share of purchased services

GSW - gross salaries and wages

op - outpatient

Laboratory (lab)

nonipsw = GSW lab * $\frac{\text{(op + referred-in + routine staff in lab units)}}{\text{total lab units}}$

= (1000502 + 1000503) * $\frac{\text{(0401302 + 0401303 + 0401304)}}{\text{(0401305)}}$

nonipsoe = ((SOE lab - purchased services) * $\frac{\text{(op + referred-in + routine staff exams in lab units))}}{\text{total lab units}}$

= ((1201101 + 1201201 + 1201301) * (0401302 + 0401303 + 0401304)) / (0401305)

nonippur = Purchased services * tests requested for op / total tests requested

= (1201101 + 1201201 + 1201301) * (0501102) / (0501101 + 0501102)

Diagnostic Radiology (dr)

nonipsw = GSW dr * op standard units / total standard units

= (1001002 + 1001003) * 0601804 / 0601805

nonipsoe = SOE dr * op standard units / total standard units

= 1001004 * 0601804 / 0601805

Therapeutic Radiology (tr)

nonipsw = GSWtr * op treatments / total treatments

= (1001102 + 1001103) * (0602502 + 0602504) / 0602505

nonipsoe = (SOEtr - purchased services) * op treatments / total treatments

= (1001104 - 1202105) * (0602502 + 0602504) / 0602505

nonipur = purchased services * op treatments / total treatments

= (1202105) * (0602502 + 0602504) / 0602505

ECG

$$\text{nonipsw} = \text{GSWecg} * \frac{\text{op ecg units}}{\text{total ecg units}}$$

$$= (1000602 + 1000603) * \frac{0401504}{(0401503 + 0401504)}$$

$$\text{nonipsoe} = (\text{SOEecg} * \frac{\text{op ecg units}}{\text{total ecg units}}$$

$$\text{nonipsoe} = (100604 * \frac{0401504}{(0401503 + 0401504)}$$

EEG

$$\text{nonipsw} = \text{GSWeeg} * \frac{\text{op eeg units}}{\text{total eeg units}}$$

$$= (1000702 + 1000703) * \frac{0401604}{(0401603 + 0401604)}$$

$$\text{nonipsoe} = \text{SOEeeg} * \frac{\text{op eeg units}}{\text{total eeg units}}$$

$$= 1000704 * \frac{0401604}{(0401603 + 0401604)}$$

NUCLEAR MEDICINE (nm)

$$\text{nonipsw} = \text{GSWnm} * \frac{\text{op nm units}}{\text{total nm units}}$$

$$= (1000802 + 1000803) * \frac{(0401804 + 0401904)}{(0401803 + 0401804 + 0401903 + 0401904)}$$

$$\text{nonipsoe} = \text{SOEnm} * \frac{\text{op nm units}}{\text{total nm units}}$$

$$= 1000804 * \frac{(0401804 + 0401904)}{(0401803 + 0401804 + 0401903 + 0401904)}$$

PHYSIOTHERAPY (pt)

nonipsw = GSWpt * $\frac{\text{op pt attendance}}{\text{(total pt attendance)}}$

= (1001402 + 1001403) * $\frac{(0700302 + 0700304)}{0700305}$

nonipsoc = SOEpt * $\frac{\text{op pt attendances}}{\text{(total pt attendance)}}$

= 1001404 * $\frac{(0700302 + 0700304)}{0700305}$

OCCUPATIONAL THERAPY (ot)

nonipsw = GSWot * $\frac{\text{op ot attendances}}{\text{total ot attendances}}$

= (1001502 + 1001503) * $\frac{(0700602 + 0700604)}{0700605}$

nonipsoc = SOEot * $\frac{\text{op ot attendances}}{\text{total ot attendances}}$

= 1001504 * $\frac{(0700602 + 0700604)}{0700505}$

OTHER THERAPY

$$\text{nonipsw} = \text{GSWoth} * \frac{\text{op oth attendances}}{\text{total oth attendances}}$$

$$= (1001602 + 1001603) * \frac{(0700702 + 0700802 + 0700704 + 0700804)}{(0700705 + 0700805)}$$

$$\text{nonipsoe} = \text{SOEoth} * \frac{\text{op oth attendances}}{\text{total oth attendances}}$$

$$= 1001604 * \frac{(0700702 + 0700802 + 0700704 + 0700804)}{(0700705 + 0700805)}$$

RESPIRATORY THERAPY (rt)

$$\text{nonipsw} = \text{GSWrt} * \frac{\text{op rt treatments}}{\text{total treatments}}$$

$$= (1001202 + 1001203) * \frac{0700904}{(0700903 + 0700904)}$$

$$\text{nonipsoe} = \text{SOErt} * \frac{\text{op treatments}}{\text{total treatments}}$$

$$= 1001204 * \frac{0700904}{(0700903 + 0700904)}$$

SPECIAL CLINICS (cln)

$$\text{nonipsw} = \text{GSWcln} * \frac{\text{op cln visits}}{\text{total cln visits}}$$

$$= (1000202 + 1000203) * \frac{0802401}{(0802401 + 0802402)}$$

$$\text{nonipsoe} = \text{SOEcln} * \frac{\text{op cln visits}}{\text{total cln visits}}$$

$$\text{nonipsoe} = 1000204 * \frac{0802401}{(0802401 + 0802402)}$$

DAY/NIGHT PROGRAMS (dn) -excludes surgical day care

$$\text{nonipsw} = \text{GSWdn} * \frac{\text{op dn}}{\text{total patients dn}}$$

$$= (100402 + 1000403) * \frac{0803303}{(0803303 + 0803304)}$$

$$\text{nonipsoe} = \text{SOEdn} * \frac{\text{op dn}}{\text{total patients dn}}$$

$$= 1000404 * \frac{0803303}{(0803303 + 0803304)}$$

DIETETICS (fd)

ipsw = GSWfd * inpatient meals (prepared by hospital + purchased from others) / total meal days

= 110304 * (0702001 + 0702101) / 0702005

ipsoe = SOEfd * inpatient meals (prepared by hospital + purchased from others) / total meal days

= 1101305 * (0702001 + 0702101) / 0702005

LAUNDRY AND LINEN (ll)

ipsw = GSWll * laundry done for own hospital / total laundry done in institution

= (1101404 + 1101504) * 0702205 / 0702405

ipsoe = SOEll * laundry done for own hospital / total laundry done in institution

= (1101405 + 1101505) * 0702205 / 0702405

PART 3 : INPATIENT SALARIES, WAGES AND SUPPLIES (Less Administration)

All estimates of non-inpatient expenditure are subtracted out of total gross salaries and wages and supplies and other expenses to produce an estimate of inpatient expenditure. That part of administrative gross salaries and wages to be prorated into inpatient/non-inpatient proportions is also netted and dealt with separately in Part 4. Similarly, employee benefits are dealt with in Part 5.

IPSW1

(net Admsw) = GSW - (Admsw + Ressw + Emergsw + HCsw + SWsw + Ambsw + Edsw + Dtsw + nonipswlab + nonipswdr + nonipswtr + nonipsweeg + nonipsweeg + nonipswnm + nonipswpt + nonipswot + nonipswoth + nonipswrt + nonipsweln + nonipswdn)

IPSOE1

(NET Admsoe) = SOE - (Admsoe + Ressoe + Emergsoe + HCsoe + SWsoe + EDsoe + Dtsoe + Ambsoe + nonipsoelab + nonipsoedr + nonipsoetr + nonipsoeeeg + nonipsoenm + nonipsoept + nonipsoeot + nonipsoeoth + nonipsoert + nonipurlab + nonipurtr + nonipsoeeln + nonipsoedn)

PART 4 : ADMINISTRATIVE SALARIES (Admsw) AND EMPLOYEE BENEFITS (EB)

That part of administrative salaries expense, which is assumed to be shared by inpatients and non-inpatient activities is assumed to be in the same inpatient/non-inpatient distribution as all other salaries and wages (net administration) for the hospital. Note that salaries and wages for medical records and library (reclbsw) is assumed to be entirely inpatient and , therefore, are not included in the prorating of administrative salaries and wages. Salaries and wages for dietetics (fdsw) and laundry and linen (llsw) are entirely prorated based on meal days and kilograms of laundry in Part 2, and the inpatient component is added in separately below. Employee benefits are assumed to follow the same inpatient/non-inpatient mix as the total salaries and wages.

$$\text{IPSW2} = \text{IPSW1} + \left[\left(\frac{\text{IPSW1}}{(\text{GSW} - \text{Admsw})} * \text{admsw} - \text{reclbsw} - \text{fdsw} - \text{llsw}\right) + (\text{ipfdsw} + \text{ipllsw} + \text{reclbsw})\right]$$

$$\text{IPSW2} = \text{IPSW1} + \left[\left(\frac{\text{IPSW1}}{(1200602 + 1200603 - 1102404)} * 1102404 - 1101204 - 1101304 - 1101404 - 1101504\right) + (\text{ipfdsw} + \text{ipllsw} + 1101204)\right]$$

$$\text{IPSW3} = \text{IPSW2} + \left[\left(\frac{\text{IPSW2}}{\text{GSW}}\right) * (\text{EB})\right]$$

$$\text{IPSW3} = \text{IPSW2} + \frac{\text{IPSW2}}{(1200602 + 1200603)} * 1200705$$

PART 5 : ADMINISTRATIVE SUPPLIES

Administrative supplies are allocated across inpatient/non-inpatient activities in a manner similar to salaries and wages in Part 4. Depreciation and interest on long term loans (DEP) are considered entirely non-inpatient and are removed from administrative supplies expense when prorating. Similarly, supplies and other expenses for medical records and library are assumed to be entirely inpatient, therefore, they are excluded from the prorating and added in separately. Dietetics and laundry and linen supplies expenses have already been prorated based on meal days and kilograms of laundry, therefore, the inpatient portion of dietetics and laundry and linen is also added in separately.

$$IPSOE = IPSOE1 + \left[\frac{IPSOE1}{(SOE - Admsoe)} * (Admsoe - fdsoe - Dep - reclbsoe - llsoe)\right] + (reclbsoe + ipllsoe + ipfdsoe)$$

$$IPSOE = IPSOE1 + \frac{IPSOE1}{(1200604 - 1200504)} * (1200504 - 1202905 - 1102005 - 1101205 - 1101405 - 1101505) + (1101205 + ipllsoe + ipfdsoe)$$

PART 6 : MEDICAL/SURGICAL SUPPLIES (MSS) DRUGS

Medical/Surgical Supplies and drugs are assumed to be in the same inpatient/non-inpatient proportion as total supplies and other expenses of the hospital.

$$IPSOE3 = IPSOE2 + \frac{IPSOE2}{1200604} * (MSS + DRUGS)$$

$$IPSOE3 = IPSOE2 + \frac{IPSOE2}{1200604} * (1200805 + 1200905)$$

PART 7 : PROPORTION OF TOTAL OPERATING EXPENDITURE WHICH IS INPATIENT (PROPINEX)

Summing the estimates of inpatient salaries and wages (IPSW3) and supplies and other expenses (IPSOE3), we obtain an estimate of total inpatient expenditure. This figure is divided by total operating expenses (TOTEX) to obtain the proportion of expenditure which is inpatient related.

TOTEX = 1201005

TOTINEX = IPSW3 + IPSOE3

PROPINEX = TOTINEX/TOTEX

APPENDIX B

A DETAILED EXAMINATION OF THE REFINED DRG GROUPER SOFTWARE APPLICATION

(AVAILABLE FROM: KAREN SCHNEIDER

HEALTH SYSTEMS MANAGEMENT GROUP

SCHOOL OF ORGANIZATION AND MANAGEMENT

YALE UNIVERSITY)

Software Application

A Description of the DRG Refinement Grouper

Introduction

In recreating the Hospital Performance Index, the author utilized the DRC Refinement Grouper (designed by Karen Schneider and Fetter R. et al of the Health systems Management Group). The proceeding description is a summary of the main features of the program and some of the problems that were faced in its application.

The DRG Refinement Grouper will generate refinement groups (RDRGs) which indicate the expected relative resource intensity of a patient as reflected by the patient's secondary diagnoses. In addition, version 3.0 of the grouper, will generate the sixth revision (Version 7) DRGs (effective October 1, 1989). The user may select generation of either refinement groups, DRGs, or both each time the program is run. Presently, versions of the refinement grouper are available for the following systems:

a)IBM PCs, XTs, ATs, PS/2s and compatibles running MS-DOS version 3.0 or greater, with either a monochrome or colour screen.

b)DEC VAXs running VMS

c)IBM Mainframes running VM/CMS

d)IBM Mainframes running MVS

For the purposes of this study the IBM PC version was chosen. The accessibility to PCs running in the MS-DOS environment was the deciding factor. The UAH plans involve training, in the mechanisms of the Acute Care Funding Project, within each individual department of the hospital. This dissemination of training will aim at decentralizing the awareness of how specific activities are impacting the hospital's funding. In this way, the hospital can investigate any specific areas promptly and effectively, with the cooperation of the individual departments, should indicators such as excessive lengths of stay or drug utilization levels necessitate action.

The 386 computer chosen to run the grouper required a 650 Mb hard drive, 4 Mb Ram and ran at 33 Mhz. The somewhat large hard drive capability was required largely for number crunching purposes and data storage (i.e. as a result of the high volume of patients that the University of Alberta Hospitals treats).

A short summary of the way the grouper works is given here.

(1)A record is read into memory from the input file. (The input file should contain all patient abstract data and the format of the data fields should correspond to the fields supplied to HMRI in the monthly tape backup).

(2)If generation of refinement groups has been specified, the grouper retrieves the diagnoses, procedures, age, sex, discharge status, length of stay and DRG fields from the record. The refinement class for all Major Diagnostic Categories except MDC 15 (Newborns) is then generated using the four Refinement Class Tables (In the main body of the program) as follows:

(a) The DRG is translated into an ADRG using a mapping table, and, for some DRGs, the presence of specific diagnoses and procedures.

(b) The refinement class for each secondary diagnosis which is considered a complication and/or comorbidity is calculated, taking into consideration the record's ADRG; whether the patient had a medical or surgical DRG; the presence of temporary Tracheostomy; sex; age less than 18 years; death within two days of admission for medical patients; and discharge against medical advice.

(c) The highest class among the secondary diagnoses is then considered the patient's Refinement Class.

ADRGs for patients in MDC 15 (Newborns) are calculated according to a different algorithm which also takes into account selected procedures, length of stay, discharge disposition, and birth weight, if it is included in the input record, or diagnoses if it is not. Then a refinement class is calculated based on the patient's diagnoses.

Calculated entries for the RGN, ADG, MDX, RRT, PED, and MRG fields (outlined below) are written into the record for each field definition card.

(4)The input record, with all specified output fields from step (3) completed, is then written to the output data set. All columns in the input record which are not overwritten by the grouper are copied intact to the output file.

The Field Definition File

The field definition file is a text file which specifies column positions for input and output fields on the patient records. The file can have fixed or variable length records. Each line consists of a three character identifier and one or more numeric values.

Command Syntax

The first three characters on a line indicate which field is being specified. This field specifier, which must have upper case letters, is followed by an optional number of blanks or commas, and one or more numbers which specify the position of the field in the record. Field positions start from 1, not 0.

In some cases (DDX and SRG lines) there may be multiple numbers on a line, specifying multiple diagnoses or procedures in the patient records. These numbers must be separated by spaces or commas.

The lines of the field definition file may occur in any order in the file. The grouper prints each line of the field definition file on the terminal as it is processed. Error messages are printed immediately after the line containing the error. Included with the software application is a test data base file. The author found it particularly helpful to compare the field definition file to the test data base in order to eliminate errors due to incorrect field lengths and generally to see exactly how the field definition file should be set up.

Refinement Grouping (Class Generation) Fields

The following fields are required: DDX, AGE, SEX, DSP, LOS and DRG. The following fields are optional, but will be filled in by default if the field definition file lines are supplied: RGN, ADX, MDX, RRT, PED and MRG.

The Field Definition Lines

The following table summarizes the field definition line requirements, "R" means required, "O" means optional, "L" functionally optional but logically required and "-" not relevant.

GROUPING PERFORMED

REFINEMENT

DDX	R
SRG	R
AGE	R
SEX	R
DSP	R
DRG	R
MDC	O
RTC	-
MPR	-
ADX	-
SDX	-
VCC	O
PR2	-
PR3	-
NOR	-
NO2	-
COM	-
LOS	R
RGN	L
ADG	O
MDX	O
RRT	O
PED	O
MRG	O
BWT	O

A brief description of the "required" field definition lines follows:

DDX

This line is used to specify the diagnosis positions. The first number specifies the position of the principal diagnosis. Subsequent numbers specify additional diagnoses. The grouper accepts up to 15 diagnoses. At least one diagnoses will be specified. If any patient has no diagnoses then an error will appear on the terminal at that line. Diagnoses on the patient records must be 5-character ICD-9-CM codes, left justified and with blanks to the right. Do not fill these blanks in with decimal points as the grouper will recognize them as part of the initial code and thus spool an error in field length.

SRG

The SRG line specifies input procedures. The grouper accepts up to 15 procedures. Procedures on the patient record must be 4-character icd-9-cm codes, left justified and with blanks to the right.

AGE

This line points to a 3-character field specifying patient age in years. Age on the patient record must be a number from 0 to 124. Leading or trailing blanks are ignored. Non-numeric values will result in a grouping error for that record.

SEX

SEX points to 1-character field specifying patient gender. A value of "1" designates male and a value of "0" designates female. Any other specified value will result in a grouping error for that record.

DSP

DSP points to a 2-character discharge disposition. Leading or trailing blanks are ignored in computing the numeric value of the field. Values that the grouper will recognize include the following:

1 - home, self care

2 - short term hospitalization

3 - skilled nursing facility (SNF)

4 - intermediate care facility (ICF)

5 - other facility

6 - home health service

7 - left against medical advice

20 - died

30 - still a patient

The use of any other numeric value will result in a grouping error for that record.

DRG

For refinement grouping, DRG specifies an input field, and must point to a 3-digit number between 1 and 477 denoting the patient's Diagnosis Related Group. The number must be right justified and zero filled (for numbers below 100).

LOS

LOS points to a 3-digit length of stay value, used by the refinement grouper. Any non-negative value is permissable for this field. Blanks will be ignored.

The PC-DOS Version

The software package contains the executable program, run-time tables used by the grouper, a test data base and associated field definition file, the source program code and tables with ADRG and RGN titles.