Case Mix Tools

FOR DECISION MAKING IN HEALTH CARE

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ABOUT THE CANADIAN INSTITUTE FOR HEALTH INFORMATION (CIHI)

The Canadian Institute for Health Information (CIHI) plays a critical role in the development of Canada's health information system. Incorporated in December 10th 1993, CIHI is a federally chartered but independent, not-for-profit organization. It brings programs, functions and activities from The Hospital Medical Records Institute (HMRI), the MIS Group, Health Canada (Health Information Division) and Statistics Canada (Health Statistics Division) together under one roof. Its primary functions are:

- collecting, processing and maintaining a comprehensive and growing number of health databases and registries, covering health human resources, health services and health expenditures;
- setting national standards for financial, statistical and clinical data as well as standards for health informatics technology; and
- producing value-added analysis from its information holdings.

Through the pursuit of these primary functions, CIHI enables its many clients to make sound health decisions based on quality health information. Stakeholders include ministries of health, health care facilities, health-related organizations and associations, the research community, private sector and the general public.

ABOUT THE HOSPITAL MANAGEMENT RESEARCH UNIT (HMRU)

The Hospital Management Research Unit, in partnership with Sunnybrook Health Science Centre since 1989, carries out a wide range of theoretical and practical research activities as part of its mandate:

- to bring about improvements in the organization and management of hospitals in Ontario;
- to enhance the hospital system's ability to deliver effective health services to the public; and
- to help Ontario maintain its place among the best health services systems in the world.

Areas of research include: health quality; performance measurement and benchmarking; primary care reform; integrated health systems; health information systems; human resource management; and development and monitoring of new organizational forms including patient-focused care, hospital realignment and restructuring, strategic alliances, integrated health systems, disease management, and virtual organizations.

The Unit is supported by a grant from the Health system-Linked Research Program of the Ontario Ministry of Health.

ABOUT THE TORONTO ACADEMIC HEALTH SCIENCE COUNCIL (TAHSC)

Health Services are undergoing dramatic changes and more reforms within the system can be expected into the next millennium. These changes are affecting health care delivery, research, and the education of health care professionals. In 1992 the Toronto Academic Health Science Council was formed by the University of Toronto and the 11 fully affiliated teaching institutions in order to work more collaboratively on service, research and educational issues that were of concern to the Academic Health Science Centre as a whole. The members of TAHSC are committed to providing high quality health care while embracing necessary changes to the health care system. In addition there is a strong commitment to working together to advance scientific research and to improve training and education for the professions in the health care system.

The goals of the Council are to:

1. Provide a forum for discussion, exchange of information and development of shared policy directions on issues of concern to its members;
2. Facilitate and support changes within and between TAHSC institutions, thereby moving TAHSC towards a common vision for the future; and
3. Advocate for the special needs of TAHSC institutions (bearing in mind unique local, provincial, national and international responsibilities), thereby enabling these institutions to fulfill their clinical and academic missions.

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Preface

As the year 2000 draws near, Canadian health care managers, clinicians and other health professionals face increasingly difficult challenges of reducing costs while maintaining or improving quality of care and access. In this environment, the importance of information that decision makers use to manage complex hospitals and regional health authorities has never been greater. Our purpose in producing this casebook is to provide a timely opportunity for health care managers, clinicians and other health professionals to share their experiences with the use of health information for decision-making.

On April 1 1997, CIHI implemented the Complexity Overlay called Complexity (Plx™) which improves the Case Mix Group method of classifying inpatients by adjusting for various complications and patient age. CIHI also produces information about ambulatory activity called Day Procedure Groups which continues to increase in importance as hospitals move more care from an inpatient to an ambulatory setting. We hope that this casebook provides an opportunity for health care managers, clinicians and other health professionals to describe in depth how they have used CIHI information to analyze various clinical and management problems and to identify the benefits and limitations of the information.

The first section contains an introductory chapter that describes Case Mix Groups, Complexity and Day Procedure Groups that are produced and reported by CIHI. The first chapter ends with a general discussion of how this information can be used for decision making. The main body of the casebook consists of eight cases that describe how CIHI information is being used by a variety of different Canadian health care organizations. These cases were received in response to a request distributed by the Hospital Management Research Unit at the University of Toronto to the Toronto Academic Health Science Council (a council of the fully affiliated teaching hospitals and the University of Toronto) and by CIHI to its clients in the Spring of 1997. The last section of the casebook contains some reflections and lessons learned from the cases and the described use of CIHI information.

This casebook is a collaboration among CIHI, the Hospital Management Research Unit, and the Toronto Academic Health Science Council. In coordinating a book of this nature, there are many individuals to whom we owe a debt. First, we thank the authors who wrote the cases. They spent much time and expended much effort in producing cases that are clear, well written and directly relevant to those health care managers, clinicians and other health professionals who must use information to make difficult decisions every day. As the quality of the cases shows, the authors made a special effort to write their cases in a way that would arouse interest and be useful in practice.

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CIHI Case Mix Tools

INTRODUCTION

Grouping methodologies such as CMG™ and DPG™ are *de facto* standards for grouping hospital patients with similar diagnoses and similar treatment requirements. Over the years, through their application, these methodologies and their accompanying indicators have established a track record of assisting health care facilities to effectively plan, monitor and manage the services they provide.

To be broadly applicable, standards for classifying or grouping patients should meet the following criteria:

ð the data elements required for grouping should be limited to routinely collected data;
ð the number of possible groups or categories should be manageable;
ð cases within a group should be clinically similar; and
ð cases within a group should be statistically similar specifically in terms of length of stay and/or total resource use.

With these criteria in mind, and using the extensive store of data in its Discharge Abstract Database (DAD), CIHI and its forerunner, HMRI, have developed and maintained case mix tools for use in Canada since 1983.

The DAD was originally developed in 1963 to collect data on hospital discharges in Ontario. Its present format dates back to 1979. Currently, it captures about 3.6 million records annually or 85% of all inpatient discharges in Canada. In addition, since 1993, at least 1.5 million outpatient records a year, mostly related to day surgery, have also been collected in the DAD. Each record captures a standard clinical, demographic and administrative data set on a patient specific basis. Clinical information used in the grouping methodologies is further standardized by coding diagnosis and procedures according to established classification guidelines. The two systems currently supported by CIHI are the International Classification of Diseases, 9th revision (ICD-9), in combination with the Canadian Classification of Procedures (CCP) and the American Clinical Modification of ICD-9, ICD-9-CM, which incorporates procedures.

This chapter will provide an overview of Case Mix Groups, Day Procedure Groups, Complexity Methodology, and Resource Intensity Weights.

CASE MIX GROUP METHODOLOGY

The CMG methodology was designed for use with hospital inpatients. Introduced in 1983, the original CMG were an adaptation of American Diagnosis Related Groups (DRG) built using ICD-9-CM to the Canadian environment of ICD-9 and CCP. By 1987, however, the CMG adaptation was mapped back to ICD-9-CM and the methodology has been applied to both coding systems since. Although CIHI introduced Complexity in 1997, the CMG methodology remains at the foundation of this new system and the way in which a CMG is assigned has not changed.

Besides the coding system used in construction, there are two major differences between CMG and DRG. The driver for DRG assignment is *principal diagnosis* while the driver for CMG assignment is *most responsible diagnosis* (MRDx). The principal diagnosis is the diagnosis which, after investigation, is found to have been responsible for the admission of the patient to hospital. The MRDx is the diagnosis which is determined, at discharge, to have been responsible for the greatest portion of the patient's length of stay. While principal and most responsible diagnoses are often the same, a significant post admission comorbidity (complication) may not be acknowledged in the DRG assignment.

The DRG methodology uses pre-defined tables to determine whether an additional ICD-9-CM diagnosis is a complication. The CMG methodology uses additional diagnoses which are specifically identified as complicating or cormobid conditions having an impact on length of stay. The identification of these additional diagnoses is accomplished using a standard coding guideline for Canada called *Diagnosis Typing*. This Canadian coding convention has been used to improve the CMG methodology, most recently as the basis for the development of the Complexity Overlay.

Since 1991 an expert team has existed at CIHI with a mandate to continually improve the CMG methodology. Clinical consultants work with CIHI methodologists, coding experts and systems analysts to ensure that the CMG patient classification accurately reflects Canadian requirements and patterns of practice in hospitals.

Case Mix Groups are ordered within Major Clinical Categories (MCC) which identify either a body system (e.g. Respiratory System), or other specific types of clinical problems (e.g. Mental Disorders, Neonates, Burns). There are 25 Major Clinical Categories, 15 of which have been revised by the CMG expert team between 1992 and 1997.

MCC assignment, which represents the first step in the grouping methodology, is almost always determined by the MRDx. Usually, the Most Responsible Diagnosis is a unique assignment to one MCC known as the 'home' MCC. There are some exceptions to this rule, such as diagnoses with gender edits and the assignment of cases to MCC 15. MCC 15, Newborns and Neonates, is based on age < 29 days or an entry code of newborn. A further division within this MCC is based on the weight of the baby.

Although the most responsible diagnosis is defined by CIHI as 'the one diagnosis which describes the most significant condition causing a patient's stay in hospital,' this may not always be the condition for which the patient is admitted. If the diagnosis recorded as most responsible is invalid, the case is assigned to MCC 999, Ungroupable Data.

The Surgical Partition

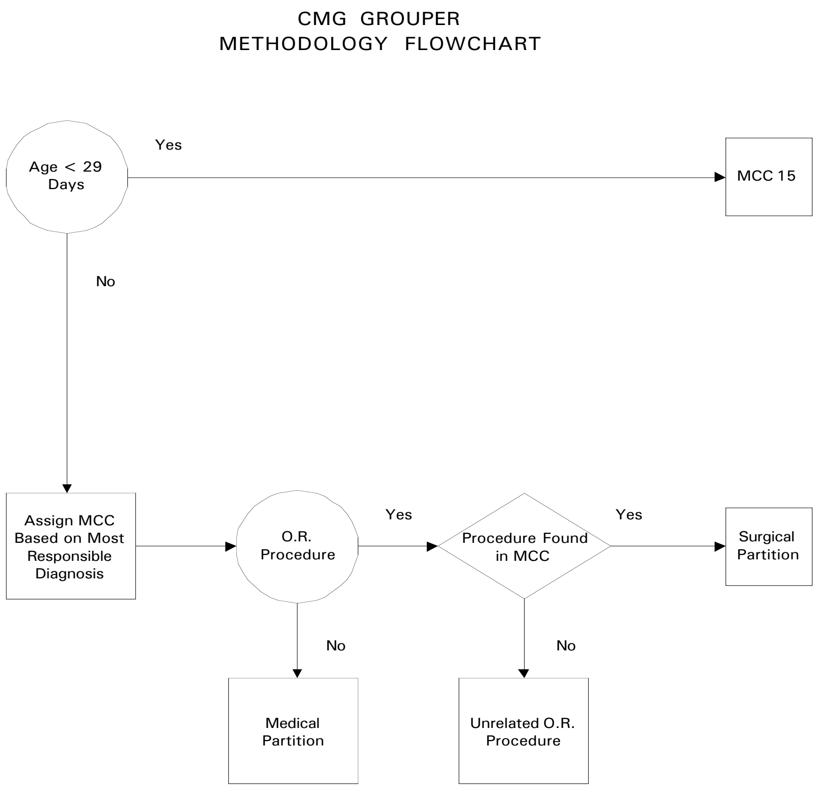
Each MCC is divided into medical and surgical partitions. The assignment of a case to a CMG within the surgical partition is determined by the presence of a procedure. The grouping methodology reads through all procedures recorded to find one that is in the same MCC as the MRDx. If it finds more than one procedure in this category the case is assigned to the CMG highest on the hierarchy. The surgical hierarchy is a decision rule that generally orders CMG within the surgical partition of each MCC from most to least resource intensive. Embedded in the surgical hierarchy is a grading of procedures used for CMG assignment according to the following categories: Extensive, Non-Extensive, May Not Require Hospitalization and Other Procedures used for CMG assignment.

In some cases, the MCC of the only procedure recorded is not a match with the MCC of the MRDx. When the procedure and the MRDx are not associated with the same MCC, the case is assigned to a series of CMG labelled Unrelated Operating Room (OR) Procedures.

The Medical Partition

If there are no procedures used for CMG assignment recorded on the abstract, the case is assigned to the medical partition of the MCC. The medical partition consists of groupings of similar diagnoses defined clinically and/or by homogeneity of length of stay. Generally, the methodology uses only the MRDx to assign a medical CMG. One exception, however, is MCC 14 (Pregnancy and Childbirth) where all delivered diagnoses are taken into account.

Figure 1: CMG Methodology Flowchart



COMPLEXITY METHODOLOGY

Over the past several years, the CMG development team at CIHI has been able to effect improvements in the clinical precision and statistical homogeneity of the CMG methodology. However, substantial variation in resource use could still be demonstrated. Complexity was intentionally designed to enhance the prediction of resource utilization in acute care. It builds on the strengths of the CMG classification and Canadian morbidity coding practice through the application of clinical judgment and CIHI abstracting guidelines while still relying on data elements routinely captured in the CIHI Discharge Abstract Database.

The perception of a need for complexity classification usually arises from concerns about the relevance or accuracy of case-mix estimates. Some hospitals, for instance, may feel that particular CMG assignments may include a much broader range of patients or treatments than fits with the more specialized care they provide. Consequently they may be uncertain about the accuracy or relevance of CMG-based resource estimates in the context of their programs. With a more case specific estimate, case-mix and LOS comparisons among programs can be evaluated with greater precision.

Complexity is applied to acute inpatient cases and makes use of diagnoses over and above the MRDx employed in CMG assignment. In general, Complexity will differentiate cases with:

- one or more chronic disease conditions outside of the primary focus of the acute care episode;
- cases with multi-system failure; and
- cases with iatrogenic or other complications.

The patient's Most Responsible Diagnosis continues to be used to assign the case to one of 25 Major Clinical Categories (MCC) and the case continues to be directed to the medical or surgical partition based on the presence or absence of an operative procedure. However, the step of further directing some cases to a specific CMG according to the presence or absence of a complication/co-morbidity (CC) or the patient's age range no longer occurs. Complexity addresses these two significant variables in a different and enhanced way. CMG with age and CC splits have been collapsed back to a single CMG to which the new Complexity Overlay can be applied.

The Complexity Overlay identifies diagnoses, over and above the MRDx used for CMG assignment, for which prolonged length of stay and more costly treatment might reasonably be expected. The application of the overlay to the base CMG divides the cases assigned to the CMG into four new groups or cells for analytical purposes.

These new groups are called Plx groups and each represents a more homogeneous aggregation of patients on which to predict length of stay and resource use. Table 1 depicts a possible range of co-morbidities related to a case with a history of breast cancer presenting with brain metastases as the MRDx.

Table 1: Possible Range of Co-morbidities in Craniotomy CMG

CMG	Plx Level with possible co-morbidity	Plx Group
001 - Craniotomy	Level 1 (history of cancer)	001 - Level 1
001 - Craniotomy	Level 2 (bone metastases)	001 - Level 2
001 - Craniotomy	Level 3 (hemiplegia)	001 - Level 3
001 - Craniotomy	Level 4 (obstructive hydrocephalus)	001 - Level 4

Where age is found to be predictive of length of stay or resource use, the age category of the patient will be used to further refine the Plx group estimate of length of stay and resource use.

The intent of the age adjustment is not to discourage documentation of the clinical characteristics of cases. Rather, the adjustment functions as a rough proxy for severity of illness within (and in addition to) the outlines of a clinical population defined by CMG and Complexity. It may soon be possible to match age effects seen in the age adjustment methodology with those documented in the clinical record. Because LOS effects are generally divided between variables of age and complexity, age tends to limit the impact of subjectivity in coding practice. In the development of Complexity grade lists, the age adjustment was calculated before determining the diagnoses that contributed to Complexity. This approach eliminated certain age-related diagnoses that, in themselves, generally did not prolong LOS but were often associated with long-stay cases.

The age and complexity components remain distinct and hence can be used independently or together to predict resource requirements. For example, age adjustments may be helpful in tracking global resource needs in relation to populations with differing proportions of elderly. Complexity may assist in looking at seasonal variation in resource requirements when weather or environmental conditions precipitate a need for acute care for patients with chronic respiratory conditions. Health-care managers may be able to link particular demographic or environmental characteristics by examining the age or complexity components of acute-care treatment patterns. Whatever the aim of the analysis, the new methodology makes it possible to specify the effects of age group and Complexity.

Diagnosis Grade Lists

The treatment context is crucial to interpreting length of stay (LOS) statistics for any given co-morbidity and, therefore, to assessing the probability of extra resource requirements. The abstracting guidelines for the DAD result in the differentiation or typing of other significant diagnoses (co-morbidities) into conditions that do influence LOS and conditions that do not. In addition, these diagnoses are qualified as to whether they are present on admission or arise after admission.

Initially, the 1993 Reference LOS database was used to identify diagnoses on the MCC-specific lists where, when the diagnosis was a co-morbid diagnosis, at least 20 cases were associated with a length of stay greater than the CMG average. In addition, the prolonged stay diagnoses on this comprehensive list were specified as pre- or post-admission and belonging to either the surgical or medical partition. The lists were then further developed through an iterative process involving both statistical analysis and clinical review.

For a given patient, other significant diagnoses on the abstract are matched to the appropriate (medical or surgical) Complexity lists. A match is made with both the specific diagnosis and the diagnosis type. Given the possibility of recording as many as 15 primary diagnoses on the CIHI abstract, a complex case may be matched to more than one list or may exhibit multiple matches to one or more lists. This information helps determine the case's Complexity level.

As a result of the combined statistical and clinical analysis, five Plx grades were established to which each diagnosis could be assigned. An individual diagnosis could be assigned to more than one grade based on its differential impact when found in either the pre- or post-admission context.

Complexity Levels

CIHI's "Surgical" and "Medical" partitions accommodate four Complexity levels. These levels are monotonic in nature, so that moving from Level 1 to Level 4 entails progressively more resource-intensive treatment or care.

The following represents the Plx Levels:

1. No Complexity;
2. Complexity related to chronic condition(s);
3. Complexity related to serious/important condition(s); and
4. Complexity related to potentially life-threatening condition(s).

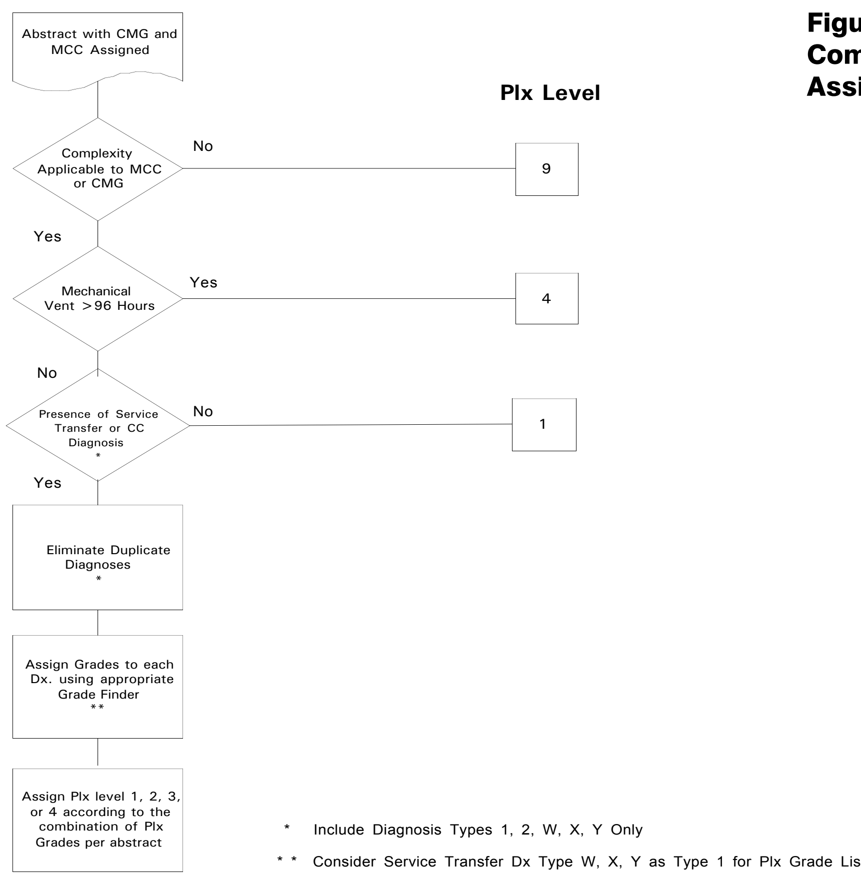
Both grade and number of matches help determine Plx level. Only Grade A or life threatening diagnoses show no level difference between a single match and combinations of A with itself or other grades. A grade A diagnosis will assign a case to Level 4 regardless of additional diagnoses with other grades. Where no grade A diagnosis is recorded a combination of diagnoses from other grade lists could still elevate a case to level 4.

For C diagnoses, which represent chronic conditions, Complexity distinguishes between those associated with the "Home" or MRDx MCC–say, Pneumonia with Diseases of the Respiratory System (MCC 4)—and those outside the MCC. Statistical analyses have shown that C list diagnoses from outside the home MCC are a more powerful predictor of LOS than those within the same MCC. That is consistent with the experience that multiple-system involvement often entails longer LOS than single-system involvement.

Although in many cases, there may be a correlation to severity, it is important to remember that Complexity is intended to reflect the interaction of a patient's multiple diagnoses with the length of hospital stay. Severity primarily qualifies how seriously ill a patient is within a given illness. For example, patients with chronic obstructive pulmonary disease can expect to stay longer in hospital if they also develop pneumonia. This "complexity" is evident from standardized currently available discharge abstract data. On the other hand, the characterization of the pneumonia as mild, moderate or severe requires the collection of additional data according to one of a number of available severity scoring systems.

In certain clinical categories (e.g. pregnancy and childbirth, newborns and neonates, mental diseases and disorders and HIV infections), the Complexity Overlay fails to demonstrate an improvement in the estimate of length of stay or resource use and, consequently, is not applied. In some cases, some other data element such as birth weight is a more powerful predictor. In other cases, such as HIV, complexity has been addressed already in the logic of CMG assignment. The exclusions represent a fundamental design principle of Complexity, namely that it is only applied where it can reasonably be expected to improve homogeneity.

Figure 2: Complexity Assignment 1997



* Include Diagnosis Types 1, 2, W, X, Y Only

* * Consider Service Transfer Dx Type W, X, Y as Type 1 for Plx Grade List

Length of Stay (LOS) Indicators

Every year, effective April 1st, updated length of stay (LOS) indicators are introduced which have been calculated using the most recent 12 months of data available from the discharge database. For example, indicators published for use with the 1997 grouping methodology are calculated from a reference database of cases collected between October 1995 and September 1996 and regrouped to the 1997 version . The LOS indicators represent an estimation or prediction of "typical" length of stay for all cases within the CMG based on actual cases occurring during the reference period. Before the introduction of Complexity, there was only a single value for all "Typical" cases within each CMG. The predictive value used was simply the average length of stay (ALOS) for typical cases in that CMG. As a result, the ALOS was also the ELOS or expected length of stay.

It is important to remember that about 35% of CMG were split when LOS was found to vary systematically with age group (age split) or with complicating or co-morbid secondary diagnoses (CC splits) within a clinical CMG category. A LOS indicator was assigned to each adjacent CMG resulting from these splits. In this way, two different ALOS indicators were available to describe different populations with the same MRDx.

In the pre-Complexity estimates, length of stay expectations corresponding to the different age range or CC splits functioned roughly as those now calculated more sensitively with the age adjustments and Complexity. Because Complexity represents an advance over CCs, CC splits no longer appear in areas where Complexity levels are assigned. Similarly, where age adjustments for the ELOS are used, age-splits have been removed.

In the Complexity methodology, where age is found to be predictive of length of stay, the patient's age group (0–17, 18–69, 70+) will be used to further refine the Plx group estimate of ELOS. Where a CMG is refined for both age and complexity, as many as 12 ‘analytical’ groups or cells will result. These analytical cells are referred to as APlx cells. For example, CMG 001, Craniotomy, is refined for both age and complexity. Therefore, for each of the 4 Plx groups, there will be ELOS calculated at each of 3 age categories, as follows:

Four levels x 3 age categories = 12 Aplx cells and 12 ELOS values.

The relationship between age, complexity and ELOS varies considerably among CMG. A statistical test (F-test) is applied to each CMG included in Complexity to determine whether or not there is a statistically significant difference between the Plx levels. If the difference is shown to be statistically insignificant, the model used to predict ELOS will not incorporate Complexity. Decision rules are also used to determine when age categories are used to further refine the estimate of ELOS. Consequently, the number of APlx cells and the resulting number of ELOS values that result will vary by CMG.

This variation in the effects of age and complexity on ELOS makes it difficult to define a a single, efficient or parsimonious model to capture the relationship appropriately for each CMG. The pilot version of Complexity, which used age as a continuous variable, is an example of a model where the number of variables produced differences whose significance was often difficult to assess. In order to avoid using a model with excessive parameters in the version introduced for 1997, regression analysis is used to compute a set of LOS expectations for each of the predictors using 5 different models. The number of cases at the CMG and Plx level is combined with a determination of the statistical significance of each of the parameters, age and complexity, and an examination of whether there is interaction between them determines which model is applied. Each model has a set of decision rules governing its use. For example, for Plx groups that have more than 200 cases in each Plx level and where the parameters are found to be statistically significant at 0.001, the formula used models the age interaction at each of the Plx levels within the CMG. On the other hand, where the complexity parameter is not found to be statistically significant at 0.005 in a CMG with more than 200 cases, the formula used models age at the CMG level.

The application of these models results in an ELOS value that is case-specific, within age groups, and expectations will vary for cases within a CMG. A trim point is calculated for each APlx cell, and is used to identify cases as outliers if the patient's actual LOS is greater than this trim point. For atypical cases such as outliers, deaths, acute-care transfers and signouts, Complexity levels are assigned, but ELOS is not.

Quarterly reports are available to each hospital which summarize the experience of each case with respect to length of stay. The actual length of stay is compared to similar cases in the national database and comparisons are provided at various levels of aggregation such as by doctor or patient service. Some examples of how length of stay reports are used are:

- review of bed utilization and length of stay patterns;
- monitoring the allocation of beds to service/program areas;
- research and planning for future service requirements; and
- assigning expected date of discharge.

DAY PROCEDURE GROUP (DPG) METHODOLOGY

DPG was developed to address the information needs related to the growing use and importance of ambulatory care as a service delivery setting. Introduced in 1993, ten years after the CMG methodology, the DPG methodology is modelled on an American system, the Products of Ambulatory Surgery. The adaptation for use in Canada also required evaluation and mapping between the two different classifications of procedures, CCP and ICD-9-CM.

The DPG methodology assigns cases to one of 69 mutually exclusive groups according to the principal or most significant procedure recorded as part of a standard outpatient record or abstract. Cases assigned to the same DPG category represent similar clinical episodes and are intended to be homogeneous with respect to resource consumption.

The DPG methodology has often been used only to monitor day surgery procedures. In recent years, advances in medical technology, changes in anaesthesia use and techniques and the drive for lower cost service delivery have enabled the shift of certain procedures from the inpatient to the outpatient setting. In response to requests from hospitals and to assist the process of monitoring the transfer of cases from inpatient to outpatient surgery, a clinical review was conducted which resulted in certain CMG being designated as "May Not Require Hospitalization" (MNRH). This group of CMG represented a target population for a possible shift to outpatient service. The growing shift to ambulatory surgery could be evaluated by monitoring CMG and DPG in parallel. It should be noted, however, that the CMG and DPG grouping methodologies behave differently and remain two separate methodologies. In addition, the designation MNRH was never intended to suggest that all cases in a CMG with this label did not require hospitalization. In fact, there are many valid clinical reasons for these cases to be treated as inpatients. This is demonstrated in the new Complexity methodology where cases grouped to a CMG labelled MNRH can subsequently be assigned to the higher levels of complexity.

To adequately fulfil the information needs of the ambulatory care service setting, a more comprehensive methodology than DPG is required. A new grouping methodology which encompasses not only day surgery but also emergency and ambulatory clinic services has been developed and is now being introduced. The integrity of the day surgery DPG has been maintained, however, and imported without change as a module of the new methodology. The increasing demand for a comprehensive ambulatory grouping methodology reflects a change in the emphasis on information. Information about ambulatory services is no longer required primarily to evaluate the rate of transfer to this lower cost environment. Rather, ambulatory care has been acknowledged as a setting of choice for the delivery of a wide range of services and it has become increasingly important to have comprehensive information to manage this setting appropriately. The challenge in ambulatory care remains the cost of data capture. Monitoring the savings of a shift to ambulatory surgery offered ample justification for the cost of submitting these records for processing by a hospital's Health Records Department. To many, the number of patient encounters in, for example, Emergency and Outpatient Clinics, precludes the collection of a standardized data set requiring abstraction by Health Records. The automation of data collection in these areas is seen as the key to successful implementation of a comprehensive ambulatory care reporting system.

RESOURCE INTENSITY WEIGHTS

Resource indicators are also updated with new values calculated based, in part, on the same data set used for length of stay. The new values are also applied to data effective April 1st of each year. The Resource Intensity Weight system is a resource allocation methodology for estimating the costs for both acute inpatients and day surgery cases. The RIW™ is used to standardize the expression of hospital case volumes, recognizing that different patients represent different burdens on health care resources. After weighting, volume can then be expressed in terms of "weighted cases." RIW estimates the resource intensity of particular cases relative to an average inpatient cost. Values for the indicator are assigned to each analytical cell of the grouping methodologies (CMG, DPG, Plx) and are defined by a model of how case costs and ELOS vary by CMG, Plx level and age. The estimation procedures are specific for three different sets of cases:

- those with a course of treatment "typical" of the cases in the cell;
- those with "atypical" courses of treatment; and
- day procedures.

Typical cases are those with a length of stay at or less than the trim point established for the cell. The trim point is calculated to exclude long stay outliers and is defined by the third quartile of the database length of stay for the cell plus twice the inter-quartile range. The typical cases are used as the basis for RIW estimation. Atypical cases are defined as, deaths, transfers to or from other acute care institutions, voluntary signouts and long stay outliers. The patient LOS used to differentiate inliers from outliers is based on the patient's total LOS including any days identified as alternate level of care (ALC). This acknowledges that non-acute days of stay generate costs, and therefore, should be included in the estimation of RIW values.

Until it is possible to guarantee a sufficient volume of comprehensive Canadian cost data on a regular basis, an American database from the state of Maryland is used in the calibration of RIW values. This U.S. database, referred to as the 'Maryland calibration database,' is a population database and contains information on all inpatient and same day surgery acute care provided in the state. These data are released annually and, in part, to ensure adequate case volumes for each cell in the grouping methodology, the most recent two years are used in the calculation of RIW. The rationale for using U.S. data to calibrate RIW values is based upon the assumption that the relationship of hospital charges to length of stay, patient age, and other classification variables which exist in the U.S. data can also be used to estimate relative costs for Canadian cases.

Maryland's history of state-wide rate regulation establishes a basic similarity with the experience of Canadian hospitals. As a result of regulation, Maryland remains one of the few states where the burden of uncompensated care is shared equally by all payer groups. This means that patients pay basically the same price for a hospital service regardless of the type of payment or insurance. This 'insurance' system helps to secure similar standards of care for all patients in Maryland, regardless of insurance status. The result is a database that is generally applicable in Canada for RIW estimation.

It is desirable to have weights for inpatient and ambulatory cases on the same relative value scale in order to facilitate comparability of weights and weighted cases across treatment settings. The Maryland calibration database provides inpatient and ambulatory costs from the same population and year which are reported using similar coding standards. Therefore, CIHI is also able to use Maryland charge data as the RIW calibration database for DPG weights.

The Calculation of RIW for Complexity

The first step in calculating RIW values is to assign Maryland inpatient cases in the calibration databases to CMG and Plx levels and SDS cases to DPG using the CIHI grouping methodologies. To adapt the CIHI grouping methodology to Maryland inpatient coding practice, the principal diagnosis is treated as equivalent to the MRDx on the CIHI abstract. Unlike the CIHI database, there is no diagnosis typing in the Maryland calibration database. As a result, it is often difficult to identify whether another significant condition occurred pre- (type 1) or post- (type 2) hospital admission. To enable the grouping of Maryland data into Complexity CMG, lists of complexity diagnoses were created for the U.S. database. These lists are based on the *differential impact* of typing on Complexity by diagnosis, and the distribution of type 1 and type 2 cases by diagnosis.

The next step consists of an adjustment to remove organ retrieval costs from Maryland charges for heart, liver and kidney transplants. This reflects differences in the way these programs are funded in the U.S. and Canada. Statistical regression analysis is applied to the Maryland database to estimate the average organ costs for the CMG. This estimate is then subtracted from the charges attached to the corresponding CMG.

Total charges and routine/ancillary *per diem* (RAPD) charges are adjusted for age and complexity where sample size permits and there exists a statistically significant effect on ELOS. Where these are not significant or a small sample size exists, pooling of adjacent levels, or age categories occurs. In addition, estimates of RIW are constrained to monotonicity in Complexity so that total RIW is the same or increases with the level of complexity.

Adjustments are made for hospital specific factors which affect patient charges. Hospital specific factors include teaching status, size, factor input prices, and the demographics of referral populations. These adjustments are made using a Hospital Specific Relative Value (HSRV) method. The HSRV method removes these hospital specific effects through iterative computations of population relative values from hospital specific estimates. In the past, these factors had to be directly specified in the regression equations to estimate and remove the bias. The advantage of the HSRV method is that the direct specification of these types of variables is not required, allowing us to control for any unspecified differences that may not have been specified or identified as variables—differences that are essentially unknown.

Finally, the weights are adjusted for differences between Maryland average LOS and CIHI ELOS. This length of stay adjustment relies on the separation of routine and ancillary (RA) charges that vary with length of stay from fixed charges that do not. To the extent that CIHI ELOS is greater than (or less than) Maryland ALOS, an unadjusted weight would underestimate (or overestimate) the Canadian resource intensity.

The CIHI RIW for a typical case, therefore, is estimated as the ratio of the ELOS adjusted mean charge for each analytical cell to the average case weighted expected charge or standardization factor. The standardization ensures that the average typical RIW equals one for the CIHI typical database.

There are no LOS adjustments with the DPG calibration databases. With this database the first step is to compute the average charge by procedure, which is then weighted by the day procedure volumes from the most current CIHI fiscal year database. The weighted average of the mean charges by procedure are calculated for each DPG.

Each type of atypical case is calculated differently. For Deaths, surgical and medical cost curves are computed which define how much more expensive per day a death case is expected to be than a typical case. The average cost per day will be higher, the shorter the length of stay prior to death. In addition, surgical cases will have higher relative costs than medical cases because fixed costs represent a higher proportion of the *per diem*. The death cost curves are used to assign a weight for all deaths up to the length of stay trim point. Deaths occurring after the trim point are assigned a weight using the outlier formula.

Similar curves are calculated and used to assign weights to Transfer cases. There are four curves for transfers, surgical cases transferred in and surgical cases transferred out, medical cases transferred in and medical cases transferred out. Transfer cases staying beyond the trim point are assigned a weight using the outlier formula.

Voluntary signouts represent less than 1% of the total cases. A signout case receives credit for each day of stay up to their ELOS but any patient days beyond the ELOS are not considered.

Outlier cases are those which stay beyond the LOS trim point. The *per diem* weight is adjusted using a formula which assumes that some days beyond the trim point are "low severity" or less acute than days within the trim point. Each outlier case receives an RIW equal to the weight of a typical case plus an adjusted per diem weight for each day from the ELOS until discharge.

Application of RIW

The primary application of RIW information is to support the translation of case mix data into costs. This is done by allocating the resulting weighted cases to clinical categories or programs, services, physicians or other groups and then assuming that dollars are likely consumed on the same basis.

Unit Cost Determination

To determine the approximate average cost of hospital programs and services using RIW weighted cases, you must first determine the overall average inpatient cost per weighted case for the hospital. The bottom line of any of the CIHI RIW Basic Summary of Activity reports shows the total weighted cases for a hospital. By calculating the total net inpatient cost for the same period and dividing this by the total weighted cases, you can calculate an average inpatient cost per weighted case. Net inpatient costs only must be identified because they were included in the cost data used to create the RIW values. To find the Net Total Inpatient Cost for a period, costs associated with ambulatory care activity, chronic patient activity and non-patient activity must be removed. Once calculated, the average inpatient cost per weighted case can be applied to the total weighted case volume for any service or program to determine the expected approximate cost to the hospital of that program.

For example, if a hospital has 4,000 RIW weighted cases during a period and a net total inpatient cost of $8 million, the average inpatient cost per weighted case is $2,000. If this same hospital had 575 weighted cases in the Orthopaedic Surgery service, the expected approximate cost to the hospital of the Orthopaedic Surgery service is:

$2,000 x 575 = $1,150,000

If the same hospital has 224 weighted cases in Major Clinical Category number 1, Diseases of the Nervous System, the approximate cost to the hospital of treating inpatients with diseases of the nervous system is:

$2,000 x 224 = $448,000

Use of the RIW as a measure of resource use cannot replace full implementation of patient costing or Global Dimension Reporting as described in the Guidelines for Management Information Systems in Canadian Health Care Facilities (MIS Guidelines), but it can provide a simple approach to estimating patient and program costs. Cost information can then be communicated to physicians and other health care providers to help ensure that they are aware of how the resources of the hospital are being used. This cost information can be used in conjunction with length of stay comparisons to target services which have the greatest apparent opportunity for improvement. Weighted case information can help you assess the financial "materiality" of the services provided by your hospital.

Targeting CMG Assignments for Utilization Review

The CIHI Basic Summary of Activity—Top 40 Case Mix Groups report will show which 40 CMG assignments account for approximately one half of a hospital's inpatient costs. Examples of questions to be asked when examining this report are:

- Are the majority of the weighted cases produced by typical or by atypical cases? Is your caseload typical or atypical and, therefore, can you use typical "benchmarks" such as ELOS to plan and monitor?
- If typical cases contribute most of the weighted cases for the CMG, how does the actual LOS compare to the expected LOS? If the actual LOS is greater than the expected LOS, the actual cost of these patients to your hospital could be even greater than the report suggests.

- If atypical cases contribute most of the weighted cases for the CMG, you should look at the atypical Case Summary—Top 40 Case Mix Groups report. Which category of atypical cases is producing the weighted cases? If the majority of your atypical cases are from transfers, this requires a different strategy than if the majority of your atypical cases are long stay outliers.
- Is the allocation of weighted cases what you would expect? Are your resources really being allocated to the types of cases or programs that you intend to emphasize at your hospital? A hospital may designate certain programs as strategically important and resource allocation may not actually reflect that decision.

Strategic Planning

Comparing the costs of programs or services may produce some unexpected results. Is the allocation of your inpatient budget (as measured by the RIW values) consistent with the planned areas of emphasis for your hospital? Are you spending appropriately on those services that you have established as your priorities? Is what you planned to do actually what is occurring?

The RIW reports can help to assess the potential financial impact of strategic decisions. As long as decisions can be modelled using inpatient volumes or case mix, the RIW information will provide a measure of the impact on resource use. For example, the RIW reports show the case volume, actual length of stay and weighted cases by MCC and physician/patient service. If a hospital is considering the addition of a new program or physician, the RIW report can assist in estimating the impact of the change using the hospital's own cost per RIW weighted case figure.

SUMMARY

This chapter has briefly explained the case mix tools currently available and their use and application for individual hospitals. Each methodology has additional documentation which can be obtained from CIHI and which describes the methodology in more depth and provides the information updated annually. In recognition of the growing need for health information for evidence based decision making, CIHI continues to work to develop and expand its case mix tools beyond the hospital setting and across the continuum of care.

Additional Material Available from the Canadian Institute for Health Information:

- CMG Directory for Use with Complexity 1997
- DAD Length of Stay Indicators for Use with Complexity 1997
- DAD Resource Indicators for Use with Complexity 1997
- DAD Procedure Codes and Resource Indicators for Use with DPG 1997
- Report: Evaluation of the Complexity Methodology

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Day Surgery Incentive Model: Funding Hospitals

CHAPTER OVERVIEW

A Day Surgery Incentive Model was developed and incorporated into the acute hospital funding formula in Ontario. The model has been used by the Ontario Ministry of Health (MoH) since April, 1996. It provides explicit incentives for hospitals to perform day surgery and transfer caseload from inpatient to outpatient where clinically appropriate. The methodology is based on the percentage of age-adjusted cases on a procedure-specific basis that a hospital completes on an outpatient care basis relative to the provincial average for each procedure. Using current clinical practice in Ontario hospitals as a benchmark for funding adjustments is viewed as an objective way to set realistic expected rates for outpatient surgery. The model is based on a clear definition of day surgery that incorporates an exclusion list.

The methodology is based on Day Procedure Groups (DPG), developed by the CIHI. DPG is a case mix, grouping methodology for day procedures that, when combined with resource intensity weights (RIW), is used as a basis for determining the relative cost and commensurate level of funding. The Day Surgery Incentive Model is an overlay on the DPG RIW for the express purpose of providing an incentive for day surgery, where clinically appropriate. The model is derived through a five-step process that identifies qualifying day surgery procedures, determines expected day surgery rates, and calculates hospital-specific weighted case adjustments and outpatient surgery indices.

Hospitals with relatively high proportions of day procedures and low average cost per weighted case experienced increased funding, whereas those with relatively low proportions of day surgery and high average cost per weighted case experienced reduced funding levels. It was anticipated that these funding changes would lead to greater funding equity and address a persistent shortcoming of the existing Ontario Equity Funding Formula.

INTRODUCTION

Technological advances, progressive changes in medical practice, better comparative information, shifting public expectations and fiscal pressures have all combined to give impetus to an unprecedented shift of hospital caseload from inpatient to ambulatory or outpatient care. Nowhere has this shift been more pronounced than in day surgery. Between 1991/92 and 1995/96, the number of day surgery procedures in Ontario grew from 602,600 to 760,800, an increase of 26%, compared to a decrease of 8% in the number of hospital separations and 19% in the number of patient days during the same period. During this time, day surgery, as a percentage of all surgery, increased from 42% to 58% (Ontario Ministry of Health, 1997).

Despite this tremendous growth in day surgery, there were no commensurate mechanisms developed and implemented to reimburse hospitals for performing these procedures. Rather, the global budget, which was used to fund the majority of hospital activity, was increasingly viewed as unable to provide equitable funding to meet changing clinical practice and hospital resource requirements. This recognition led Ontario to consider new approaches and methods for funding hospital activity that were more equitable and responsive to changes in hospital activity - both inpatient and outpatient. A chronological summary of these events and developments can be found in *The History of Ontario's Hospital Funding System* (JPPC, 1993b).

This chapter describes the development of a methodology used to implement an incentive model for funding hospital-based day surgery in Ontario. Although the model was designed to be used with a case-costing approach for funding day surgery, it can be used in conjunction with other funding formulae. The milestones surrounding the development of the model are chronicled, the definition of day surgery is described, the methodology is detailed, the implications and applications are outlined, and the benefits and limitations are identified.

CHRONOLOGY OF EVENTS

In the fall of 1992, the Board of the Ontario Hospital Association (OHA) passed a resolution in which they urged the Ministry of Health (MoH) to ***"take immediate action to rectify the disincentives in the Equity Formula respecting ambulatory care and day surgery to support hospitals to use such delivery methods to provide care and allocate resources on the most appropriate and cost effective basis"*** (OHA, 1992). The MoH, which had introduced the mandatory collection and reporting of day surgery abstracting through the CIHI a year earlier, agreed to the need to resolve funding disincentives for day surgery. The task of developing a funding approach and methodology that was equitable and that encouraged the clinically driven delivery of day surgery was undertaken by the Ontario Joint Policy and Planning Committee (JPPC).

The JPPC is a partnership between the MoH and the OHA to recommend and facilitate the implementation of hospital reform within the context of the health care reform agenda in Ontario (JPPC, 1996a). The JPPC strives to meet the following objectives through its work:

- to define the role of hospitals in a reformed health care system;
- to recommend hospital funding that promotes effectiveness, efficiency and equity among hospitals;
- to provide input with respect to policies and methods to implement health care reform;
- to assist in the development and implementation of provincial standards for hospital information; and
- to assist hospitals to effectively use information for internal management purposes.

In August, 1993, the JPPC's Activity Measurement Working Group released two reports on Day Procedures—*Report on Day Procedures* (JPPC, 1993c) and *Equity Formula Adjustments for Day Procedures* (JPPC, 1993a). The former report contained recommendations that advocated the adoption of the CIHI DPG grouping methodology (see related chapter) and the use of weights, derived from the Maryland charge database, for the funding of day surgery/procedures. DPG are a procedure-driven grouping methodology which classifies approximately 1,650 surgical and medical procedures.

The second report, *Equity Formula Adjustments for Day Procedures*, outlined a methodology to incorporate funding adjustments into the Equity Formula for the proportion of outpatient surgery a hospital performs, relative to the Ontario experience. The development of this methodology was particularly timely because it appeared likely that the Equity Formula would be used for reallocating funding among hospitals in 1994/95. This methodology, however, was dependent on the acceptance and use of the DPG grouping methodology and the use of weights to develop the DPG equivalent of inpatient weights (JPPC, 1994b, p. 4).

Before accepting the recommendations of the Activity Measurement Working Group respecting DPG, the Hospital Funding Committee of the JPPC requested that an independent review be conducted. The purposes of this review were: (1) to evaluate the proposed modified DPG system as a grouping methodology and weighting scheme for Day Procedures; (2) to evaluate the appropriateness of using the Maryland charge database to develop DPG weights; and (3) to recommend the scope of procedures (definition and/or list) to be incorporated into Ontario funding formulae.

The independent study, *Review of Day Procedure Groups and Weights* (JPPC, 1995d), concluded that the DPG grouping methodology was "as robust as any other system currently in use" and that DPG could serve well as a grouping system around which to structure a weighting system". The report cautioned, however, that more investigation was needed before the Maryland charge data could be used to develop a weighting system for funding day procedures.

Following the independent review, an Ad Hoc Day Procedure Group was convened to coordinate the necessary follow-up analyses that had been identified in the report. This included an assessment of the stability of charge-based weights year over year, the potential impact of implementing the weights on overall hospital funding, and a comparison with the Ontario Case Cost Project day procedure costs. The report also recommended that a decision be made concerning a (revised) definition of day procedures/ outpatient surgery that could be applied on a consistent basis by/across all hospitals, particularly as it relates to a specified period of time (JPPC, 1994bs).

Much of the concern expressed over the adoption of DPG pertained to the use of the Maryland charge database to determine relative weights. CIHI outlined its rationale for moving from RIW, based on 1985 New York data, to RIW, based on 1991 and 1992 Maryland charge data, in a report entitled, *Moving to the Maryland Database* (CIHI, 1994).

Day Procedure funding was first implemented in 1995/96 (see Appendix III). At that time, the Maryland charge database was used to calculate the relative weights for the DPG grouping methodology for outpatients as well as for inpatients, via Resource Intense Weights (RIW). While Ontario's own Ontario Case Cost Project (OCCP) data were considered as an alternative to Maryland, the outpatient case costs were just beginning to be collected and, therefore, weights derived from these costs would not be available for several years. Even then, the sample size would not be sufficient to generate a set of weights for all day procedures. The Maryland database provided an acceptable alternative while "made in Ontario" weights continued to undergo development, testing and evaluation.

REVISING THE DEFINITION FOR DAY SURGERY/PROCEDURES

Both the independent review and the Report on Day Procedures stressed the need to review the definition of day surgery/procedures (as used in the Ontario funding formulae) to clarify its interpretation and use. Clarification would ensure more consistent reporting, particularly in relation to the time parameters for a day procedure. In the fall of 1994, the Day Surgery Definition was revised, retroactive to the Spring of 1994. The definition read as follows:

> All procedures performed on patients whose hospital stay/visit (from time of registration to discharge), occurs on the same calendar day *or* (if over the midnight hour) is less than 12 hours, irrespective of the site/location within the hospital, anaesthetic route/administration, or whether the procedure was scheduled/ unscheduled (JPPC, 1994b, p. 5).

Although this new definition does not provide an incentive for moving 2– or 3–day cases to 24 hour observations, it does provide an incentive for hospitals to discharge patients by midnight. It also makes cost profiles for day surgery patients more homogeneous. It was thought that this definition would ensure more consistent reporting, particularly in relation to the time parameters for a day procedure, and the specific identification of procedures that should be excluded from the definition.

The following exclusions were applied to the definition of Day Surgery:

- Visits within the definitions of a General and Special Outpatient Clinic or a Medical Day/Night Care Program.
- Attendances to private physicians' offices located within the hospital (such as rented space or GFT offices).
- Attendances solely for the purpose of undergoing a diagnostic procedure for which a professional and technical component is billable (including interventional radiography procedures).
- Endoscopic procedures such as anoscopy, colposcopy, otoscopy, proctosigmoidoscopy, rhinoscopy, and vaginoscopy are normally performed as a simple outpatient procedure and may not be counted as a Same Day Surgery Program except in the unusual circumstance where use of hospital Same Day surgery facilities is required because of clinical indications.
- Minor procedures such as removal of cysts, warts, toe nails, and simple nasal polyps may not be counted as Same Day Surgery Program cases except in unusual circumstances where use of anaesthesia and post-anaesthesia recovery, or an operating suite and a post-recovery room is required because of clinical indications.

With CIHI's assistance, the funding formulae were applied retroactively using the revised definition because admission hour and discharge hour were already mandatory fields in the day surgery database. With minor exceptions hospitals were not required to re-code or re-abstract.

METHODOLOGY

In developing the Day Surgery Incentive Model, several options were considered, including:

1. Identify inpatient procedures from the ICD-9 (International Classification of Diseases—9th Revision) procedure list which "should" be completed as day surgery. Then identify these inpatient procedures at individual hospitals and give them credit for the day surgery resource intensity weight (RIW).

2. Based on the ICD-9 procedure list, map day surgery procedures to the corresponding inpatient procedure at the provincial level. Then identify these mapped day surgery procedures at individual hospitals and give them the inpatient RIW for the day surgery procedure.

3. Similar to option (1) and (2) except calculate an acceptable percentage of cases that will be expected to be performed on an inpatient basis taking patient age, co-morbidities, and other factors into consideration. Then calculate a "blended" rate which would be a weighted average of the inpatient and outpatient weights.

These options were discussed but dismissed for several reasons. Options (1) and (3) required the identification of surgical procedures that are suitable for surgical day care. Though option (2) does not require this identification, this option would have resulted in hospitals potentially being over-compensated for day surgery procedures because there is no consideration of the expected percentage of day surgery cases.

In reviewing the strengths and weaknesses of these different options, it was decided that clinical practice in Ontario at the time should be used to determine the expected percentage of day surgery cases. This reduced the need to make arbitrary decisions concerning eligible outpatient procedures and allowed for automatic inclusion of future advances in day surgery. The expected percentage of outpatient cases is also a moving target which will remain responsive over time to changes in clinical practice in Ontario hospitals (JPPC, 1995b, pp. 1–2).

The Day Surgery Incentive Model was, therefore, selected based on clinical utilization. With the application of the Day Surgery Incentive Model,

> hospitals with a higher proportion of same day surgery cases than the provincial average by procedure [were] rewarded. They received the inpatient weight for the percentage of day surgery cases greater than the provincial average by procedure. Hospitals with a lower proportion of day surgery cases than the provincial average by procedure were penalized and received the outpatient weight for the percentage of inpatient cases above the provincial average (JPPC, 1994b, p. 7).

DAY SURGERY INCENTIVE MODEL—METHODOLOGY: A FIVE-STEP PROCESS

Step 1: Application of Exclusions to the Outpatient Database to Identify Appropriate Day Surgery Cases

Exclusions (listed in Appendix I) were applied to CIHI's 1993/94 statistical database for Ontario hospitals to identify surgical procedures performed on a day surgery basis. The original model was developed using 1993/94 data. More recent data were used in subsequent refinements and applications (JPPC, 1996b, 1996c). Initially, no consideration was given to those outpatient surgery cases where the procedure was performed (e.g. pacemaker implants) and the patient returned to the referring hospital on the same day. This was addressed in the first refinement to the incentive model.

To assist hospitals in reconciling their CIHI reports with the Day Surgery Incentive Model results, a special report was prepared. Outpatient cases that were coded by individual hospitals as a sub-service other than sub-service 1[1] (i.e. qualifying day surgery cases) are listed in a separate companion report entitled *Comparison of Hospitals' Weighted Case Adjustment and Overall Performance Relative to the Ontario Experience* (JPPC, 1995a). Those qualifying day surgery cases that were excluded due to the aforementioned exclusion criteria are also listed in this report. Outpatient cases excluded in step 1 were also excluded from both the Day Surgery Incentive Model and Equity Formula calculations.

Step 2: Application of Exclusions to the Inpatient Database to Identify Candidates for Day Surgery

To operationalize the incentive model for day surgery it was necessary to estimate the volume of inpatient cases (by procedure) that might be eligible for shifting to day surgery. Exclusions listed in Appendix II were applied to CIHI's acute inpatient statistical database for hospitals in Ontario to identify surgical procedures performed on an inpatient basis which are *also* performed on a surgical day care basis (surgical procedures were automatically excluded from the Day Surgery Incentive Model if no Ontario hospital completed them on a day surgery basis).
In addition to the listed exclusions, there were a few hospitals where the inpatient RIW value was lower than the comparable outpatient RIW value for a small number of procedures. This occurred because of differences in the

[1] Sub-service 1 or Ɫpatient sub-service 1Ɫ is a category of the patient service reporting process, created to identify Same Day Surgery cases. The sub-service 1 captures all procedures which meet requirements for Surgical Day Care, also known as Qualifying Day Surgery abstracts. Patient sub-service 2, 3 and 4 are also used to abstract other visits not considered to be qualifying Surgical Day Care procedures. These categories are used by hospitals primarily for internal utilization management purposes (HMRI, 1991).

methodology used to assign cases to DPG and CMG. Day surgery cases are assigned to DPG by procedure. CMG, however, are assigned by most responsible diagnosis, then by principal procedure, patient age, and the absence or presence of complications and co-morbidities.

If these cases were considered in the Day Surgery Incentive Model, a hospital would be penalized for completing them on a day surgery basis. To remove this disincentive, in those cases where the inpatient RIW value was lower than the outpatient RIW value, the inpatient RIW value was changed to the outpatient RIW value plus an additional 25%. A 25% adjustment was applied because it was believed this would provide an appropriate incentive to complete these cases on a day surgery basis. This adjustment was implemented to compensate for a small number of procedures in which the weighting systems used in conjunction with CMG and DPG are neither aligned nor reflective of true costs. This incentive measure was used to encourage hospitals to continue to perform procedures on an outpatient basis where clinically appropriate by removing any financial barriers.

Step 3: Calculation of the Expected Inpatient Rate for ICD-9 Procedures

After applying the aforementioned exclusions to the inpatient and outpatient data sets, each ICD-9 procedure was subdivided into six categories based on patient age and the presence of complications or co-morbid conditions (CC): 1) 0 to 15 no CC; 2) 0 to 15 with CC; 3) 16 to 69 no CC; 4) 16 to 69 with CC; 5) 70 plus no CC; and 6) 70 plus with CC. For each of the six categories within each ICD-9 procedure, the percentage of cases performed on an inpatient basis in Ontario, as reported to CIHI, was calculated as shown in Table 1.

Table 1: Calculation of the Expected Inpatient Rate

ICD-9 Procedure Description	DPG	Average & CC Categories	ONT. Out-patient Cases	ONT. In-patient Cases	ONT In & Out-patient Cases	ONT. % Inpatient
01.03 Direct Laryngoscopy	17	0 to 15 no cc	17	10	27	37.0
		0 to 15 w/ cc	1	2	3	66.7
		16 to 69 no cc	128	13	141	9.2
		16 to 69 w/ cc	26	8	34	23.5
		70 plus no cc	18	5	23	21.7
		70 plus w/ cc	3	0	3	0
01.04 Other Non-operative	17	0 to 15 no cc	16	3	19	15.8
		0 to 15 w/ cc	4	7	11	63.6
		16 to 69 no cc	230	22	252	8.7
		16 to 69 w/ cc	33	3	36	8.3
		70 plus no cc	36	5	41	12.2
		70 plus w/ cc	9	1	10	11.1
01.05 Pharyngoscopy	17	… etc.				… etc.

These calculated inpatient percentages by ICD-9 procedure code split into 6 categories, were then used as proxies for the expected percentage of procedures that should have been performed on an inpatient basis.

Step 4: Calculation of the Hospital-Specific Weighted Case Adjustment

The weighted case adjustment by procedure is calculated by multiplying the difference between a hospital's actual and expected number of inpatient cases, by the difference between the inpatient and outpatient RIW. A hospital's weighted case adjustments are then summed for all surgical procedures, with the resultant total being the net weighted case adjustment to be applied to a hospital's total weighted cases using the equity formula.

For each Ontario hospital, the expected number of inpatient cases by ICD-9 procedure was calculated, as outlined in a hospital-specific report entitled, Calculation of the Hospital Specific Weighted Case Adjustment, distributed to all Ontario hospitals. The expected number of inpatient cases were compared with a hospital's actual number of inpatient cases and used to calculate a hospital's weighted case adjustment as shown in Table 2.

Table 2: Calculation of the Hospital-Specific Weighted Case Adjustment

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10
ICD-9 Procedure	Hosp In & Outpatient Cases	Ont % Inpatient Cases	Hosp Expected Inpatient Cases Col 2 & 3	Hosp Actual Inpatient Cases	Expect minus Actual Col 4□5	Average Inpatient RIW□	Aver age. Outpatient RIW□	RIW□ Diff. Col 7□8	Weighted Case Adjust Col 9 & 6
Carpel Tunnel	90	11%	10	10	0	0.9	0.7	0.2	0
D & C	50	0%	0	5	-5	0.8	0.6	0.2	-1.0
Hernia Repair	100	14%	14	10	4	1.1	0.6	0.5	2.0
Total			24	25					1.0

This table calculates an "expected" number of inpatient cases for this hospital based on the Ontario wide experience (col 2 & col 3). The actual number of inpatient procedures performed is subtracted from the expected values (col 4—col 5). The resultant number is multiplied by the difference between the inpatient RIW and the corresponding outpatient RIW (col 9 & col 6). This calculation is made for all procedures and then summed. The resultant total is the weighted case adjustment to be made to a hospital's total weighted cases used in the Equity Funding Formula calculations.

Step 5: Calculation of the Hospital-Specific Outpatient Surgery Index and Weighted Case Index

In order for individual hospitals to compare their performance relative to the Ontario experience, a hospital specific index was calculated. This was completed to help hospitals better understand their weighted case adjustment (see Table 3).

Table 3: Calculation of the Hospital-Specific Outpatient Surgery and Weighted Case Index

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
Hospital Name	Hospital Expected Inpatient Cases	Hospital Actual Inpatient Cases	Actual/ Expected Case Index (Col 3/Col 2)	Actual/Expected Weighted Case Index	Weighted Case Adjustment
1 2 3	100 300 200	200 300 100	2.000 1.000 0.500	(Hospital Actual Inpatient weighted cases divided by Hospital Expected I/P weighted cases)	(see Table 2 in step 4)

The hospital specific *Actual/Expected Case Index* is calculated by dividing the actual number of inpatient cases by the expected number of inpatient cases. Hospitals with a lower percentage of inpatient cases than expected will have an index less than one, while hospitals with a higher percentage of inpatient cases than expected will have an index greater than one. Hospitals with a weighted case index less than one will have positive weighted case adjustments, and hospitals with a weighted case index greater than one will have negative weighted case adjustments. Since the expected inpatient cases are based on the provincial average, the total expected inpatient cases for the province divided by the total actual inpatient cases for the province approximates 1.000.

IMPLICATIONS & IMPACT OF THE WEIGHTED CASE ADJUSTMENT

A hospital receives a positive weighted case adjustment if its expected number of inpatient cases is higher than its actual number of inpatient cases (i.e. the actual number of outpatient cases is higher than expected). This adjustment means that a hospital receives the inpatient weight for the percentage of outpatient cases completed in excess of the provincial average. In the Equity Funding Formula, this adjustment lowers a hospital's average cost per weighted case because a hospital receives the inpatient weight but incurs the outpatient cost.

Conversely, a hospital receives a negative weighted case adjustment if its expected number is lower than its actual number of inpatient cases (i.e. the actual number of outpatient cases is lower than expected). This adjustment means that a hospital receives the outpatient weight for the percentage of inpatient cases completed in excess of the provincial average. In the Equity Funding Formula this adjustment increases a hospital's average cost per weighted case because a hospital receives the outpatient weight but incurs the inpatient cost.

The percentage change in hospitals' total weighted cases as a result of this weighted case adjustment ranges between plus or minus 2%. This translates into a similar change in a hospital's average cost per weighted case. Appendix IV provides a detailed example of how the Day Surgery Incentive Model works, and the impact of this weighted case adjustment on a hospital's average cost per weighted case.

PRACTICAL APPLICATION FOR UTILIZATION MANAGEMENT

In developing the Day Surgery Incentive Model, it was argued that if such incentives were to be incorporated into the equity funding formula, tools should be developed to assist hospitals in developing better utilization management practices. Toward this end, the JPPC Utilization Management Committee was asked to develop tools that could assist hospitals in the management of day surgery utilization. CIHI outpatient surgery data and the outpatient grouping methodology were used by the JPPC to produce comparative reports to assist hospitals to improve their performance and make shifts to outpatient surgery. As part of the JPPC's "How Do You Compare?" series, *Moving to Outpatient Surgery* (JPPC, 1994a, 1995c) provides hospitals with comparative information to determine where to focus their attention for change, and to identify opportunities and strategies to improve utilization management practices and processes. *Moving to Outpatient Surgery* (JPPC, 1994a, 1995c) illustrates several strategies that have been successfully used in hospitals to achieve high outpatient surgery rates. These strategies include:

ð fostering progressive attitudes about utilization management;
ð emphasizing patient education and guiding patient expectations;
ð making the care process convenient for patients, surgeons and anaesthetists;
ð identification and involvement of physician champions;
ð post-discharge services;
ð ensuring teamwork and accountability; and
ð investing in technology, new anaesthetic agents and pain/nausea management.

BENEFITS AND LIMITATIONS

The Day Surgery Incentive Model was developed in response to the demand by hospitals to not only fund day surgery, but to also encourage the move away from inpatient surgery. While the Day Surgery Incentive Model had some technical and data-based limitations, some of which were resolved in subsequent refinements to the original model, it clearly resulted in several **benefits**, including:

ð It addresses the day surgery part of the OHA resolution passed in the fall of 1992 (Proceedings from OHA Annual Convention, November, 1992) by providing a financial incentive for hospitals to perform more cases on a day surgery basis. It is also consistent with the Ministry of Health directive for hospitals to increase the percentage of procedures performed on an outpatient basis.

ð The weighted case adjustment is simple to calculate and understand. Hospitals with a high proportion of day surgery cases are rewarded, as weighted cases will be added to the Equity formula "total weighted cases" calculation. Hospitals with a low proportion of day surgery cases will be penalized, as weighted cases will be removed from the Equity Formula "total weighted cases" calculation. The case and weighted case indices also provide an easy to understand summary measure of a hospital's overall performance.

ð The methodology accounts for differences in age mix and complications and co-morbid conditions, making it more acceptable to clinicians.

ð No additional data collection or definitions are required.

ð The methodology is based on current clinical practices. It does not make arbitrary decisions concerning eligible outpatient procedures. The expected percentage of outpatient cases is also a moving target which will remain responsive over time to changes in clinical practice in Ontario hospitals.

ð The methodology allows for automatic inclusion of new advances in day surgery as they occur from year to year.

ð The Model also has the flexibility to be applied to future funding methodologies under development.

The **limitations** of the model are as follows:

ð The percentage of procedures that a hospital is expected to perform on a day surgery basis is a "moving target" based on historical data. Hospitals will not know the current year's targets until September/October of the following year, when CIHI year end data are available. Some view this as an advantage, however, because hospitals would not know if they have achieved or surpassed the targets and, therefore, would continue to strive for improvements.

ð Hospitals with a low percentage of day surgery cases are penalized equally, whether their reasons are appropriate or not. For example, a hospital may have a low percentage of day surgery cases due to factors beyond its control (e.g. geography, demographics of the referral population, availability of community services, etc.). There are also no provisions for peer group differences when calculating the expected percentage of inpatient cases by procedure. Inpatient and outpatient data for all Ontario hospitals were combined to compute these percentages.

SUMMARY

For the first time, a significant and growing segment of hospital activity in Ontario is being funded on a case-mix basis. Hospitals which have a low proportion of day surgery cases relative to the Ontario average receive a negative weighted case adjustment, resulting in a higher average cost per weighted case in the Equity Formula. Hospitals with a higher proportion of day surgery cases relative to the Ontario average receive a positive weighted case adjustment, resulting in a lower average cost per weighted case.

The incorporation of funding and incentives for day surgery/procedures into the hospital funding formula in Ontario was an important milestone that would not have been possible without the development of DPG and RIW. The success of this undertaking in Ontario has fueled the current search for case-mix and case-weight based funding for other areas of hospital activity, including chronic/continuing complex care, rehabilitation, mental health and ambulatory care.

The impetus for undertaking these developmental efforts derives from the hospitals who have argued for equitable approaches to hospital funding. Implementation of these efforts has been supported by the Ontario Ministry of Health and the Ontario Hospital Association, and has been made possible by the pioneering work and cooperation of the CIHI.

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The following exclusions were applied to the 1993/94 statistical *outpatient* database for Ontario Hospitals:

1. Cases not assigned to patient sub-service 01 (i.e. non-qualifying same-day surgery cases). **Note:** Cases that are re-assigned to sub-service 09 are excluded.

2. Cases where the principle procedure suffix was:

   - 0—procedure performed out of hospital
   - 8—cancelled surgery, or
   - 9—previous surgery prior to admission

3. Cases where the principle procedure code was blank or invalid.

4. Cases not assigned to a DPG category.

5. Stillborns

6. Cases assigned to patient service 51—obstetrics delivered, patient service 54—new-born, Dilation and Curetage (D & Cs) following delivery or abortion (ICD-9 81.01); are not excluded.

7. Cases assigned to the following DPG:

   DPG 02 Spinal Procedures
   DPG 03 Nerve Injections
   DPG 20 Angiography
   DPG 59 Skin Procedures (no complications or comorbid conditions recorded)
   DPG 62 Haemodialysis
   DPG 63 Transfusions
   DPG 64 Cardioversion
   DPG 65 Chemotherapy
   DPG 66 Myelogram
   DPG 99 Ungroupable

   DPG 02, 03, and 62 to 66 are medical day care cases and do not qualify as day surgery according to the old day surgery definition. DPG 20, angiography, is excluded because it has a technical component which is billable. Minor skin procedures under DPG 59 (i.e."lumps and bumps") are also excluded because they do not qualify as day surgery according to the old day surgery exclusion list.

8. Minor endoscopic procedures (ICD-9 (CCP[1]) procedure codes):

   01.01 Rhinoscopy
   01.23 Sigmoidoscopy
   01.24 Proctosigmoidoscopy
   01.25 Anoscopy
   01.32 Otoscopy
   01.36 Vaginoscopy
   82.81 Culdoscopy/Colposcopy

9. Cardiac Catherizations (i.e. ICD-9 codes: 49.95 right, 9.96 left and 49.97 combined right and left catherizations).

10. Outpatient surgery Cases where the procedure was performed and the patient returned to the referring hospital on the same day.

(from JPPC reference document #RD4-6A, Ontario Hospital Cost Distribution Methodology By Patient Activity, March 20, 1997, pp. 28–29.)

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[1] CCP is the Canadian Classification of diagnostic, therapeutic, and surgical Procedures.

The following exclusions were applied to the 1993/94 statistical *inpatient* database for Ontario Hospitals:

Atypical cases (i.e. deaths, transfers, signouts, and outliers)

1. Cases where inpatient length of stay was greater than 3 days (i.e. 4 days or greater)

2. Cases where the principal procedure suffix is 0 (i.e. procedures performed out of hospital), 8 (i.e. cancelled surgery), or 9 (i.e. previous surgery).

3. Cases where the principal procedure code was blank or invalid (i.e. zzzz).

4. Cases where the DPG is not assigned (i.e. DPG = **)

5. Stillborns

6. Cases assigned to patient service 51—obstetrics delivered, including ICD-9 procedure code 81.01, D & C following delivery or abortion.

7. Cases assigned to patient service 54—newborn.

8. Cases where the principal procedure maps to DPG 02 (Spinal Procedures), DPG 03 (Nerve Injections), DPG 20 (Angiography), DPG 59 no CC (minor Skin Procedures), DPG 62 (Haemodialysis), DPG 63 (Transfusions), DPG 64 (Cardioversion), DPG 65 (Chemotherapy), DPG 66 (Myelogram), and DPG 99 (Ungroupable).

9. Cases with the following ICD-9 (CCP) procedure codes as principal procedure:

   01.01 Rhinoscopy
   01.23 Sigmoidoscopy
   01.24 Proctosigmoidoscopy
   01.25 Anoscopy
   01.36 Vaginoscopy
   82.81 Culdoscopy/Colposcopy

At the September 16, 1994 meeting of the Joint Policy and Planning Committee (JPPC) the following recommendations were approved in principal:

1. **Outpatient Grouping Methodology:** That the Canadian Institute for Health Information's (CIHI's) Day Procedure Group (DPG) grouping methodology be used to group day procedures.

2. **Outpatient Weights:** That the Maryland charge database be used to calculate a set of relative weights for the DPG classification scheme.

3. **Linking Inpatients and Outpatients:** That the Maryland charge data base be used to calculate a set of relative weights for both inpatients RIW and outpatients DPG.

4. **1995/96 Funding:** That Equity Funding Formula (i.e. Case Cost Formula) calculations for 1995/96 incorporate day procedures using 1993/94 data (or the most current data available).

(from JPPC Discussion Paper: Report & Recommendations for Day Surgery/Procedure Funding, Draft 1.7, November 21, 1994, p. 1.)

Hospital Example of Calculations in the Day Surgery Incentive Model

A hospital example is given to help clarify the different components of the Day Surgery Incentive Model and to show how it will be applied to the Equity Funding Formula.

Verification of Exclusions Applied to the Outpatient Database in Step 1

Hospital	Total Outpt Cases	Total Outpt RIW□	Total Subs1 Cases	Total Subs1 RIW□	Non Subs1 Cases	Non Subs1 RIW□	Subs1 Excl Cases	Subs1 Excl RIW□	Net Equity Cases	Net Equity RIW□
x	9000	2000	6000	1500	3000	500	1000	200	5000	1300

Total Outpt (Oupatient) Cases refers to those cases for which hospitals submitted a Same Day Surgery abstract to CIHI.

Total Subs1(Sub-Service) Cases refers to those outpatient cases coded by the hospital as sub-service 1 (i.e. day surgery).

Non Subs1 Cases refers to those outpatient cases coded by the hospital as a sub-service other than subservice 1.

Sub1 Excl (Excluded) Cases refers to those day surgery cases that were excluded due to the exclusion criteria outlined in step 1.

Net Equity Cases refers to those outpatient cases that are eligible for the Day Surgery Incentive Model and the Equity Formula calculation because they passed all of the exclusion criteria for qualifying as day surgery cases.

Calculation Weighted Case Adjustment for Hospital X (Step 4)

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10
ICD-9 Procedure	Hosp Inpt & Outpt Cases	% Ont Inpt Cases	Hosp Expected Inpt Col 2 & 3	Hosp Actual Inpt	Expect minus Actual Col 4 □5	Avg Inpt RIW□	Avg Outpt RIW□	RIW□ Diff. Col 8 □7	Wtd Case Adjust Col 9 & 6
Carpel Tunnel	90	11%	10	10	0	0.9	0.7	0.2	0
D & C	50	0%	0	5	-5	0.8	0.6	0.2	-1.0
Hernia Repair	100	14%	14	7	7	1.1	0.6	0.5	3.5
Total			24	22					+2.5

Calculation of the Hospital X's Case and Weighted Case Indices (Step 5)

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 6
Hospital Name	Hospital Expected Inpatient Cases	Hospital Actual Inpatient Cases	Actual / Expected Case Index (Col 3/ Col 2)	Hospital Expected Inpatient Wtd Cases	Hospital Actual Inpatient Wtd. Cases	Actual/ Expected Weighted Case Index
X	24	22	**.9167**	24.4	20.7	**.8483**

As reported on Hospital X's Equity Worksheets for 1993/94:
Total Acute & Newborn Costs + Day Surgery Costs = $200,000
Total Equity Weighted Cases = 100
Average Cost Per Weighted Case = $200,000/100 = $2,000/ wtd. case
Weighted Case Adjustment (as per Day Surgery Incentive Model) = +2.5
Revised Total Equity Weighted Cases = 102.5
Revised Average Cost Per Weighted Case = $200,000/102.5 = $1951.21/ wtd. case

Net Impact of Day Surgery Incentive Model:
% Change in Total Weighted Cases = 2.5%
% Change in Average Cost Per Weighted Case = 2.5%

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Program Information: The Application of Information to Clinical Decision Making

CHAPTER OVERVIEW

This chapter describes the experience of the London Health Sciences Centre (LHSC) in the application of information to planning and decision making. The Program Information Department was established at the LHSC to provide leadership in facilitating the application of information to management of both clinical and administrative processes. Team members, known as Program Information Specialists, are aligned to specific clinical programs as the information resource and expert analyst for the clinical team. The chapter describes how this collaborative effort has enabled teams to translate health care data into information that enables planned change in practice patterns and approaches to care.

Three case examples illustrate how internal and external information resources have been effectively applied to planning and decision making within the LHSC. Case 1 describes the development of utilization targets in operational planning; case 2 describes how changes from inpatient to ambulatory care were facilitated; and case 3 deals with planning for consolidation of clinical services. These cases illustrate the effective transformation of health care data to information and the facilitative role of the Program Information Specialist in this process, working directly with the clinical teams as an expert resource and support.

As health care is evolving toward integrated delivery systems and more regionalized planning models, the information requirements are also changing. These developments require access to and meaningful application of information. Information remains a critical success factor in achieving a preferred future. At the LHSC, the Program Information Department is evolving to meet these challenges posed by the new dynamic health care environment.

INTRODUCTION

In recent years, the health care industry has experienced unprecedented reductions in funding from government sources and increased demand to maximize operational efficiency. This has resulted in enormous pressure within the industry to maintain the standards of care Canadians have come to expect while responding to the economic imperative. Many jurisdictions have looked to new organizational models and partnerships to facilitate adaptation to this challenge.

In London, Ontario, the community envisioned a future that included exemplary health care for the residents of Southwestern Ontario and a leadership role in the provision of health services education and research. They responded by supporting the realignment of institutional health care services within London. The London Health Sciences Centre (LHSC) was established in September 1995 through the merger of two acute care teaching hospitals affiliated with the University of Western Ontario, University Hospital and the two sites of Victoria Hospital, South Street Campus and Westminster Campus.

The priorities for the LHSC were established within the context of the corporate vision, the provincial health services restructuring process, and the economic imperative created by Ministry of Health funding levels. Among these priorities were:

ð safeguarding and maintaining our commitment to high quality patient care, teaching and research;
ð fulfilling the LHSC mission effectively and efficiently within available resources, including the pursuit of innovative and appropriate business opportunities; and
ð consolidating LHSC from three to two sites.

It was recognized that one of the keys to successfully achieving these outcomes was the application of information to planning and decision making. The need for leadership in managing information resulted in the establishment of a new department, Program Information, within the division of Finance and Information Management.

The Program Information Department was developed in April 1996 to facilitate the application of information to management of both clinical and administrative processes. As Backer (1995) describes, a "diverse and creative palette of strategies [is] needed to change clinical practice at the individual and organizational levels." Thus, the department was designed to bring together a team of individuals from throughout the organization, with a range of skills and experience in utilization management, clinical pathway planning and evaluation, operational reviews, program planning, case costing analysis, and education in the application of health care information. Each of these individuals, titled Program Information Specialists, was aligned to specific clinical programs as the information resource and expert analyst for the clinical team. As Shortell and his colleagues have stated:

> “personnel directly involved in the caregiving function typically lack the time and all of the needed expertise to do what is required … Caregivers can identify the problem, and of course, be held responsible for implementation, but they must be given resources and support in order to transform clinical processes and better coordinate such processes across the continuum. (Shortell et. al., 1996, p. 174)”

The Program Information Specialist role was designed to be dynamic and responsive to the needs of each clinical team. The Specialists collaborate with the team to determine the information needs associated with addressing issues specific to their area, and develop mechanisms for disseminating that information in meaningful ways. "Striking examples where the intelligence of the team exceeds the intelligence of the individuals in the team and where teams develop extraordinary capacities for coordinated action" are described by Senge (1990). It is this collaborative effort and the facilitative role of the Specialist that have enabled teams to translate health care data into information that enables planned change in practice patterns and approaches to care. Senge further suggests that:

> “the fundamental "information problem" faced by managers is not too little information but too much information. What we most need are ways to know what is important and what is not important, what variables to focus on and which to pay less attention to—and we need ways to do this which can help groups or teams develop shared understanding. (Senge, 1990, p. 128)”

Based on this, it was concluded that a proliferation of health care data within the clinical team was clearly not the answer. A focused approach was taken to develop standard reports that would meet generic information needs and then to develop customized information products consistent with the needs of the specific clinical situation.

Reports consisting of internal utilization and costing data were distributed to the clinical teams. In addition, information provided by the Canadian Institute for Health Information (CIHI), the Joint Policy and Planning Committee (JPPC) and the Ministry of Health (Ontario) including the Planning Decision Support Tool (PDST) and the Day Surgery Incentive Model was used extensively. These resources provided data for Case Mix Group (CMG) and Day Procedure Group (DPG) analysis, benchmarking to best practices, and case costing analysis. The information was applied to a range of processes: operational planning, clinical pathway development and variance tracking, program planning, and peer review. The restructuring initiatives within the Province of Ontario rely heavily on these same data resources.

Three case examples are described in this chapter to illustrate how internal and external information resources have been effectively applied to planning and decision making within the LHSC. As Backer (1995) states, we need to "think globally and act locally ... micro-change is represented by practice change for physicians and hospitals; macro-change is represented by health care reform and other changes in the whole health care system." The impact of these types of changes at LHSC is illustrated in the three cases presented below.

CASE 1: OPERATIONAL PLANNING—DEVELOPMENT OF UTILIZATION TARGETS

To facilitate restructuring of health services within the province of Ontario, the Ministry of Health has established the Health Services Restructuring Commission (HSRC). The role of the Commission is to make decisions about health system restructuring that will assist local, district and regional processes to move forward logically and sensibly. This process is to occur while accounting for quality of care, management and administrative efficiency, broader health system integration, availability of capital and operating resources, accessibility to health services in the community, and other relevant factors (HSRC, 1997).

In July of 1996, the Health Services Restructuring Commission undertook a review and analysis of the London region. With the Commission report and directives pending, the LHSC proceeded in November 1996 with budget planning for fiscal 1997/98. Critical organizational decisions needed to be made that would address an expected 8% reduction in Ministry of Health funding, yet ensure alignment with the anticipated recommendations of the Commission. In order to forecast utilization patterns, define inpatient bed requirements, and develop operational plans, it was decided that the HSRC utilization analysis methodology be adopted based on the two previously published reports in Thunder Bay and Sudbury, Ontario.

The primary utilization tool employed for the analysis was the Ontario Ministry of Health Planning Decision Support Tool (PDST). The PDST is designed to assess hospital utilization patterns against provincial targets and benchmark performance levels in key categories of hospital activity (PDST, 1996). It was decided that the standard targets would be applied to LHSC utilization data according to the following assumptions:

ð average length of stay (ALOS) would be reduced to achieve the 50th percentile relative to comparable hospitals using benchmark data available through CIHI;

ð preoperative days would be reduced by 100% for elective admissions;

ð alternative level of care (ALC) days would be reduced by 50%;

ð patient days related to CMG 851(social admissions) and CMG 910 (diagnosis not generally admitted) would be reduced by 100%;

ð may not require hospitalization (MNRH) days would be reduced by 25%; and

ð day surgery would meet the 75th percentile benchmark according to the JPPC Day Surgery Incentive Model.

The targets established for the organization were developed with a view to modifying the HSRC approach to meet the specific needs and interests of the LHSC and the one year time horizon for the budget process. The assumptions were generally consistent with the PDST except for the following:

ð ALC days were reduced by 50% as opposed to 100% given the one year time frame;

ð occupancy rates were established at 85% versus 90%; and

ð benchmark ALOS was set at the 50th percentile in recognition that the 75th percentile level was a multi-year target and would be difficult to achieve in one year.

The Program Information team accessed Health Records data to provide CMG specific information for the two campuses (Victoria and University) and determine the number of cases and days currently associated with each of the variables. The assumptions were then applied to the data to establish utilization targets for 1997/98, as shown in Table 1.

Table 1: Conservable Patient Days Fiscal 1997/98

Strategy	Total Days to be Saved
1. Reduce 50% ALC days	1,601
2. Eliminate 100% CMG 851	307
3. Eliminate 100% CMG 910	109
4. Reduce 25% MNRH	1,966
5. Adjust to 75th percentile day surgery	2,600
6. Adjust to 50th percentile ALOS	21,938
Total	**28,521**
Elimination elective pre-operative days	5,004

Adapted from the Planning Decision Support Tool (1996) Ontario Ministry of Health.

While this analysis established a goal for the entire hospital, micro analysis needed to occur that was specific to doctor service and would facilitate planning of operational changes to address these targets. Therefore, a further step was undertaken by the Program Information Specialist to apply the amended PDST tool to each doctor service for the two campuses. The data were further categorized based on elective, urgent or emergent status. These were further subdivided to capture whether or not pre-admit workup had occurred; whether or not it was a same-day admit for surgery; the number of pre-operative days; whether or not the case was transferred in from another institution; whether or not the case came through the emergency department; the total number of cases; and the total number of days.

While the target reduction was established at approximately 28,500 days for the organization, this additional detailed analysis indicated that 5,000 of these days could be achieved by eliminating all pre-operative days for elective cases only (see Table 1). Furthermore, the detailed analysis by doctor service provided the Program Information Specialists with insight into the clinical areas where savings could be achieved for specific categories. For example, the majority of ALC days were attributable to the Neurology service at the University Campus and Family Practice at the Victoria Campus. Differences in patient populations at the two campuses were clearly illustrated and, as a result, strategic decisions were more carefully considered. Areas where improvements could be made in terms of operational efficiencies became apparent.

The experience of the Musculoskeletal program illustrates how the application of information to decision making and operational planning was achieved. Analysis of the program specific information indicated a high number of pre-operative days for urgent cases. An analysis by CMG indicated that the issue was predominantly associated with patients with hip fracture where the average number of pre-operative days per case was 2.3 (see Table 2). The Program Information Specialist facilitated discussion among the Chief of Orthopaedics, Manager and Coordinator of the program to identify the system issues that would account for this number. A review of operational processes indicated that Operating Room (OR) scheduling was a contributing factor. Through a collaborative effort with the Operating Room leadership, a change in OR scheduling is being considered that will improve access for urgent cases during the week. This will not only reduce unnecessary days for the service, but will achieve a more patient centred approach to care. In addition, the Musculoskeletal program planned to reduce 25% of MNRH cases and shift inpatient cases to day surgery where appropriate. In cases where the surgeons felt it imperative to admit patients with designated MNRH procedures, the patient population was aggregated with other CMG with a length of stay of less than 4 days. This allowed a critical mass to be identified that could sustain the implementation of a 5-bed short-stay unit that would only be operational Monday to Friday and consequently achieve a reduction in paid hours.

Table 2: Pre-Op Days for Orthopaedic Admissions

CMG™	Admission Category											
	Elective			Urgent			Emergent			Grand Total		
	Cases	Total LOS (Days)	Pre-Op Days	Cases	Total LOS (Days)	Pre-Op Days	Cases	Total LOS (Days)	Pre-Op Days	Cases	Total LOS (Days)	Pre-Op Days
356 Fractured Femur Proc with CC	10	125	12	73	1219	183	4	45	4	87	1389	199
Average		12.5	1.2		16.7	2.5		11.3	1		16	2.3
357 Fractured Femur Proc w/o CC	12	75	10	88	871	128	0	0	0	100	946	138
Average		6.3	0.8		9.9	1.5					9.5	1.4

In order to achieve the 75th percentile length of stay benchmarks for the peer group, the Musculoskeletal program implemented clinical pathways and established target lengths of stay for all high volume cases. To facilitate this, extensive education for staff, physicians, and physicians' secretaries was undertaken to ensure a uniform communication strategy to patients and their families around expected hospital stay. As a result of these combined utilization strategies, a reduction of five inpatient beds, an increase in day surgery activity, and the implementation of a short-stay unit were achieved for the Musculoskeletal program without affecting patient throughput.

Overall, clinical services throughout the organization determined what utilization efficiencies they could achieve, and these were subsequently matched to bed requirements and outpatient capacity. This approach resulted in expansion of preadmission and one-day stay programs as well as the closure of 85 beds for fiscal 1997/98, all being achieved while sustaining the corporate commitment to meeting service demand. Subsequent to this planning process, the LHSC has been compelled to review utilization at the 90th percentile for fiscal 1997/98 as a result of continued financial constraint. The result of this review has not been concluded at this time.

CASE 2: FACILITATING CHANGES IN CARE MODALITY—INPATIENT TO AMBULATORY CARE

In February 1996, the Funding Integration Sub-Committee of the Joint Policy and Planning Committee released a report on day surgery activity comparing activity within specific institutions to the provincial average. This information related directly to a Day Surgery Incentive/Disincentive funding methodology that had been adopted by the Ministry of Health and applied to funding allocation decisions within the province. The incentive was designed to encourage hospitals to achieve a benchmark level of performance for day surgical procedures. The report stated that "hospitals completing more procedures on a day surgery basis relative to the provincial average would receive a financial incentive, while hospitals completing fewer procedures on a day surgery basis relative to the provincial average would receive a financial disincentive" (JPPC, 1996). The LHSC proceeded to fully examine practice patterns in comparison to the provincial experience.

The JPPC report provided DPG data as well more specific information at the ICD-9-CM procedural code level. The DPG data enabled the Program Information Specialist to identify where the most significant opportunities for improvement existed in the percentage of day surgery procedures compared to the provincial average.

Where activity was adversely affecting funding levels, further analysis was conducted at the ICD-9-CM code level of detail. One of the limitations in the analysis was the historical nature of the data. A number of clinical areas had realized improvements in practice during the current fiscal year that would not be evident in the data. In an effort to overcome these limitations, information for the most recent fiscal year was extracted from the Health Record database and the methodology used by the JPPC was applied. The analysis focused on typical inpatient cases with a length of stay less than four days. These cases provided the highest probability of conversion to day surgery.

The data were developed into a table that illustrated cases attributable to day surgery and typical inpatient activity during the past two fiscal years. This approach enabled a high level analysis which could then be used to set corporate objectives for achieving changes in care modality. Within the clinical teams, the Program Information Specialists provided information on the JPPC methodology and the comparison of specific practice patterns at the LHSC. Where areas of opportunity for improvement were identified, further analysis was provided to identify variability in surgeon practice patterns.

A number of clinical programs were able to benefit from this process. For example, the General Surgical program identified laparoscopic cholecystectomy and hernia repair as procedures which could potentially shift to day surgery. Table 3 provides an illustration of these procedures over a two year period. The information provided to the team served to validate the direction in which the team had been proceeding in development of clinical pathways for ambulatory care. The clinical team had identified effective pain control as a major obstacle which prevented physicians from moving their patients to day surgery. As part of the clinical pathway process, a literature search was undertaken and the principles of evidence-based research were applied to the resulting articles. The physicians were asked to review the articles that addressed the options for pain control. They identified proven pain control techniques that were integrated into the clinical pathways. This provided a level of confidence that facilitated moving to the ambulatory care model.

Table 3: Inpatients with <4 Days Length of Stay and Day Surgery (University Campus)
(Procedures with at least 1 Inpatient and 1 Day Surgery occurrence)

	1995–96			1996–97		
Procedure No & Description	Total Inpatient	Total Day Surgery	% Day Surgery	Total Inpatient	Total Day Surgery	% Day Surgery
LAPAROSCOPIC CHOLECYSTECTOMY	152	2	1%	112	58	34%
HERNIA REPAIR	44	9	17%	21	45	68%

Another focal area was Ophthalmology. Analysis based solely on length of stay benchmarks led to the conclusion that all inpatient cases had an average length of stay below that of the provincial standard. The Day Surgery Incentive model, on the other hand, highlighted that over half of these cases could be managed on a day basis. This provided the impetus for change. Understanding the day surgery benchmarks for retinal procedure, phakofragments, and lens procedures led to the development of admission criteria for the program. Together, the Chief of Ophthalmology, Manager, Coordinator and Program Information Specialist established guidelines and admission criteria that were utilized by the ophthalmologist in determining appropriateness of admission versus day surgery. Within several months, a shift in practice pattern was clearly evident.

These examples illustrate how utilization information was successfully applied in planning practice changes in a number of clinical areas. The data were also useful in projecting activity levels for fiscal 1997/98 as part of the operational planning process described in the previous section of the chapter. By using the tools available and adapting these for the specific needs of the organization, effective change has been realized.

CASE 3: PLANNING FOR CONSOLIDATION OF SERVICES—CLINICAL NEURO SCIENCES

One of the many reasons why hospitals merge is to be able to provide improved service and reduced costs without compromising patient volume. These were significant objectives of the merger for the LHSC.

Early in the process, the Clinical Neuro Sciences (CNS) service was identified as a clinical service ready and willing to consolidate onto one site, namely, the University Campus. Historically, like most tertiary care hospitals, each had its own neurology/neurosurgery service. The merger provided the opportunity for consolidating the service in order to provide improved patient care and physician training, and to achieve operational efficiencies. A pre- and post-consolidation look at the CNS experience illustrates the application of information to program planning.

The "old" model (pre-consolidation) offered adult CNS services at both campuses from specialist physicians, with the exception of epilepsy diagnosis and treatment which was centred at University Campus for both adult and paediatric cases. In the newly consolidated model, all adult CNS services are located at University Campus. The use of clinical and financial information was central in the process of planning for the consolidation of CNS services.

Clinical Information

In order to plan or corroborate the number of beds to be transferred from one Campus to the other, a review of the number of cases by doctor service was carried out. This information provided a snapshot of the current activity at each campus. Since Family Practice and Medicine would continue to see certain neurological cases at Victoria Campus, only cases in which the Doctor Service was either Neurology or Neurosurgery were evaluated. The data were categorized into those patients who were classified as elective, urgent or emergent admissions. The data were collected with an age split which allowed the Program Information Specialist to determine the number of paediatric patients who would no longer be serviced at University Campus. Since the emergent category of patients would continue to be treated at the Emergency Room in which they presented, only urgent and elective patients were reviewed in detail.

The number of Emergency Room visits in which the CNS service played an important role was determined for both campuses as a basis for predicting the volume of patients which would be redirected. In general, patient volume data provided information that was essential in defining the resources required at the "recipient" campus—from the number of beds required to the staffing and other operating budget requirements. CMG data were also utilized to determine the number of trauma patients who would be redirected to Victoria from University Campus. In addition, CMG data were useful in determining the number of surgical patients who would require the Operating Room and ICU resources.

Data were collected with respect to the diagnostic services utilized, specifically laboratory and imaging services. This was important in order to allow the diagnostic services to reassign staff depending on the volume of work which was to be transferred from one campus to the other. For example, it might be necessary to relocate an imaging technologist if the capacity of the imaging department at the recipient campus did not exist. The information also provided the imaging department with an opportunity to redistribute resources within supply budgets.

Financial Information

Financial information was essential in redeploying resources from one budget centre to another. Knowing the patient volumes within the different components of CNS along with their associated costs provided an opportunity to calculate the total dollars involved in the care of the patient population. Total costs included nursing costs and associated unit expenses, as well as costs incurred in diagnostic and support areas including laboratory, radiology, pharmacy, operating room, health records, food services, and others. An example of the total costs associated with a particular population of CNS patients is illustrated in Table 4.

Table 4: CNS Consolidation

Neurosurgery		Actual Variable Direct Cost ($)
6040	CCU	22
6045	DAY SURGERY	4,803
6050	CRITICAL CARE TRAUMA CENTRE	28,248
6052	CCTC TECHNICAL SUPPORT	416
6085	CNS 8 MDX	225,978
6105	BURNS/PLASTICS/SURGERY	3,311
6120	LEVEL 7,TOWER 2,(ONCOLOGY)	3,101
6235	7 E&M PSYCHIATRY	36
6325	6C UROLOGY	1,533
6330	3W (VASC SURG)	812
6335	2 W (CARDIOVASCULAR)	1,495
6340	3M (ORTHOPAEDIC)	828
6345	3E (ORTHOPAEDIC)	612
6354	4B FAMILY MEDICINE	1,005
6358	5E MEDICINE SSC	1,151
6452	OPERATING ROOM	231,645
6456	POST ANAESTHETIC CARE UNIT	23,011
6611	ANATOMICAL PATHOLOGY	14,526
6615	INTEGRATED LAB SSC	7,417
6616	INTEGRATED LAB WC	256
6617	BLOOD BANK S S	4,741
6625	CLINICAL MICROBIOLOGY	2,257
6652	HEMATOLOGY S S	10
6662	NUCLEAR MEDICINE	896
6680	DIAGNOSTIC CYTO PATHOLOGY	309
6710	PHARMACY	50,418
6720	RADIOLOGY	23,656
6732	PHYSIOTHERAPY	11,027
6742	OCCUPATIONAL THERAPY	6,450
7405	PATIENT REGISTRATION	5,024
7500	HEALTH RECORDS DEPARTMENT	7,131
7556	PATIENT FOOD SERVICES	6,461
7558	NUTRITIONAL SUPPLEMENTS	50
7564	CLINICAL NUTRITION SERVICES	2,700
7805	PATHOLOGISTS	0
7825	PROFESSIONAL FEES DIAG RAD	18,623
	Total Neurosurgery	**$689,959**

Costs associated with Operating and Post Anaesthetic Recovery Rooms form a significant component of the total costs for surgical CNS patients. An example showing the utilization of the Operating Room by a population of CNS patients is shown in the top section of Table 5. For the most part, direct variable costs were used throughout the consolidation planning process. Table 5 illustrates one approach in determining the supply costs which may be transferred to the "recipient" Operating Room.

Collecting and interpreting the patient volumes, as described above, also provided information necessary to determine the staffing needs at both the "donor" and "recipient" campuses. This exercise required insight into work patterns because it was not always possible to move staff and patients in the same proportion. Indeed, in some situations in the CNS consolidation, additional staff were required. For example, the need for EMG and EEG services at the Victoria Campus would continue despite the consolidation of the majority of services to the University Campus. This required additional paid hours. However, economies of scale were achieved in other areas such as inpatient units which resulted in reduced total staffing.

Table 5: OR Expenses

Operating Room Costs				
		Admit Category		
Doctor Service	**Data**	**Elective**	**Urgent**	**Grand Total**
NEUROLOGY	Sum of Var Dir Cost	524	10,674	11,198
	Sum of Cases	1	15	16
NEUROSURG	Sum of Var Dir Cost	252,053	173,532	425,585
	Sum of Cases	189	139	328
Total Sum of Var Dir Cost		**252,577**	**184,206**	**436,783**
Total Sum of Cases		**190**	**154**	**344**
Operating Room Budget				
Total	12,361,639			
Materials	6,135,040			
Materials of Total Budget (%)	49.6			
Labour of Total Budget (%)	50.4			
Distribution of O.R. Direct Variable Costs for Neuro and Neurosurgery				
T1 Direct Variable Costs (from Table)($)	436,783			
Materials ($)	***216,774***	***"T1 Target"***		
Labour ($)	220,009			

The dollars actually transferred between sites were based on analysis of the data and on negotiation between the key stakeholders. Once the amounts were determined, the transfer of both staffing and supplies dollars between Victoria and University Campuses was tracked on a spreadsheet. The sheet clearly illustrated the changes in staff mix as well as the total financial impact on LHSC resulting from the consolidation. The template used in the consolidation of CNS is shown in Appendix I. This template has subsequently been used in the consolidation of other LHSC programs and for planning service moves with other hospitals in the area.

The cornerstone of the consolidation process was a clear vision of the new model and its objectives for the future. Implementation of the new model required a significant amount of clinical and financial information, information which is inextricably linked together. The collection and analysis of both clinical and financial information allowed the planning team to make objective and informed decisions and to understand the potential economic implications of subsequent decisions.

CONCLUSION

These cases illustrate the effective transformation of health care data to information and the resulting application of this information to a range of planning and decision-making processes. The Program Information Specialist has facilitated this process by working directly with the clinical teams as an expert resource and support.

As health care is evolving toward integrated delivery systems and more regionalized planning models, the information requirements are also changing. The increasing emphasis on evidence-based practice, clinical pathway development and monitoring, and more aggressive standards for best practice benchmarking are demanding current and accessible information. As program management structures evolve, more members of the health care team participate in planning and decision making; they need to understand the information and its application to management. The new partnerships and alliances that are developing in response to a more integrated care system have needs for sharing information and creating comparability across organizations and into the community. The need to better understand the needs of the population and the referral patterns of care is gaining greater relevance.

All of these developments require access to and meaningful application of information. Information remains a critical success factor in achieving our preferred future. At the LHSC, Program Information is evolving to meet these challenges posed by the new dynamic health care environment.

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Program Transfer Template

	CURRENT		PROPOSED															
	Victoria		University		Victoria								London Health Science Centre			
	8 Middlesex		CNS program		Consol Ortho		Paediatrics		Trauma		Rehab		Corporation		Summary	
	FTE	Dollars	FTE	Dollars	FTE	Dollars	FTE	Dollars	FTE	Dollars	FTE	Dollars	FTE	Dollars	FTE	Dollars
1 Inpatient Unit																
Reg Nurse																
Reg Practical Nurse																
Unit Clerk																
Orderly																
Coordinator																
Total																
Supplies																
CNS/NP																
Drugs (from Pharmacy)																
In-Patient Summary																
2 Applied Health Services																
Physiotherapist																
Occ Therapist																
Social Worker																
Neuropsychologist																
Dietician																
Psychometrist																
Sp Lang Path																
Applied Health Summary																
3 Critical Care																
Reg Nurse																
Supplies																
Drugs (from Pharmacy)																
Critical Care Summary																
4 Operating Room/PACU																
PSA																
Staff :CN/RN/ORT																
Supplies																
Drugs (from Pharmacy)																
Operating Room Summary																
5 Emergency Transfer																
Dir Var Costs - evaluate over time																
Emergency Summary																
6 Outpatients																
7 Radiology																
8 Laboratory																
9 Current - Proposed													-	-	-	

LYNN M. NAGLE, JUDITH SHAMIAN, MARGARET CATT, MARTIN STEIN, JOSEPH MAPA

Optimizing Clinical Utilization: Structure and Strategies

CHAPTER OVERVIEW

Achieving a balance between cost-savings and sustaining the quality of patient care is a challenge for all health care organizations in Canada today (Leatt, et al., 1996). Many organizations have adopted innovative approaches to support effective and efficient management of limited hospital resources (Sheps, Anderson, and Cardiff, 1991). These approaches have included new organizational structures, models of care delivery, and strategies for resource utilization management. In this chapter, we describe the development and evolution of one hospital's structures, strategies, and processes to optimize resource utilization. Specific clinical examples are used to demonstrate the application of data from the Canadian Institute for Health Information (CIHI). A case study describes the successful application of utilization tools and strategies by one of the Clinical Teams in order to optimize resource utilization.

BACKGROUND

The Organization

A number of external factors have provided the impetus for health administrators to analyze the focus and mechanisms of care delivery within health care organizations. Specifically, funding reductions and hospital restructuring have brought issues of appropriate and effective utilization of resources to the fore. Moreover, changes to the hospital accreditation standards and processes necessitated a rethinking of the existing clinical management infrastructure.

The development of Mount Sinai Hospital's (MSH) utilization management program reflects the transformation of the Canadian health system and the focus on cost reduction. In this context, MSH initiated a multi-dimensional, multi-disciplinary strategy aimed at improving efficiency while maintaining quality of service rendered. Three fundamental tenets provided the basis for this strategy:

1. *excellence,* which not only pertains to quality care but also includes using resources effectively to provide cost-efficient care without compromising quality;
2. *continuous improvement,* which recognizes the need for continual reassessment of the way in which we use our limited resources; and
3. *responsiveness,* through the creation of an infrastructure that facilitates excellence and continuous improvement in an environment of cost constraints.

In 1995, the Hospital established a new organizational structure to manage the affairs of the institution and support the principal foci of quality and utilization management in accordance with these tenets. Essentially, the new infrastructure consists of three multi-disciplinary Planning Councils with overall responsibility for a number of related patient care teams. While the Councils have an overarching macro-perspective, the patient care teams focus on micro-level activities associated with the care of specific patient populations (e.g. Surgical Council, Muskuloskeletal Team). This model was selected to facilitate more decentralization of more decision-making, engage the largest number of constituents, and operationalize the implementation of necessary changes, while respecting the needs of the patients being served. In addition, the utilization program needed to develop initiatives that would effect changes across councils and teams. Given our organizational culture, it was recognized early on that the involvement of clinicians from all disciplines would be critical to the success of a utilization program. Thus, we have built the organizational structure with multiple teams and multi-disciplinary membership.

In sum, the model was designed to support the operationalization and optimization of utilization management strategies. This structure provides the platform for distributing the accountability for clinical utilization to interdisciplinary teams. Moreover, a convergence of clinicians and administrators provides an opportunity to optimize the decision-making associated with clinical cost reductions. More detail about the specific work of the structure's constituents follows in a discussion of roles and responsibilities.

The new structure was implemented in the summer of 1995 and in May of 1996, the hospital was scheduled for accreditation. Many team members believed learning the new accreditation standards and preparing to respond to the accreditors as a team rapidly greatly facilitated team development. They also perceived the multiple team discussions pertaining to the standards helped them learn more about each others' role and system wide issues. Teams were aggressively reviewing their performance in relation to accreditation and simultaneously discussing methods to reduce length of stay for their target populations. This ground work set the stage for each team to develop and implement clinical utilization strategies.

Each team is co-chaired by a physician and another professional (e.g. nurse, social worker, respiratory therapist). The co-chairs of the teams were asked to appoint a Resource Utilization (RU) liaison who would be the designated change agent for this effort. In addition, each team identified a Quality Improvement Liaison and Patient Care Process representative (see Figure 1). Each of these individuals is accountable to the team for certain responsibilities including attendance at educational sessions provided by the hospital and standard meetings. The liaison for each corporate initiative may be the expert for the team or ensure that individuals with specific expertise meet with the team on a regular basis.

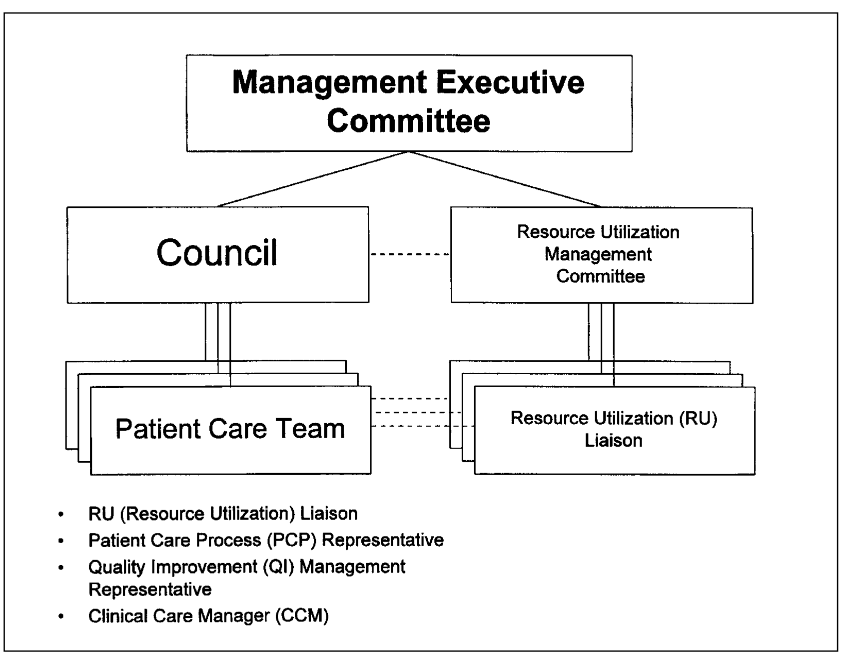


Figure 1: Organizational structure for resource utilization management.

A Resource Utilization Management Committee (RUMC) was created to develop the utilization strategies and to support the Councils and Teams in their implementation. In order to bridge the financial and clinical perspectives, RUMC is co-chaired by the Vice-President Finance and the Vice-President Nursing, since in our opinion, these perspectives are inseparable when it comes to cost-control and utilization management. RUMC includes a broad multi-disciplinary membership and a close working relationship with the Councils and Teams through the team-based Resource Utilization Liaisons.

RUMC established an educational subcommittee which was charged with the responsibility of developing a multi-faceted educational strategy. The subcommittee's educational strategies were of varied breadth and depth for different groups. Each team RU liaison, at least one other team member, and the Directors and Management team attended a two day in-house educational session offered in December, 1995. This workshop provided:

ð a comprehensive overview of utilization management and review processes;
ð an introduction of CIHI data and terminology including CMG, average length of stay, case mix and case weights;
ð an overview of case costing;
ð an overview of reports available from Health Records and Decision Support and processes to request data;
ð an introduction to benchmarking; and
ð a review of Patient Care Process strategies such as care plan development.

Each RU liaison was provided with a reference binder containing the workshop materials. Members of the councils and teams attended an abbreviated educational session which introduced them to the concepts of the utilization program. These sessions were conducted over a period of six weeks and served to raise awareness and enhance a broader understanding of utilization management.

Resource utilization management is the application of evidence-based practice to resource consumption. Moreover, resource utilization management represents a shift away from process management based upon tradition and personal preference, towards process management based upon verifiable data (Sheps, Anderson, and Cardiff, 1991). However, this shift does not suggest that there exists a single best method of practice or management. Instead, it encompasses the idea that there are many possible solutions to the complex problems encountered in healthcare. In combination, the processes of utilization management and review allow for the identification, analysis, and evaluation of variations in management and practice patterns (Payne, 1987). To this end, many of the concepts found in total quality management (TQM) are employed in these processes (Cyr, Secord, and Prendergast, 1995). The work of the Resource Utilization Management Committee is therefore encapsulated by the following three questions:

1. Are we doing the right things? (Effectiveness)
2. Are we doing things right? (Efficiency)
3. How can we improve the things we do? (Continuous Improvement)

Roles and Responsibilities

The **Resource Utilization Management Committee** (RUMC) was given the mandate to develop, implement, and evaluate a comprehensive, integrated resource utilization program including components of utilization review and utilization management. In this regard, RUMC provides support to the councils and patient care teams to develop and implement utilization management initiatives. This committee is also responsible for the conduct of external scanning and impact analysis related to pending changes (e.g. funding recruitment, program shifts, etc.). Educating the members of all teams and councils about issues of resource utilization is also the responsibility of this group.

The three **Planning Councils** have the responsibility for determining the volume and case mix for their clinical populations. They receive quarterly reports from both RUMC and their respective teams in relation to utilization performance. The councils participate in utilization management and review, reporting to the Management Executive Committee and the Medical Advisory Committee on the utilization performance of their teams.

The **Patient Care Teams** have responsibility for monitoring volume, case mix, length of stay, and cost per case and must report to the Planning Councils on a monthly basis. Each team identifies areas of variance and is expected to develop, implement, and evaluate utilization management initiatives to correct undesired variance. Strategies are developed in partnership with other relevant teams, departments, and stakeholders. One of the tools used by the teams in this process is CMG specific data for the purposes of reviewing and benchmarking their performance. These data encompass costing and length of stay comparative data. The identification of opportunities for utilization improvements are followed by discussions of strategies such as the development of critical pathways and care protocols. As will be described later in this chapter, many of the patient care teams have developed expertise in this strategy.

Each patient care team has designated an individual to be the team's **Resource Utilization** (RU) liaison. All of the team liaisons have been provided with in depth training about utilization review and management. More specifically, they have developed a high level of understanding of various utilization reports including CIHI data. Hence, they are able to provide the teams with utilization review and management expertise. They are further supported in these efforts through regular monthly meetings with the other liaisons and continued development under the direction of the RUMC. They collaborate with other utilization liaisons to maximize utilization management opportunities and provide regular updates about utilization activities to the Team. Through the regular meetings with other liaisons and links to RUMC, these individuals stay abreast of new external developments (e.g. CIHI and hospital funding changes) and strategies (e.g. patient care processes) and bring this information to team discussions. The liaisons also submit requests for utilization reports on behalf of the team and in most cases, oversee the resource utilization review processes of the team. They are active participants in the resource utilization management initiatives and prepare and submit utilization review and management reports to RUMC, Councils and others.

CLINICAL UTILIZATION STRATEGIES

“Optimalization”, a term used by Petryshen and colleagues (1995), refers to the balancing of costs against efficient, efficacious, and effectiveness of care (Petryshen, O’Brien-Pallas, and Shamian, 1995). In establishing a clinical utilization program, our goal was to reach an optimalization of patient care resources. The strategic direction of the utilization program was developed by RUMC. In determining the key elements of the utilization program a number of clinical data sets were examined. The areas of utilization that were reviewed included:

ð Length of stay (LOS) for different CMG and how it compared to other institution’s LOS.

ð Inpatient—Outpatient ratio. How do we compare to other institutions and what are the benchmarks?

ð A comparison of our utilization performance to others was conducted using Canadian and American comparator hospitals (CIHI, Health Records Data).

ð Internally, we used case costing and LOS data to compare costs and practice variations among physicians and clinical departments. Are there differences between like cases being cared for by different teams? For example, is the care of a pneumonia patient (CMG 140) under Family Medicine similar to the care of a pneumonia patient by General Medicine? If not, what can we learn from it?

These diagnostic processes helped us to identify the areas where we had the greatest opportunity to achieve improvements in utilization. Based on the diagnostic data, and considering organizational factors, RUMC decided that the first wave of organizational utilization initiative would focus on LOS reductions. Our analysis demonstrated the potential to reduce current inpatient stays by approximately 14,000 patient days.

In January, 1996 each team responsible for inpatient clinical management received an assignment to reduce length of stay (LOS) for two or more CMG. The target reductions in the assignments were derived from the CIHI 1995/96 database and benchmarks provided by external consultants. Some of the target LOS in the assignments aimed for a shorter LOS than the CIHI database.

Upon receiving a team assignment for LOS reduction, the teams developed mechanisms to implement the corporate clinical utilization strategies to meet the LOS targets. Assistance was available to help the RU liaisons understand and analyze the data. Furthermore, expert staff were available to provide guidance with utilization strategy development and implementation.

The Resource Utilization liaison for all teams attend a regularly scheduled meeting to discuss and share team utilization strategies. At each meeting, the RU liaison updates the larger group about their team's methods to reach the LOS target assignment. The meetings have also included presentations from Health Records, Decision Support, Finance, and CIHI. The RU liaisons have found these meetings very helpful, particularly when they were new to the role. RUMC developed a set of standard reports to assist councils and teams to become familiar with their performance generally, and in relation to their specific targets for their assigned LOS.

Each RU liaison also met individually with the person overseeing the implementation of the corporate resource utilization strategies. During these meetings, time was allocated to compare LOS data for typical patients from January 1, 1996 to March 31, 1996 to a second time period, April 1, 1996 to June 30, 1996 and similarly for each subsequent quarter of the year. Team progression toward the LOS reduction targets and strategies for meeting the targets continued to be reviewed and discussed. For some of the target CMG, LOS was reduced significantly. For example, for CMG 237 (Arrhythmia >70 with complications) average length of stay decreased from 7.0 days to 4.7 days from January to December 1996). Depending upon success to date, some teams have been assigned additional CMG targets for LOS reductions.

In order to achieve length of stay reductions of this magnitude and sustain the provision of quality patient care, several management strategies and review tools were developed and implemented. Global strategies which were developed and implemented to achieve length of stay reductions included: 1) processes for CMG assignment; 2) clinical tools to streamline patient care processes and advance evidence-based practice (e.g. critical pathways and protocols); 3) case management; and 4) on-line utilization reports. In the next section of this chapter, each of these initiatives will be described in more detail. The final section provides a description of one team's efforts to utilize these strategies in order to achieve their target reductions.

Processes for CMG Assignment

Prior to the initiation of the clinical utilization program, all CMG data were available monthly, on a retrospective basis. These data are based upon the final chart coding procedures conducted within the Health Records department and are not available until at least 30 days after discharge. The goal of assigning CMG upon admission was to provide clinicians, RU liaisons, and Care Managers with a reference point for expected length of stay (ELOS). The existing MSH admission/discharge/transfer system was modified to incorporate a CMG table and ELOS for all CMG.

Because of the unique nature of each clinical population, the processes of assigning CMG on admission were different across the three planning councils. For example, in surgery the CMG is assigned at the time of the booking request for each case, whereas medical patients have a CMG assigned as soon as possible after admission. It is the responsibility of the Care Managers in the medical units to assure that CMG are assigned to patients, with a focus on the target CMG. The process of assigning a CMG automatically links to an ELOS (based upon CIHI database figures). As a result, care managers, nursing unit administrators, social workers, and physicians are able to review the patient list daily and identify those at risk for exceeding the expected length of stay. Subsequently, action may be taken to expedite interventions and discharge planning to assure timely disposition of each patient. Although our initial focus has been to have CMGs assigned for target populations, it is intended that this process will be eventually applied to as many patients as possible.

At this time, the CMG assigned on admission is not necessarily congruent with that which is ultimately assigned by Health Records coders. However, we are reviewing the incidence of discrepancy and attempting to understand why this may be the case. In many instances, we have identified the need to improve clinical documentation so that complications and co-morbid conditions (which change the CMG assignment) are captured. It is premature to report on our findings about these differences at this time. However, it has been a useful mechanism to enhance the clinicians' recording of relevant information.

The Patient Care Process

The Patient Care Process at MSH is an innovative approach to co-ordinating patient care. It aims to create an environment for quality patient care and cost effectiveness by capturing: 1) the multiple processes and phases of care, 2) multidisciplinary scope of clinical events, 3) co-morbid conditions, and 4) outcomes of care. The goals of the Patient Care Process are to:

- ð develop clinical care plans, guidelines and protocols to support the clinical management of patients and the concept of "best practice";
- ð decrease length of stay for target populations;
- ð decrease the cost per case for target populations;
- ð enhance patient care outcomes;
- ð enhance the discharge planning process;
- ð support efficient and effective use of clinical resources;
- ð provide the capacity for clinical variance analysis; and
- ð support the values of total quality management.

The patient care process is facilitated by individuals with expertise in the development of patient care protocols and care plans. As will be illustrated later in this chapter, these care plans encompass a broad range of clinical interventions, but primarily focus on activities other than those found in care plans (i.e. they are not limited to tests, treatments, consults, and medication) or the typical Care Map™ as described elsewhere (Zander, 1988). Additionally, the tools being developed to address the patient care process have shifted to a focus on discharge outcomes. Identified outcomes thus have associated care activities provided by the multidisciplinary team.

To date, several teams have developed and begun to implement plans of care which primarily focus on the CMG targeted for LOS reductions. However, there have also been several initiatives which focus on protocols of treatment, phases of care, and co-morbid conditions. Ideally, these plans of care should be computerized for ease of review, documentation, and analysis. The ongoing development and implementation of an order entry system incorporates the care elements identified within the various protocols and care plans for specific CMG. Although future plans for clinical computerization include this functionality, paper documentation is maintained at present and an interim method has been developed for data analysis. Actual data from the variance tracking records collected thus far are currently being analyzed.

Case Management

As in other organizations (Cohen, 1991; Ethridge, 1991; Ethridge and Lamb, 1989), our case management program was designed to support the co-ordination of patient care and actualization of cost-savings. The work of population-focused Care Managers occurs within the context of the council, team, and departmental structures. Some of these individuals fulfil a dual role as the RU liaison for specific teams. In general, the Care Managers utilize a variety of strategies to support the co-ordination of patient care. They work in close collaboration with all members of the multi-disciplinary team and have been extremely effective in identifying process issues which impede timely and effective patient care.

Overall, the desired outcomes associated with case management include:

ð decreased length of stay for target population;
ð decreased cost per case for target population;
ð improved patient care outcomes;
ð seamless co-ordination of services to patients;
ð reduced duplication and delays in service;
ð processes which enhance/ensure continuity of care;
ð improved discharge planning process;
ð efficient and effective use of clinical resources;
ð strong linkages to community-based services and supports; and
ð strong interdisciplinary approach to patient care.

At the time of this writing, these individuals have been in their new roles for almost a year. Evaluation of performance to date, demonstrates that in conjunction with other utilization efforts, the Care Manager provides a valuable supporting role to the work of the clinical teams.

On-line Utilization Reports

The RU liaisons have access to multiple paper reports to help them monitor CMG specific resource utilization. The specific details of these reports are described in Chapter 5 by Davis. In order to reduce the workload and costs associated with generating multiple copies of multiple reports, a computerized reporting tool was developed. The RUM Online Access (ROLA) application was designed by in-house resource personnel using PowerBuilder™ database software. On a monthly basis, data extracts are obtained from the case costing system, validated by Health Records and Decision Support, and downloaded to the application. These data can be queried by the end users according to the categories of council, team, and physician. Searching for CMG specific performance, data can be retrieved in relation to average costs and lengths of stay, comparing over time, team to team, or by physician. Unfortunately, the currency of the data is always at least 90 days retrospective, but still provides a visual, tabular, and interactive way for teams to review their performance.

A CASE STUDY: THE FAMILY MEDICINE TEAM

The Family Medicine team was formalized as a result of the new organization structure. Although many of the team members worked together day to day to direct and provide patient care, they had not routinely met to discuss quality of care, utilization or operational issues.

This Clinical Team's assignment was to review and manage the length of stay for CMG 13 (Cerebral Vascular Disorders except Transient Ischemic Attacks), herein referred to as the CVA patient population, and CMG 14 (Transient Ischemic Attacks and Precerebral Occlusions). This case study will specifically discuss the team's approach to the CVA patient population. This CMG was targeted because the average LOS at MSH for typical patients (11.4 to 12.5 days) was greater than the CIHI expected length of stay (11.0 days). Furthermore, according to reports generated by the Health Records Department, the LOS for CMG 13 varied considerably by physician and across teams (see Figure 2), as did the cost per case (see Figure 3). The target for LOS reduction involved multiple teams and care providers in several geographical locations. Thus, the strategies used to meet the target LOS required extensive communication with several people across clinical teams (e.g. Emergency, General and Specialty Medicine, and Family Medicine).

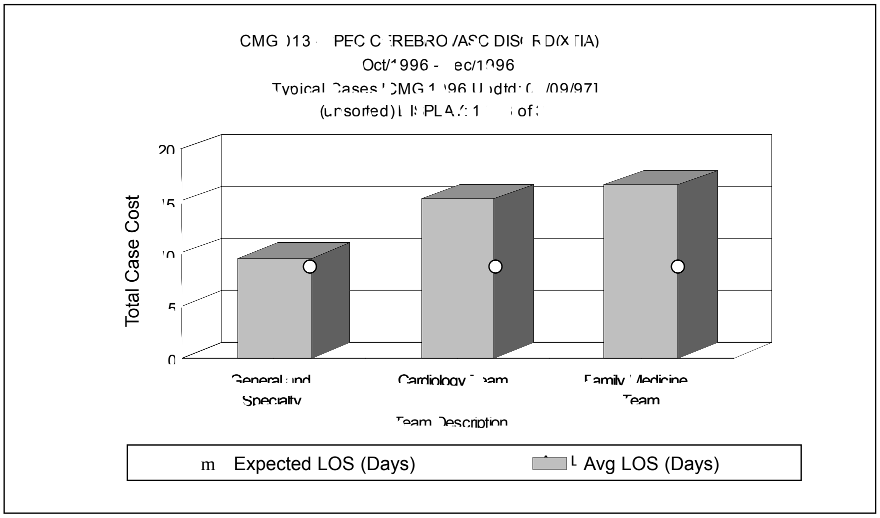


Figure 2: Comparison of length of stay for CMG 13 across clinical teams

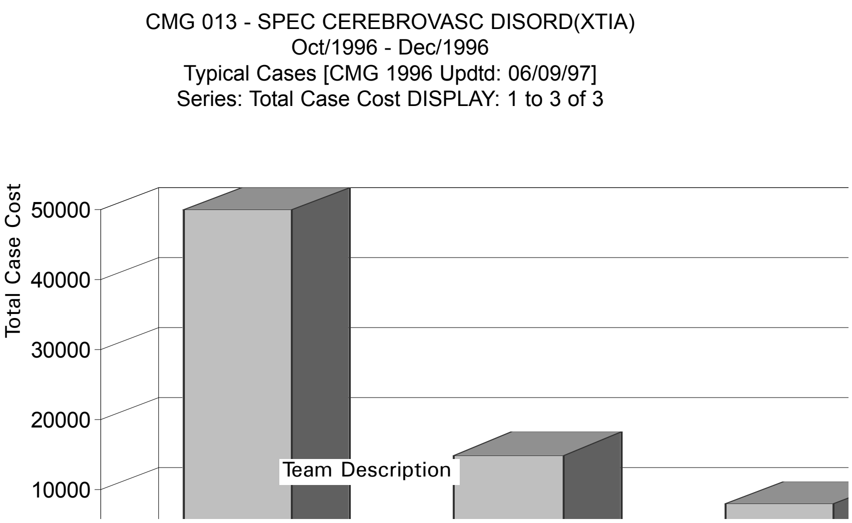
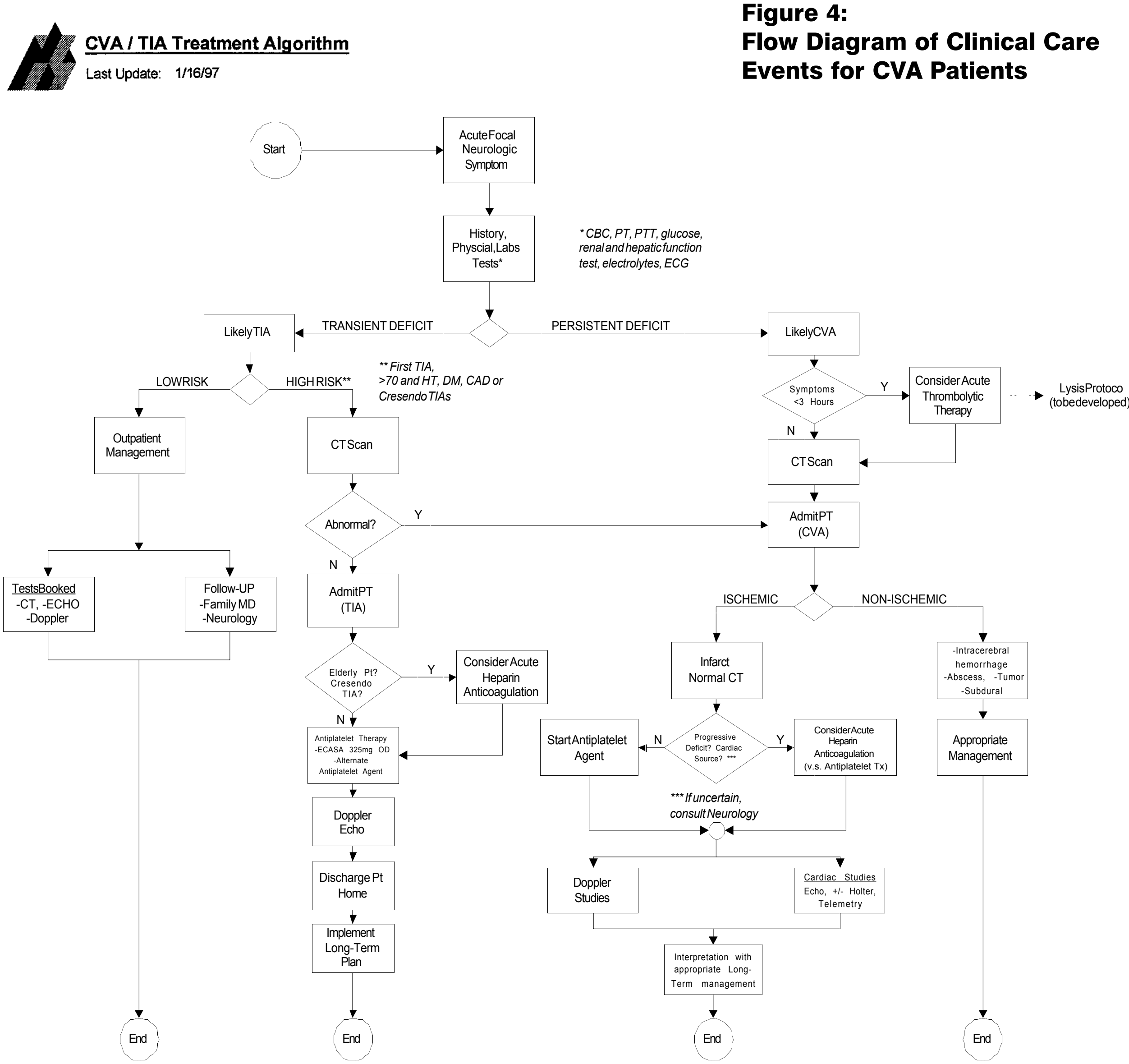


Figure 3: Comparison of total cost per case for CMG 13 across clinical teams

The Family Medicine team requested assistance to evaluate the care of the CVA population within the context of the Patient Care Process. They believed this patient population could be better managed using a consistent plan of care but were not clear as to how to proceed with the development. To better understand the current LOS of the CVA population, the team was encouraged to discuss processes in current patient care management. They were then guided to develop a flow diagram (see Figure 4) which provided them with a map of the multiple processes involved in clinically managing this patient grouping. During these discussions, some team members identified a delay of diagnostic tests and consults which could have contributed to an increased length of stay. The flow diagram highlighted barriers in the processes. It should be noted the flow diagram reflected not only patient flow, but also provider flow and information flow.

Figure 4:
Flow Diagram of Clinical Care Events for CVA Patients



The Family Medicine team requested assistance to evaluate the care of the CVA population within the context of the Patient Care Process. They believed this patient population could be better managed using a consistent plan of care but were not clear as to how to proceed with the development. To better understand the current LOS of the CVA population, the team was encouraged to discuss processes in current patient care management. They were then guided to develop a flow diagram (see Figure 4) which provided them with a map of the multiple processes involved in clinically managing this patient grouping. During these discussions, some team members identified a delay of diagnostic tests and consults which could have contributed to an increased length of stay. The flow diagram highlighted barriers in the processes. It should be noted the flow diagram reflected not only patient flow, but also provider flow and information flow.

The purpose of this diagram is to demonstrate the multiple steps of a process within the context of a more extensive process. Further analysis was required to identify the specific system issues which were barriers to the timely delivery of care. The discussions which occurred at team meetings allowed the team to realize that they did not have a consistent approach to manage this patient population, nor did they always know the contribution or priority setting of other team members and departments. Therefore the team reviewed each subset of the larger CVA flow diagram. This task was tedious and labour intensive, but the team then had a much better understanding of delays in diagnostic tests and consults. The discovery of the steps involved in the multiple processes added to the difficulty of reviewing current practice to manage this patient grouping.

Once the flow diagram was complete, a few members of the team conducted chart reviews of the CVA population. The members were looking for commonalities in physician practice, referral patterns, patient functionality, and delays in obtaining diagnostics. The information obtained from the chart review assisted the team to establish discharge goals for the development of a patient care plan. The information obtained from the flow diagram and the chart review prepared the team to develop a patient care plan. The patient care plan at MSH is a tool which has established events/activities to occur within an expected time frame to meet predetermined discharge outcomes. A new template for the patient care plan has been developed at MSH which incorporates the Patient Care Plan and Variance Tracking Record on one form. This format allows clinicians to visualize the multidisciplinary plan of care and to document the variances on the same form (see Figure 5).

Figure 5:
Sample Page of Care Plan for CVA Patient Population

The Patient Care Process
Patient Care Plan and Variance Tracking Record
Mount Sinai Hospital, 600 University Avenue, Toronto, Canada, M5G 1X5

Patient Care Name: M001
Cerebral Vascular Accident (CVA)

Page: 1 *of* 5 D413 97.07.03

Name / Position	Initial	Name / Position	Initial

PLEASE STAMP CLEARLY

PATIENT CARE PLAN

EVENT / ACTIVITY						
Phase		Description	Resp*	Date (yy.mm.dd)	Time (24h clock)	Initial
PHASE 1 (of 9) 0 - 12 Hours	1	Implement CVA/TIA Treatment Algorithm	MD	. .	:	
	2	CT Head Results Obtained	MD	. .	:	
	3	Identify Concerns/Issues re: DNR	MD	. .	:	
PHASE 2 (of 9) 13 - 24 Hours	1	Patient/Family Education - Patient Care Plan	PT/RN	. .	:	
		Nursing - Admission Assessment:				
	2	(i) Falls Risk Assessment Done	RN	. .	:	
	3	(ii) Skin Assessment Done	RN	. .	:	
	4	(iii) Continence Assessment Done	RN	. .	:	
	5	(iv) Patient Weight on Chart	RN	. .	:	
	6	Patient Mobilized	PT/RN	. .	:	
		Acute Feeding Route Established:				
	7	(i) Oral	MD	. .	:	
	8	(ii) Enteral	MD	. .	:	
	9	(iii) NPO	MD	. .	:	
	10	Physiotherapist Consult Requested	MD	. .	:	
	11	Occupational Therapist Consult Requested	MD	. .	:	
	12	Social Work Consult Requested	MD	. .	:	
	13	Speech/Swallowing Consult Requested	MD	. .	:	

VARIANCE TRACKING RECORD

Reason Code	**Reason Codes** (specify if necessary) 01- Discharge Outcomes Not Met 02- Transport Issues 03- Forms Incomplete 04- Patient Condition 05- Not Required 06- Missed 07- Not Available (specify) 08- Off Hours/Weekend 09- Other (specify)	Patient/Family	Care Giver	System	Community	Initial

*Responsibility: MD-Medical Doctor, RN-Registered Nurse, PT-Physiotherapist, OT-Occupational Therapist, RD- Dietitian, Ph-Pharmacist, HC-Home Care, SW-Social Worker, RT-Respiratory Therapist, SP-Speech Pathologist, CM-Care Manager

As mentioned earlier, information gathered from the chart review assisted the team to develop the discharge outcomes. However, it also helped the members of the team establish which events/activities were to be tracked. Medical guidelines were developed for implementation in the Emergency Department, thus the focus of events/activities were not a rewrite of physicians' orders. The team was encouraged to establish the discharge outcomes, phases of care and milestones to meet the outcomes. It should be noted the discharge outcomes are patient specific, the phases of care may be hours, days or weeks and the milestones are events/activities which must occur prior to or within the phase of care. This team reviewed the literature, talked to people in other organizations and developed a care plan to reflecting the LOS target rather than current practice.

It is interesting to note this population of patients may be admitted to any one of three teams at MSH. However, the Family Medicine team was given the responsibility to develop a methodology to manage these patients within the targeted length of stay and then to share the results with other teams. Throughout this process, it was a challenge to know when to include members from other teams as they also had LOS targets to meet and not all practitioners could attend every meeting during the development process. This became more significant as physicians on teams began to develop medical directives. Nonetheless, the physicians and other team members developed a process to communicate the medical directives and care plan progress to all potential users of the plan including patients. The Care Manager with this team was also their RU liaison and actively participated in the development and communication of the CVA patient care plan. The CVA care plan was being implemented at the unit level at the time of this writing.

Using the ROLA application, the Care Manager for this team was able to review utilization performance for CMG 13 according to doctor number and by team. The capability to graph CMG length of stay and costs over time, by physician and team, was demonstrated to be extremely valuable in monitoring utilization performance (see Figures 2 and 3). At the time of this writing the LOS for CMG 13 has fallen to 6.6 days (CIHI expected LOS - 11.0 days) for the last quarter of 1996. In general, the change in LOS can be attributed to the combined efforts of care managers and clinicians, and the application of consistent plans of care. Improved discharge planning and focused attention on the specific care needs of this population has contributed to the success of the team's work. Although the decrease has been substantial over the year, we continue to monitor this CMG as well as many others to ensure that changes to practice persist.

In the future, the clinical events and outcomes being captured on the care plan will be reviewed in conjunction with these data. This convergence of clinical, health records, and costing data will thus provide further understanding of care processes and guide future utilization efforts. In particular, we have begun to monitor several clinical indicators to ascertain the "optimalization" (Petryshen, O'Brien-Pallas, & Shamian, 1995) of resource use, and to make certain that efforts to achieve increased efficiency in patient care delivery are not compromising the provision of quality care.

CONCLUSION

At the organizational level there are a number of lessons to be learned from our experience.

- ð To have a successful utilization program one needs to have a strong partnership between clinicians and management.
- ð The clinical utilization initiative at the clinical level has to be driven by clinicians.
- ð This work needs designated champions (in our case the RU Liaisons and Care Managers).
- ð Experts need to be driving the process (e.g. Health Records, Clinicians).
- ð The patient population focused approach is an effective strategy to facilitate context based action plans.
- ð The overall organizational team (RUMC) needs to have members from both the clinical side of the house, and the data—financial, health records, and information services.
- ð Strategic initiatives need to be identified and developed at the corporate level.

In summary, a utilization program will become successful when the organization integrates the basic tenets of such a program as part of the culture of the organization. At this era of evidence-based clinical practice and shrinking resources, a strong active utilization program can help organizations to optimize their resource utilization.

In retrospect, focusing on a single issue (LOS reductions) at the outset was very important to the successful introduction to the utilization program. Clinicians and administrators were able to focus on something tangible. Through 1996/97 we have seen a significant drop in LOS in all teams. Many of the LOS targets have surpassed and dropped below the benchmarks. In the future, we intend to further expand the utilization work to include the review of specific diagnostics and therapeutics and the development of team-based scorecards to monitor the "optimalization" of organizational resources.

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CATHY DAVIS

Using Case Mix Tools with Case Costing Data for Utilization Management

CHAPTER OVERVIEW

During the past two years, Mount Sinai Hospital has changed its organizational structure from a departmentally-focused structure to a maxtrix-based structure with multi-disciplinary patient care teams. To support this change, a challenge for Information Services was to provide teams with information that facilitates decision making. This chapter describes how information was used to meet this challenge. It discusses the use of information to: 1) assign patients to teams; 2) set utilization targets for length of stay and shifting inpatient care to an ambulatory setting; 3) identify best practice hospitals; 4) develop standard reporting packages; 5) analyze cost variances; 6) enhance reports with complexity data; and 7) isolate case types for patient care planning. Finally, key results and recommendations for Information Services at Mount Sinai Hospital are identified.

INTRODUCTION

During the past two years, Mount Sinai Hospital has undergone a shift from the traditional, department-specific organization structure to a matrix-based structure with multi-disciplinary patient care teams. The shift to a team-based structure corresponds to a shift in the focus of the Canadian accreditation program. In 1994 the Canadian Council of Health Services Accreditation (CCHSA) published a document advising that "each client/patient care team serves a particular group of clients/patients with similar needs and patterns of resource consumption" (CCHSA, 1994, p. 17). This chapter describes how case mix and case costing information was used to identify these groups at Mount Sinai Hospital and to support changes in organization structure as well as provide a basis to focus utilization management efforts.

THE ORGANIZATIONAL STRUCTURE

Mount Sinai Hospital is a teaching hospital in Toronto with a range of programs including high risk obstetrics, neonatal intensive care, oncology, gastrointestinal diseases, musculoskeletal, sarcoma, diabetes and psychiatry. Mount Sinai Hospital began participating in the Ontario Case Cost Project in 1991. During the past six years, the use of the data for budgeting, decision-making and utilization review has continued to increase.

With the shift to a team-based organizational structure at Mount Sinai Hospital, Planning Councils were established for each of three major patient populations: Perinatal, Surgical/Peri-operative, and Medical and Academic Community Health. Each Council is Co-chaired by a clinical chief and a vice president. The Planning Councils provide the Medical Advisory Committee and the Executive Management Committee with advice and guidance on clinical policy issues in relation to the associated patient populations. Within the three Planning Councils, a total of 20 patient care teams were established. The Councils are also responsible for working with the teams to meet the needs of the patient population, promote clinical and academic activities, ensure appropriate resource utilization management including costs associated with volume, case mix and modalities of care, and determine the need for and impact of new physician recruits and capital equipment.

The patient care teams focused on clinically similar patient populations and are responsible for three key and equally important processes as they pertain to the team's specific patient population. These processes are:

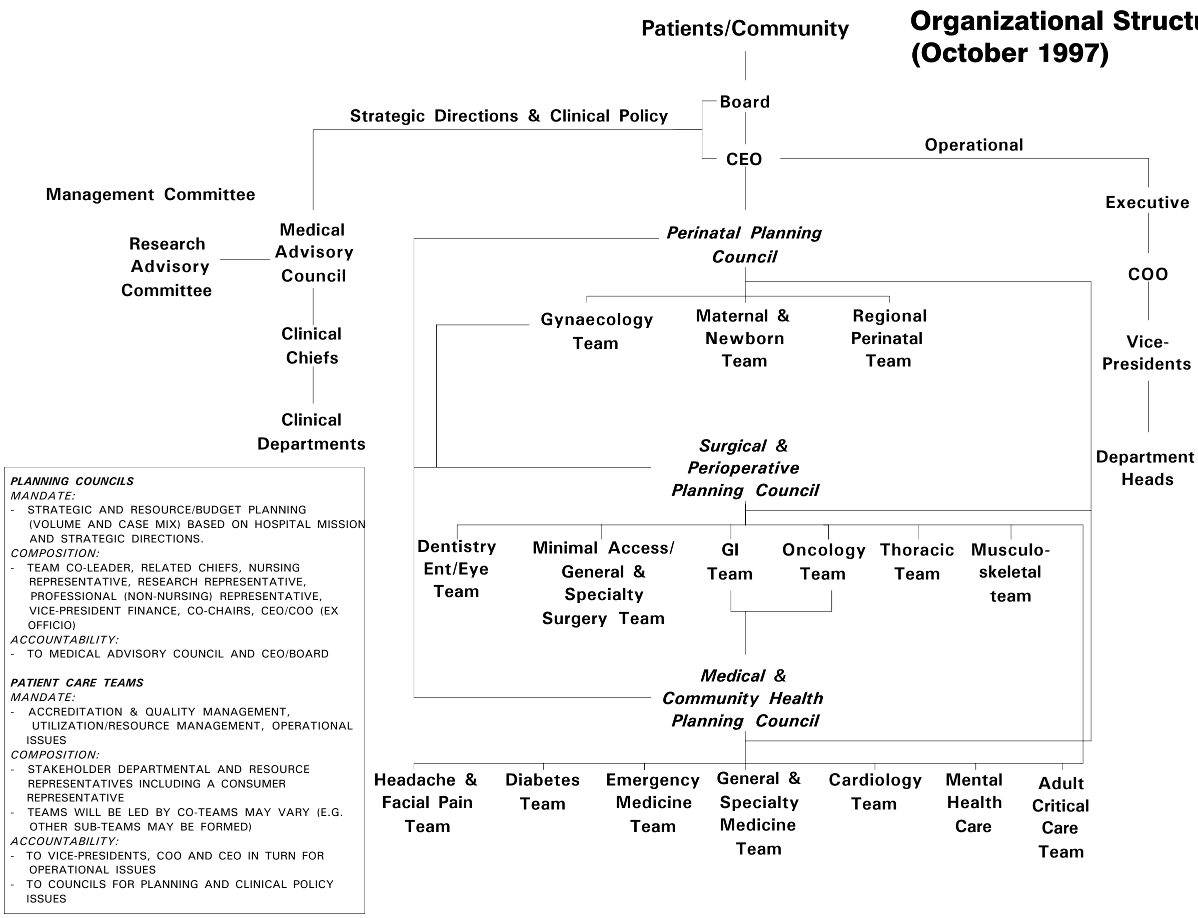
1. Accreditation and quality management. This includes development of quality indicators to enable continuous self-assessment to evaluate specific areas of patient care such as assessment, care and treatment planning, and discharge follow-up.

2. Day-to-day operations. Day-to-day operational issues are addressed using team analysis and resolution to ensure efficient and effective workflow.

3. Resource utilization management. The monitoring of resource use by patients is assigned to each team, and suggesting and implementing processes to improve management of those resources is a team responsibility.

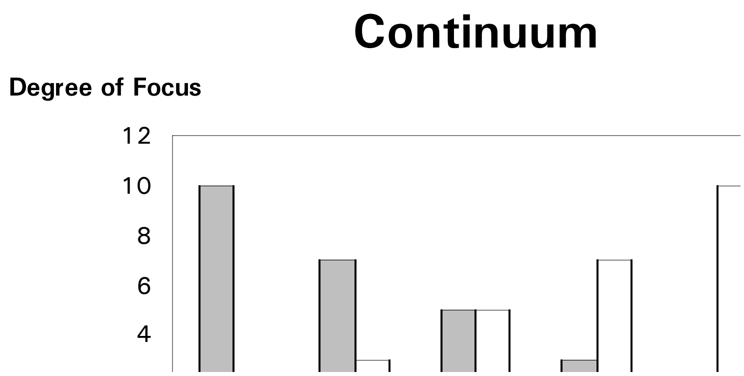
The interaction of teams, councils and departments is outlined in the organizational chart in Figure 1.

Figure 1: Mount Sinai—Organizational Structure (October 1997)



This change in organization structure has had a significant impact on hospital processes for decision making, budgeting and information management including data collection, reporting and use. Rather than an absolute shift as a result of the change in structure, these processes have moved, and continue to move, along a continuum from a *department* focus to a *patient* focus. Each of these processes changes at its own rate and some are further along the continuum than others. The extreme points on this continuum are described for some specific processes in Figure 2. Almost all decision-making, budgeting and information management processes within the hospital can be described in terms of their progress along this continuum.

Figure 2: Hospital Processes—Department verses Patient Focus



Hospital Processes	Department Focus →	Patient Focus
WORKLOAD MEASUREMENT	* workload measured retrospectively by department function	* workload measured and tracked to individual patient activity and episodes of care
MONITORING	* retrospective monitoring of resource use	* concurrent monitoring of resource use
CHARTING	* charting often retrospective, incomplete, low level of specificity	* concurrent charting complete with high level of specificity
BUDGETING	* budgets based on historical departmental data and departmental projections	* budgets based on projected case mix, volume, complexity and funding potential
DECISION MAKING	* isolated decision making * limited impact analysis	* team decision making, multi-disciplinary * impact on resources and quality of care accurately determined
PATIENT ASSIGNMENT TO TEAMS	* assignment of patients to teams retrospectively	* assignment of patients to teams at registration

MOVING TOWARD PATIENT FOCUSED PROCESSES

To move continually along this continuum as an organization, many changes were necessary. A significant step away from the department focus was to move accountability for utilization/resource management to patient care teams. This part of the teams' mandate was undertaken simultaneously and in conjunction with quality improvement in patient care. The goal was to provide teams with the tools they needed to move forward with their mandate. The challenge was to provide information so that decisions could be made without data overload. To begin the process of utilization management, teams needed information on their *specific patient population* including volumes, case mix, practice patterns and length of stay. By combining these CIHI data elements with patient specific costing, a "tool kit" of information was provided to teams to focus their efforts and support their decision-making process.

CLARIFYING GUIDELINES FOR ASSIGNING PATIENTS TO TEAMS

The first step in providing this information involved establishing criteria for assigning patients to teams. To accomplish this, data managers in Health Records Services were asked to sort cases into one of the teams named on the organizational chart using CIHI data. Using one month of data, a process was outlined for establishing criteria that would be used to assign patients to teams. This step generated a series of questions for the teams and councils which would help to more accurately describe the patient population.

Each team was led through a series of questions by the data managers. Sample questions for the Oncology team are outlined in Figure 3. To assist the teams in deciding patient groupings, many data elements in the CIHI abstract were used. Of key importance were not only Major Clinical Categories (MCC) and Case Mix Groups (CMG) but more specifically diagnosis codes, diagnosis types, procedure codes, doctor service and patient service. The rationale for using data at a more specific level than CMG for the assignment of cases to patient groupings is illustrated with the oncology team. Although there are some CMG which relate specifically to oncology, many CMG include cases with both oncology and non-oncology cases. Using CMG only would have assigned many oncology cases to other care teams.

Sample questions posed to our oncology team to clarify What is an oncology patient?

- Do we include patients with malignant neoplasms only or should neoplasms that are benign, in situ or of uncertain behaviour be included?
- Do we include patients with an oncology workup for breast or sarcoma, regardless of the outcome?
- Do we include patients who return to the hospital with complications of chemotherapy or radiation therapy such as febrile neutropenia? how do we determine this from the documentation?
- Since the oncology team is part of the Surgical Council, is both medical and surgical oncology included?
- How do we distinguish between medical and surgical oncology?
- Is thoracic surgery for malignancies included in the oncology team or the thoracic team?

Figure 3: Sample Questions to Clarify Oncology Patient

Currently each patient episode is assigned to **one team only,** even though several teams may have been involved with the care of the patient. In the future, with the development of the costing system, specific portions of the episode of care will be assigned to the appropriate team. For example, currently there are no patients assigned specifically to the Adult Critical Care Team because, using the criteria, they have all been assigned to one of the other medical or surgical teams. As the information management process moves along the continuum toward the patient focus, information will be collected in such a way as to isolate the resources used during the critical care portion of a visit from those used on the other nursing units.

Discussions were held with the teams including both administrative and clinical team members to confirm data elements used for team assignment. It was necessary to ensure agreement on the definition of the patient population being assigned to the team. Without this agreement at the beginning of the process, teams would have resented being held accountable for patients for whom they did not control resources. Once agreement was reached, team members took responsibility for addressing areas where the data highlighted variances.

SETTING UTILIZATION TARGETS

Goals for Length of Stay

After patients were sorted into teams, the teams began setting utilization targets. Length of stay review was the initial focus. Teams needed information that would help them highlight **specific groups of patients** for whom length of stay could be shortened. All teams were provided with data that sorted patients by assigned team, CMG, and typical and atypical groups (with the CIHI database length of stay displayed). The Mount Sinai Hospital length of stay for typical cases was compared to the CIHI ALOS and patient groups were highlighted where it appeared that a significant number of patient days could potentially be saved. The following formula was used to target those CMG with a high potential for days saved.

$$\sum_{i=1}^{999}\left(MSH\ ALOS_{CMGi} - CIHI\ ALOS_{CMGi}\right) \times typical\ cases = potential\ days\ saved$$

As a result, 40 CMG were targeted for possible length of stay reduction. Teams were provided with computerized case summaries of each individual patient in the targeted CMG (Figure 4 shows a sample).

Figure 4: GI Team—Inpatients—Case Summary (Apr. 1 to Apr. 30, 1996)

msh no.	Age	Res	alc los	act los	CIHI LOS	Plx□ LOS	md #	Diag type	Diag code	Diagnosis	Pr md	Proc code	Procedure	Disc unit	MOH Q	MOH RIW□	Plx□ RIW□	Plx□ CMG□	Plx□ Lev
1234	29	scrar	2	11	16.3	10.9	xx	MO	5556	univ ulcer colitis, chro	xx	4622	continent ileostomy	14S	2	3.7425	3.0532	251	1
								AD	5569	ulc colitis, unspec		485	abd-perineal rect resect'n						
								PR	v552	att'n to ileostomy									
5678	68	etob	0	12	16.3	13.5	xx	MO	7872	dysphagia	xx	4632	percutan jejunostomy	16N	2	3.7425	3.1562	251	1
								PR	438	late eff cerebrovasc dis									
								PR	7843	aphasia									
								PR	9993	inf'n compl'n care nec									
								SE	6823	cellulitis of arm									
								SE	4111	staph aureus inf'n									
								E	e8798	abn rxn-procedure nec									
								AD	436	CVA									

Key to Column Titles

msh no.	hospital chart number	**Diagnosis**	diagnosis description
Age	patient's age	**Pr md**	procedural doctor
Res	patient's residence description	**Proc Code**	procedure code (ICD-9-CM)
alc los	days awaiting placement (alternative level of care)	**Procedure**	procedure description
Act los	acute hospital length of stay	**Disc unit**	nursing unit patient discharged from
CIHI ALOS	CIHI database length of stay for CMG	**MOH Q**	Ontario Ministry of Health LOS quartile
Plx□ LOS	complexity expected length of stay	**MOH RIW□**	Ontario Ministry of Health resource weight
md #	most responsible doctor identification number	**Plx□ RIW□**	complexity resource intensity weight
Diag type	diagnosis type (defined by CIHI)	**Plx□ CMG□**	complexity CMG
Diag code	diagnosis code (ICD-9-CM)	**Plx□ Lev**	complexity level

Standard pieces of information in the summary included the most responsible diagnosis, complications and co-morbid conditions, procedures, date of surgery, physicians involved in the case, age of patient, acute LOS, CIHI ALOS, Alternate Level of Care (ALC) days and residence code. Additional pieces of information were added on request for specific teams. Using this summary, team members could quickly highlight factors that seemed to account for the longer length of stay. The information helped to focus the team's attention on specific issues to address, rather than wading through stacks of charts looking for patterns.

Examples of changes implemented as a result of team review of this basic information include:

ð improvement of the process for admission of elective surgical patients on the day of surgery;

ð reduction of ALC days by changes in the discharge planning process;

ð identification of 'flags' for specific patients to identify potential problems in advance; and

ð heightened awareness by all team members of their impact on utilization management and cooperative effort toward the utilization goals.

Shifting from Inpatient to Ambulatory Care

In conjunction with the goals for reducing length of stay, many teams began to ask for data that would help them determine whether patients who had an inpatient stay should have been treated in an ambulatory setting. Reports were prepared that highlighted any case in a CMG flagged as May Not Require Hospitalization (MNRH) and any elective admission that stayed less than 48 hours. Case summaries were prepared for these as well. This process resulted in improvements in the registration process, better utilization of the pre-admission unit, and a reduction of MNRH cases from 9% of discharges to less than 4%. Hospital staff in the areas of patient registration, booking and pre-admission were educated on possible MNRH cases and a process was put in place to follow-up with physicians who booked possible MNRH cases as inpatients. Doctors were asked to identify the clinical condition of the patient that made an overnight stay more appropriate than ambulatory treatment. Physicians were encouraged to document these conditions on the booking form as well as the hospital chart. This documentation would eliminate delays in booking their patients. This also highlighted the important link between complete documentation and data quality.

IDENTIFYING BEST PRACTICE HOSPITALS

As the teams moved along the continuum, they began to focus on establishing benchmarks and best practice guidelines for their patient group. Using the Comparative Hospital Activity Program (CHAP) reports, names of hospitals with the best results for length of stay and ambulatory surgery by procedure were highlighted and communicated to teams. Some teams chose to contact their counterparts at these hospitals to investigate their processes to see if these could be implemented at Mount Sinai Hospital.

DEVELOPING A STANDARD REPORT PACKAGE

It became clear during the process that much of the same information was of interest to all teams. The common information required by each team is summarized in Figure 5. The identification of these common data elements resulted in development of a set of standard reports which was made available to teams and councils on a routine basis. These reports provided a snapshot of how well the team had performed in the most recent time period. The Standard Report Package is listed in Figure 6. In keeping with the quality improvement philosophy at Mount Sinai Hospital, these reports and the utilization targets are reviewed and refined on an ongoing basis as processes are investigated.

Figure 5: Common Information Required by Teams

Common Information Required by Teams	Data Elements / Calculations		Discussion
• volumes of cases by CMG • typical / atypical split • length of stay performance	**typical cases** **atypical cases** **total cases**	total # by CMG; average LOS for MSH; CIHI ALOS; total weighted cases total # by CMG total # by CMG; average LOS for MSH total weighted cases	These three pieces of information require analysis and presentation together since they impact each other. The report is presented as a matrix with CMGs listed down the left side. Volume and LOS information is then presented for typical, atypical and total groups across the top. This provides the team with a snapshot of their performance in these categories for the time period. When presented for consecutive quarters, trends in volumes, case mix, length of stay and practice patterns become useful indicators.
• % admissions on day of surgery	total elective inpatient admissions with admission date equal to surgery date divided by the total elective inpatient admissions with surgery		High percentages of same day admission and ambulatory surgery may be indicators of efficient performance and patient-focused care. Individual physician practice often changes with regular feedback and reporting on these indicators for an accepted peer group.
• % ambulatory surgery	total day surgery cases divided by the total elective inpatient admissions with surgery plus total day surgery visits (including cystoscopy and endoscopy)		
• % pre-admission work-up	total patients with a pre-admission work-up divided by the total elective inpatient admissions with surgery plus total day surgery visits		The percentage of elective patients who have a preadmission work-up. This information is collected in a number of categories including work-up outside of Mount Sinai Hospital, diagnostic work-up only and diagnostic work-up with a visit to the preadmission unit at MSH. Effective use of the preadmission unit can reduce inpatient costs and length of stay.
• average case weight (or case mix index) • weighted case load • average cost per case • average cost per weighted case	$\bar{x}$ case weight = ä ocw · ä cases weighted caseload = ä ocw $\bar{x}$ cost per case = ä cost · ä cases $\bar{x}$ cost per weighted case = ä cost · ä ocw		As with volume, LOS and case mix review, weighted caseload and cost also require analysis and presentation together since they impact each other. Here again reports are presented as a matrix with CMGs listed down the left side. Average case weights, total weighted caseloads and average cost per case are presented for typical, atypical and total groups.
• direct vs. indirect costs	Actual direct cost; actual indirect cost; actual total cost Direct costs are patient specific costs allocated from direct patient care departments such as laboratory, diagnostic imaging, nursing & pharmacy. Indirect costs are allocated across the entire patient population and include costs of support departments such as administration, finance, human resources and health records.		This information allows teams to focus on direct costs, since teams can have the most impact on these costs specifically.
• variance from funding potential based on OCW	Actual cost minus potential funding Funding potential = ocw x hospital-specific cost per weighted case assigned by Ministry of Health		The Ministry of Health in Ontario has calculated a hospital specific funding amount for one weighted case. This is based on a variety of variables including the level of care, teaching activity and age of patients. By determining the variance between the actual cost of a case and the potential funding, teams can investigate possible utilization questions.

To maximize the use of information, each team identified one individual as a utilization liaison who would be responsible for initial data review and presentation of information to the team. To enhance data analysis and use, reports were made available to team utilization liaisons on-line, so that information on specific patient groups within the team could be sorted, graphed and reported in a format customized to the team.

Figure 6: Resource Utilization Management—Standard Report Package

REPORT #	REPORT DESCRIPTION	FREQUENCY	DISTRIBUTION		
			COUNCIL CO-CHAIRS	TEAM CO-LEADERS	UTILIZ-ATION LIAISON
1	Analysis of % Weighted Caseload by Council & Team ▯ Acute Inpatients	Semi-annual	x	x	x
2	Analysis of % Weighted Caseload by Council & Team ▯ Day Surgery	Semi-annual	x	x	x
3	Planning Council Cost Variance Summary by Team by CMG▯ ▯ Acute Inpatient	Semi-annual	x	-	-
4	Clinical Team Cost Variance Summary by CMG▯ ▯ Acute Inpatient	Semi-annual	-	x	x
5	Clinical Team Cost Variance Summary by DPG ▯ Day Surgery	Semi-annual	-	x	x
6	Analysis of Top 25 CMG▯ by Team ▯ Inpatients	Semi-annual	-	x	x
7	May Not Require Hospitalization CMG▯	Semi-annual	x	x	x
8	% of Same Day Admit and Pre-admit Work-up by Team	Semi-annual	-	x	x
9	LOS and Critical Care Unit Days for Typical/Atypical Cases by Team	Quarterly	-	x	x
10	Clinical Team Cost Variance (Top 25 CMG▯) ▯ For Planning Council	Semi-annual	x	-	-
11	Clinical Team Cost Variance (Top 25 CMG▯) ▯ For Clinical Team	Semi-annual	-	x	x
12	Clinical Team Feeder Department Costs (Top 25 CMG▯)	Semi-annual	-	x	x
13	Cost Variance By Physician with Typical/ Atypical Split (Top 25 CMG▯)	Monthly	-	-	x
14	Feeder Department Costs by Physician with Typical/Atypical Split (Top 25 CMG▯)	Monthly	-	-	x
15	LOS and Volume by CMG▯	Monthly	-	-	x
16	LOS Variance by CMG▯ (All CMG▯) by Team	Quarterly	-	x	x
17	Cost Variance by Physician (Top 25 CMG▯)	Monthly	-	-	x
18	Feeder Department Costs by Physician (Top 25 CMG▯)	Monthly	-	-	x

ANALYSIS OF COST VARIANCE PER WEIGHTED CASE

Mount Sinai Hospital is fortunate to be part of the Ontario Case Cost Project (OCCP). This provides the opportunity to analyze information from both the Health Records database using CIHI methodologies and tools, as well as information from the Case Costing database. At Mount Sinai Hospital, the CIHI data collected in Health Records, as well as the costing data collected in Decision Support, are accumulated at the *visit specific level by patient.* All data submitted in the abstract to CIHI are transferred to the costing system to be integrated with cost data. The data elements are merged to produce an integrated financial/clinical record for every inpatient, day surgery and emergency visit. In this way, detailed resource utilization management information can be provided at the episode specific patient level and aggregated in a variety of ways.

Costing data linked with case-specific diagnostic and procedural information is a powerful tool for utilization management within health care organizations. Cost variances were calculated for each case by using the case weight to determine the potential funding and then comparing it to actual cost. Variances were summarized at the team and Planning Council levels. From these variance reports, cases were sorted into two categories:

ð Positive variance cases' if the potential funding exceeded the actual total cost of treating the case at Mount Sinai Hospital; and ð Negative variance cases' if the costs were in excess of the potential funding for the case.

This report allows the team to concentrate on those areas of clinical practice which would have the biggest impact on the bottom line.

These variance reports helped teams identify which practices should be benchmarked at Mount Sinai Hospital - "the positive variances." The "negative variances" were investigated using CIHI information together with the costing information to determine if cases within that particular CMG fell into clusters which had not been recognized by the CIHI methodology and that seemed to make a difference in the cost. As a result of this analysis, several areas were identified which highlighted the need for review of the CMG and RIW methodology. One example of this review within a CMG identified a significant difference in the cost of joint replacement surgery between oncology and non-oncology cases. This resulted in a review by CIHI of all cases in the Canadian database in this group, and an additional CMG for Joint Replacement for Malignancy was added in CMG 1995.

USE OF COMPLEXITY DATA

In order to maximize the value of the complexity overlay to the CMG, this information was incorporated into reporting to the teams. To do this, a screen was added to the hospital's abstracting software (Med2020) with eight basic data elements on complexity for each case. These data elements are:

ð Plx CMG;
ð Plx level;
ð Plx expected length of stay (ELOS);
ð database expected length of stay (ELOS) for average age;
ð database average age;
ð Plx RIW category;
ð procedure for Plx CMG; and
ð Plx RIW value.

These pieces of information have been used to produce reports that illustrate the variance of LOS and cost within a CMG based on the level of complexity. This is then compared to the same data without the complexity overlay to illustrate the wide range of differences within one CMG. This varies greatly by team and requires individual team attention.

Figure 7 shows that for 60 cases from the Gastrointestinal team, the ELOS changes greatly after complexity is applied. This information allowed the team to focus utilization efforts for reducing LOS on more clinically similar groups of patients.

Figure 7: Cases—Without Complexity

Current CMG	*Total Cases*	*MSH ALOS*	*Database LOS*
251 Gastrostomy & Colostomy	**60**	**29.5**	**16.3**

Mount Sinai Hospital Cases — With Complexity

Complexity CMG & Level	*Total Cases*	*MSH ALOS*	*Plx Exp LOS*
CMG 251 - Level 1	27	16.5	11.8
CMG 251 - Level 2	10	12.2	15.0
CMG 251 - Level 3	5	52.4	17.7
CMG 251 - Level 4	11	77.9	35.6
Subtotal	***53***	***31.8***	***17.9***
CMG 253 - Level 1	6	12.0	8.3
CMG 253 - Level 2	1	8.0	11.0
Subtotal	***7***	***11.4***	***8.7***
Total	**60**	**29.5**	**16**

Teams were also provided with data which outlined the distribution of cases among the different levels of complexity for the team (see Figure 8). Teams were advised to determine, from their clinical knowledge of the patients, if the **proportion of patients in each level of complexity** appeared appropriate. In many cases the teams were surprised by the high proportion of patients in complexity level 1. They used this information to do a spot check of charts to confirm accurate and complete documentation. In this way, they were able to identify specific areas of concern for incomplete documentation and/or recommended changes in coding practices.

Figure 8: Council/Team Complexity Level Analysis (Apr. 1 to Sept. 30, 1996)

76% of cases in the GI team are in level 1

17% of the 3244 MSH cases in level 1 are in the GI team

Team	Total	Level One			Level Two			Level Three			Level Four		
	Cases	Cases	% Team	% Hosp	Cases	% Team	% Hosp	Cases	% Team	% Hosp	Cases	% Team	% Hosp
Regional Perinatal	1573	3	< 1	< 1	0	0	0	1	< 1	< 1	0	0	0
Maternal / Newborn	3812	0	0	0	0	0	0	0	0	0	0	0	0
Gynaecology	282	189	67	6	22	8	5	1	< 1	< 1	2	< 1	< 1
Perinatal Council	**5667**	**192**	**3**	**6**	**22**	**0**	**5**	**2**	**0**	< 1	**2**	**< 1**	< 1
GI	725	551	76	17	69	10	16	41	6	20	28	4	14
Gen & Spec Surgery	148	75	51	2	9	6	2	7	5	3	3	2	1
Musculoskeletal	433	303	70	9	43	10	10	12	3	6	12	3	6
Thoracic Surgery	130	83	64	3	9	7	2	7	5	3	8	6	4
Minimal Access	88	78	89	2	5	6	1	3	3	1	0	0	0
Oncology	1304	832	64	26	119	9	27	55	4	26	72	6	35
Dental / Eye / ENT	257	93	36	3	3	1	< 1	5	2	2	1	< 1	< 1
Surgical Council	**3085**	**2015**	**65**	**62**	**257**	**8**	**58**	**130**	**4**	**62**	**124**	**4**	**60**
Gen & Spec Med	544	344	63	11	78	14	18	39	7	19	39	7	19
Cardiology	700	580	83	18	64	9	14	27	4	13	16	2	8
Diabetes	31	23	74	< 1	5	16	1	0	0	0	2	6	< 1
Craniofacial Pain	36	4	11	< 1	0	0	0	0	0	0	0	0	0
Family Medicine	126	79	63	2	16	13	4	8	6	4	13	10	6
Palliative Care	2	1	50	< 1	0	0	0	1	50	< 1	0	0	0
Mental Health	179	2	1	< 1	0	0	0	0	0	0	0	0	0
Medical Council	**1618**	**1033**	**64**	**32**	**163**	**10**	**37**	**75**	**5**	**36**	**70**	**4**	**34**
Unassigned	17	4	24	< 1	0	0	0	2	12	< 1	9	53	4
Hospital Total	***10387***	***3244***	***31***		***442***	***4***		***209***	***2***		***205***	***2***	

Level One - no complexity
Level Two - related to chronic conditions
Level Three - related to serious / important conditions
Level Four - related to potentially life-threatening conditions
Level Eight - age adjustment applied only
Level Nine - no complexity or age adjustment (exclusion)

31% of cases in the hospital are at level 1 complexity

Only 4% of hospital cases are at complexity levels 3 & 4

Team	Level Eight			Level Nine			Total
	Cases	% Team	% Hosp	Cases	% Team	% Hosp	Cases
Regional Perinatal	11	< 1	1	1558	99	29	1573
Maternal / Newborn	2	< 1	< 1	3810	100	71	3812
Gynaecology	37	13	4	31	11	< 1	282
Perinatal Council	**50**	**1**	**6**	**5399**	**95**	**100**	**5667**
GI	36	5	4	0	0	0	725
Gen & Spec Surgery	53	36	6	1	1	< 1	148
Musculoskeletal	63	15	7	0	0	0	433
Thoracic Surgery	23	18	3	0	0	0	130
Minimal Access	2	2	< 1	0	0	0	88
Oncology	224	17	25	2	< 1	< 1	1304
Dental / Eye / ENT	155	60	18	0	0	0	257
Surgical Council	**556**	**18**	**63**	**3**	**< 1**	**< 1**	**3085**
Gen & Spec Med	44	8	5	0	0	0	544
Cardiology	11	2	1	2	< 1	< 1	700
Diabetes	1	3	< 1	0	0	0	31
Craniofacial Pain	32	89	4	0	0	0	36
Family Medicine	10	8	1	0	0	0	126
Palliative Care	0	0	0	0	0	0	2
Mental Health	177	99	20	0	0	0	179
Medical Council	**275**	**17**	**31**	**2**	**< 1**	**< 1**	**1618**
Unassigned	2	12	< 1	0	0	0	17
Hospital Total	***883***	***9***		***5404***	***52***		***10387***

Level One - no complexity
Level Two - related to chronic conditions
Level Three - related to serious / important conditions
Level Four - related to potentially life-threatening conditions
Level Eight - age adjustment applied only
Level Nine - no complexity or age adjustment (exclusion)

9% of hospital cases have been adjusted for age only (level 8) and the majority of these are in Oncology, Mental Health & Dental / Eye / ENT teams

The importance of the complexity data will continue to increase as health care organizations are compared at local, regional, provincial and national levels. One of the difficulties with setting benchmarks is the ability to compare like cases. Even with national guidelines for coding and a standard CMG methodology, there are still hospital decisions which have a significant impact on coding practices including the typing of diagnoses which plays a significant role in all of the data. The current CIHI guidelines for assigning diagnosis types state that a "pre-admit co-morbidity" is one which "usually has a significant influence on the patient's length of stay and/or significantly influences the management/treatment of the patient while in hospital." (CIHI, 1994, pp. 31–32). But how does the individual hospital interpret 'significant influence'? Health records coders require team specific guidelines for assigning diagnosis types. This point is illustrated by an example from the Gastrointestinal care team at Mount Sinai. A review of GI cases showed that specific diagnoses were being missed consistently or typed as a secondary diagnosis. Secondary diagnoses are not considered in the complexity methodology because by definition they "did not significantly contribute to the patient's length of stay in the hospital." Many patients in the Inflammatory Bowel Disease program suffer from malnutrition. Since this is such a common co-morbidity for these patients, it was not consistently being recorded on the patient's chart. Sometimes it was captured by the coder as a secondary diagnosis since the coder could not always determine from the chart if the malnutrition significantly affected length of stay or treatment. In discussion with the GI team, guidelines were developed for Mount Sinai Hospital coders (see Table 1).

Table 1: Coding Guidelines for Malnutrition

Diagnosis	Diagnosis Type	Guidelines
Malnutrition	"1" if before surgery "2" if post surgery	• always code if patient is on TPN or TEN at any time during their course of treatment. Use both diagnosis and procedure codes. • if malnutrition is noted as "severe", use codes 261 or 262. • always code if recent weight loss is >10%. • for albumin values <28 g/L review chart for other indicators of malnutrition or contact physician.

This variation by hospital is also true for the costing data. Implementation of the MIS guidelines will not eliminate all hospital-based decisions on allocation of costs such as 'what is included in department costs?' and 'what is included in indirect cost?'. In determining what to include in department costs, consider two hospitals, each with a Diagnostic Imaging Department. One hospital may have an administration cost centre for the department and one hospital may not. For the hospital that does not have the administration cost centre all the administrative costs will be allocated to patients as a direct cost. For the hospital with the administration cost centre, administrative and support costs can be allocated as indirect and removed from direct costs, thereby making the information less comparable.

Standardizing the assignment of direct and indirect costs is also difficult. Consider a hospital that has introduced a multi-skilled worker such as a 'Service Assistant'. This position combines duties previously provided by the departments of housekeeping, portering and food services. This new position now reports to the Department of Nursing. For the hospital with the service assistant, the cost for the position is included in direct costs because the department of nursing is a direct department. For hospitals without this position and operating with the more traditional department divisions, the costs will all be indirect because housekeeping, portering and food service departments are indirect departments.

ISOLATING CASE TYPES FOR DEVELOPMENT OF PATIENT CARE PLANS

CIHI data have been useful in the process of development of patient care plans. Initially the data were used to identify high volume, high cost cases within a CMG with a wide variation in practice patterns among physicians (for example LOS). After a CMG was identified, complexity data were used to define a specific case type within the CMG, for inclusion on the care plan. This data analysis also helped to identify specific co-morbid conditions which may be indicators to exclude the case from the plan or to remove the patient from the plan if one of these conditions develops in hospital. This initial review of the cases within a CMG highlighted variances in complexity and allowed the team to refine the definition of the cases to be considered in development of the patient care plan.

SUMMARY OF RESULTS

The use of case mix data to support utilization management activities has been reviewed in the preceding discussion. To emphasize the usefulness of the data, key results for Mount Sinai Hospital are highlighted here:

1. documentation of specific criteria, developed by the teams to assign all inpatients and day surgery cases to 16 patient care teams;
2. development of a standard report package for utilization management and review for each patient care team;
3. development of an on-line tool which facilitates information review by utilization liaisons for each team;
4. enhanced understanding of the multiple clinical definitions possible for any "program" and an improved ability to assess the feasibility of integration of clinical programs between facilities as a result of in depth knowledge of the mix of patients;
5. facilitated organizational move along the continuum toward preparing clinical budgets for patient care teams and councils;
6. increased organizational motivation to change from episode-specific information to date-specific information, i.e., to adopt a system that not only shows that the patient's stay cost $5,000 but also the distribution of this cost on a day-to-day basis within the stay to highlight resource use for specific areas such as critical care and operating room;
7. improved data quality due to heightened awareness of the importance of timeliness, completeness, accuracy, specificity and relevance;
8. improved coding practices with clinical input and education of coding staff on disease processes within specific patient populations;
9. a heightened awareness and understanding by all team members, of the interaction among patient care, costs, charting, funding and budgeting has improved resource utilization at all levels of the organization; and
10. significant improvement in determining the impact of decisions for all departments and at a hospital-wide level. Before case mix and costing information was available at a patient specific level, it was more difficult to do an impact analysis. For example, decisions about the care and treatment of patients with acute myocardial infarction were appropriately made by the cardiologists and nursing unit where most of these patients were treated. This has not changed, but the additional information has highlighted the significant impact on a variety of other areas including family practice, social work, emergency department, and pharmacy.

RECOMMENDATIONS

As information to support hospital initiatives is improved, some basic guidelines and goals for the Mount Sinai Hospital information service have been identified. These are:

1. Include data collection for as many episodes of care as possible, e.g. inpatient acute care, day surgery, emergency, pre-admission visits, clinic visits, etc. Current mandatory data collection in Ontario includes only inpatient and day surgery episodes. To address the full spectrum of health service and related utilization, data must be collected on all visits.

2. Develop criteria to easily link related episodes of care in the data base and to ensure the ability to report either separately or together. For example, a pre-admission unit visit should link with the related day surgery visit; the emergency visit should link with the related inpatient admission; the mother's visit information should link with that of the newborn.

3. Conduct regular data quality checks between systems and databases. For example, request the same data from two different departments (health records and decision support) and compare the results. Different results may not mean an error, but rather a difference in the interpretation of the request. Data quality checks help both the data user and the information provider. They assist users to improve the quality of the request and to understand the complexity of the data and they develop the skill of the information provider in interpreting the request to ensure the users' needs are met.

4. Develop careful processes and time frames for making changes, updates and corrections. Changes to the criteria for assigning patients to teams need to be documented and authorized by all teams affected. Removing patients from a team also removes resources and costs just as adding patients to a team will add resources and costs. Both teams should have this information available to make an informed decision about whether or not to add or delete patients. Changing criteria mid-year may be suggested as teams become more familiar with the implications of the criteria they have developed for patient assignment.

However, changing it is not recommended because this complicates the ability to compare between time periods and to identify trends.

5. Ensure that data being compared are run on the same CMG year. Mount Sinai Hospital has a policy to maintain the last full fiscal year as well as the current year using the most recent CMG methodology. Documenting the CMG year on all reports is also encouraged as previous reports are often compared with current reports and can create confusion for the user if this is not clear.

6. Inform teams regularly on significant changes to CMG and RIW methodology and coding practices.

7. Provide users with a 'Glossary of Terms' which explains all available data elements which appear on reports.

8. Minimize the time delay between the patient's stay in the hospital and the availability of data related to that stay.

9. Educate! Educate! Educate! There are few things that can be stated without question when it comes to information management, but one thing is certain, there can never be too many education sessions for users. The more information sessions are provided for users, the more the data will be used and the better the data quality. Mount Sinai Hospital has developed a series of education modules that cover many different topics at a variety of levels, including coding practice and diagnosis typing, the impact of documentation, CMG and RIW methodology, Case Costing methodology, report interpretation and analysis, and funding methodologies.

The Mount Sinai Hospital experience in using the CIHI data for decision making has been successful. The hospital continues to improve information processes due to increased and varying demands as it moves away from the department focus. Users are shifting their focus from the vast amount of information that is not yet available towards using and improving the vast amount of information that is available.

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DEBORAH NOWICKI, DIANE FRENCH, KATHERINE CHOPTAIN

Utilization Management at St. Boniface General Hospital, Winnipeg, Manitoba

CHAPTER OVERVIEW

St. Boniface General Hospital (SBGH) is a 603-bed teaching hospital and is a nationally recognized centre of excellence in patient care, education and research, under the ownership and guidance of the Grey Nuns. Located in Winnipeg, Manitoba, the hospital offers a comprehensive range of outpatient, outreach and inpatient services at all levels, including primary, secondary and tertiary care.

In the fall of 1991, SBGH developed the Utilization Management (UM) program, a central component of the Total Quality Management initiative within the hospital. The formation of this program was timely, given the provincial government's health reform protocol announced in May 1992 which focused on strategies to assure the future of Manitoba's health services system within decreased funding from the Federal Government. The mandate of the UM program is to provide administrative and clinical staff with access to information to aid in evaluating the appropriateness, effectiveness, and efficiency of health care delivery at SBGH.

To achieve the objectives of the program, information from various hospital databases is merged, extracted and presented to clinical team leaders at routine meetings. Length of stay (LOS) data, a primary indicator of hospital utilization, are regularly reviewed. For this purpose, data from Canadian Institute for Health Information (CIHI) reports are provided by CMG and doctor service. LOS data by CMG are particularly useful since team leaders are able to compare their performance with both the CIHI database and select peer groups. When LOS appears higher at SBGH, questions are raised and explanations regarding practice patterns and patient characteristics are sought. Evaluation of this type ensures the continuous monitoring of health care delivery within the hospital. Further, CIHI's introduction of the complexity overlay and age-adjustment enhancement will provide more precise information by which to define the patient population within SBGH and peer group facilities.

In addition to inpatient reports, DPG data are regularly presented to surgical department heads. The inpatient/outpatient comparison by doctor service identifies short-stay inpatients and illustrates the potential transfer of these patients to day surgery procedures. Continued effort to reduce LOS in Surgery is also measured by examining the percent of elective patients admitted on the same day of their surgical procedure.

With the availability of CIHI data, the UM program at SBGH is able to provide precise and timely information to clinicians, the service providers ultimately responsible for the efficient delivery of health care services to patients.

INTRODUCTION

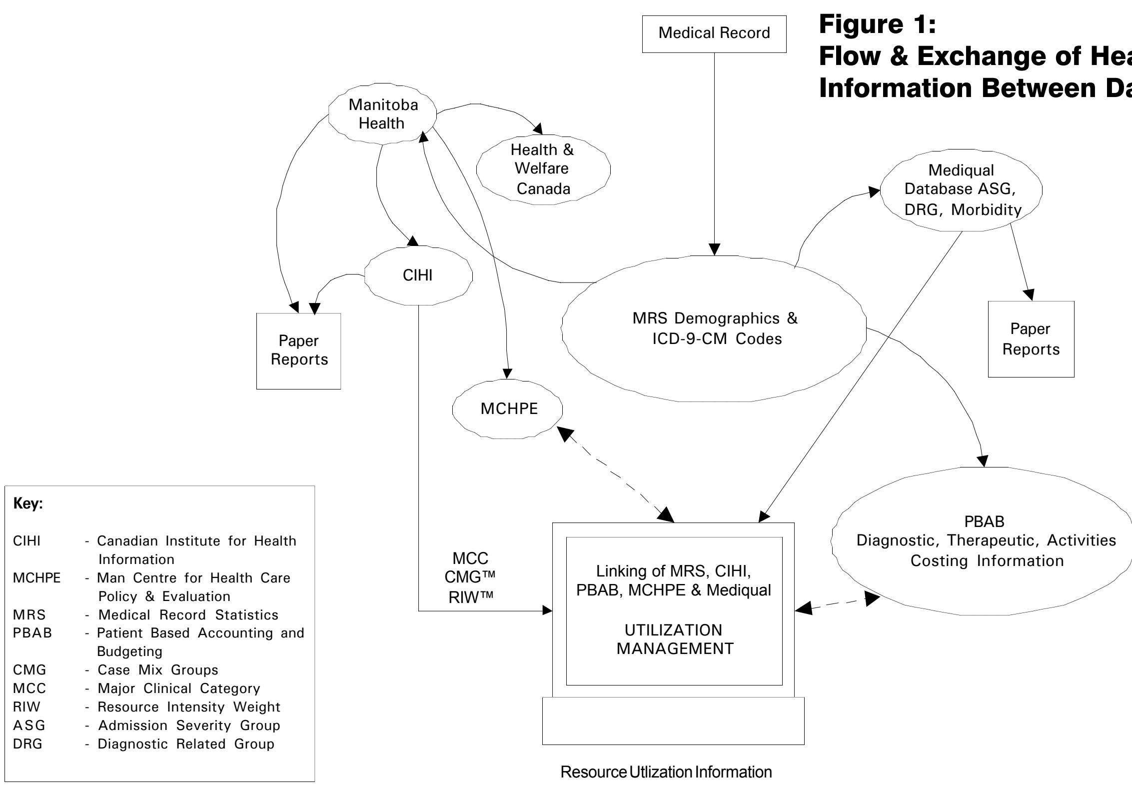
In March 1990, St. Boniface General Hospital undertook a voluntary and ongoing partnership with the Canadian Institute for Health Information (CIHI) as part of its endeavor to establish a comprehensive health care information system within the hospital. This partnership is in addition to fulfilling the mandatory requirement for submission of hospital information to the provincial Ministry of Health (i.e. Manitoba Health). Shortly afterwards, St. Boniface introduced its Utilization Management Program. The objectives of this chapter are: 1) to describe the Utilization Management Program and 2) to describe for client hospitals, the role of CIHI within this program. For purposes of illustration, length of stay data are presented for the Departments of Obstetrics and Surgery. Strengths and limitations of CIHI data are discussed.

UTILIZATION MANAGEMENT PROGRAM

St. Boniface General Hospital (SBGH) is a 603-bed teaching hospital affiliated with the University of Manitoba, and is a nationally recognized centre of excellence in patient care, education and research, under the ownership and guidance of the Grey Nuns of Manitoba (St. Boniface General Hospital, 1995). Located in Winnipeg, the hospital serves the City of Winnipeg, Province of Manitoba and the Northwestern Region of Ontario. A comprehensive range of outreach, outpatient and inpatient services at all levels, including primary, secondary and tertiary care is provided.

During the fall of 1991, the Utilization Management Program was developed, a central component of the total quality management initiative within the hospital. The formation of this program was timely, given the provincial government's health reform protocol, announced in May 1992, which focused on strategies to assure the future of Manitoba's health services system with decreased funding from the federal government (Manitoba Health, 1992). The mandate of the Utilization Management Program is to provide clinical and administrative staff with access to information to aid in evaluating the appropriateness, effectiveness, and efficiency of health care delivery. To achieve these objectives, SBGH maintains a health care information system comprising several databases (see Figure 1). Using medical record statistics (MRS) which comprise all inpatient and day-care encounters as the primary source of information, CIHI (inpatient and day-care encounters), MediQual (inpatient encounters) and Patient-Based Accounting and Budgeting (inpatient and day-care encounters) databases have been established. Each of these databases may be utilized individually or linked by common data elements to provide accurate and comprehensive health care information for patients at SBGH.

Figure 1: Flow & Exchange of Health Information Between Data Bases



On a monthly basis, SBGH submits one hundred percent of its monthly discharges to CIHI. Case mix groups (CMG) and Resource Intensity Weights (RIW) are assigned to each inpatient record. Day-care records are grouped into Day Procedure Groups (DPG) and DPG weights are assigned accordingly. CIHI returns CMG-grouped data on diskette. In addition, reports describing inpatient and day-care utilization are distributed to the hospital. Similarly, reports presenting hospital comparisons are included for client peer-group hospitals.

MedisGroups, a Severity of Illness grouping system and product of MediQual Systems Inc., was implemented at SBGH in October 1991. In addition to demographic data and ICD-9-CM diagnosis and procedure codes, MediQual (MQ) uses Key Clinical Findings abstracted from the medical record. A computer algorithm subsequently assigns the patient's severity of illness upon admission, as measured by the probability of death (Steen et al., 1993). With the exception of obstetrics, newborns and neonates, psychiatry and palliative care, all remaining inpatient discharges are included within the MQ system (approximately 55% of 22,000 annual inpatient discharges).

Most recently, the Patient-Based Accounting and Budgeting (PBAB) database was developed to provide accurate cost data for SBGH patients. Information from clinical databases (e.g. radiology, pharmacy, laboratory, physiotherapy) is integrated with data elements from the MRS database. By linking patient-specific activity of treatment, this system calculates and assigns the cost of treatment per individual patient, whether patient groups are defined by diagnosis group, CMG or other criteria.

Currently, the Utilization Management Program includes three utilization analysts with training in nursing and health records administration. Each analyst is responsible for data abstraction (e.g. MQ—Key Clinical Findings), analysis, presentation and interpretation of health care data. A data entry clerk supports the MQ System. Further assistance is provided by an advisory group comprising three individuals with training in epidemiology, computer programming, mathematics and health records analysis. Overall, the Utilization Management Program is managed by the Director of Medical Information Services. Meetings are routinely scheduled with clinical staff and administrators to review health care data. Since its inception, more than 200 meetings have taken place and many clinical staff have adopted a leadership role, identifying information to monitor resource utilization within their department. In the near future, the health care information system will be available on-line so that clinical team leaders and hospital administrators will have immediate access to hospital data to facilitate utilization review.

LENGTH OF STAY

In Manitoba, hospital efficiency has been examined by comparing length of stay (LOS) across urban hospitals after adjusting for patient characteristics (e.g. age, case-complexity, income level, Treaty Indian status) (Brownell and Roos, 1995). This study estimated the potential for substantial savings, as measured in patient days and hospital beds, if study hospitals were to adopt similar LOS practices as those reported at the shortest-stay facility. At SBGH, LOS practices are similarly reviewed. For this purpose, utilization analysts regularly review various CIHI reports, such as Length of Stay, RIW and Comparison of Hospital Activity Program (CHAP) reports, and present LOS data by CMG and doctor service to clinical team leaders. CIHI data are particularly useful since hospital-specific LOS may be compared with the LOS of the CIHI database or select peer-group hospitals while controlling for the case-mix of the patient population. With the availability of these data, performance relative to the reference may be assessed and LOS benchmarks may be considered as practice targets. Most importantly, the availability of comparative data facilitates utilization review by generating questions and plausible explanations to explain variation in LOS (e.g. practice patterns, patient characteristics).

In the following sections, data from the Departments of Obstetrics and Surgery are presented to illustrate the use of CIHI case-mix tools in the management of LOS. While not exhaustive, these examples demonstrate how utilization analysts report and interpret CIHI data.

Obstetrics

At SBGH, the Department of Obstetrics and Newborns accounts for the largest segment of inpatient activity (approximately 45% of annual inpatient discharges and 18% of inpatient days). Therefore, any consistent reduction in LOS will serve to improve overall hospital efficiency. Table 1 reports the number of deliveries and average length of stay (ALOS) by case mix group for fiscal year 1995/1996. The higher volume CMG include CMG 611 (Vaginal Delivery, no VBAC, no CC) and CMG 609 (Vaginal Delivery, no VBAC, with CC) accounting for 54.1% and 22.3% of deliveries respectively. Overall, Cesarean sections (C/S) were performed in 17.4% of cases[1].

[1] The percent of Cesarean sections is based on the total number of cases for corresponding case mix groups divided by the total number of deliveries (e.g. 657/3770).

Table 1: Number of Deliveries and Average Length of Stay (days) by Case Mix Group, Department of Obstetrics, St. Boniface General Hospital, April 1, 1995 to March 31, 1996

CMG (1)	No. Total Cases (%) (2)	ALOS [1] (3)	No. Typical Cases (%) [2] (4)	Typical ALOS (5)	CIHI ALOS [3] (6)
600 - Major Proc. in Childbirth	3 (0.1)	10.0	0 (0)	-	-
601 - Repeat C/S, with CC	79 (2.1)	9.1	61 (77.2)	5.0	4.8
602 - C/S, with CC	199 (5.3)	7.8	171 (85.9)	6.0	5.6
603 - Repeat C/S, no CC	173 (4.6)	4.2	168 (97.1)	4.1	4.3
604 - C/S, no CC	206 (5.5)	4.9	188 (91.3)	4.6	4.7
605 - Fetal Surgery	1 (0.0)	3.0	1 (100.0)	3.0	2.1
606 - Vaginal Delivery with Sterilization	43 (1.1)	4.3	41 (95.3)	4.1	3.4
607 - Vaginal Delivery with Minor Procedure	17 (0.5)	5.0	15 (88.2)	4.1	3.2
608 - VBAC, with CC	55 (1.5)	4.5	48 (87.3)	3.5	3.1
609 - Vaginal Delivery, no VBAC, with CC	839 (22.3)	4.1	738 (88.0)	3.5	3.2
610 - VBAC, no CC	114 (3.0)	2.7	107 (93.9)	2.6	2.4
611 - Vaginal Delivery, no VBAC, no CC	2041 (54.1)	2.6	1958 (95.9)	2.5	2.4
TOTAL	**3770 (100)**	**3.6**	**3496 (92.7)**	**3.2**	**3.0**

[1] ALOS is average length of stay.
[2] For each CMG, the percent of typical cases is calculated as the number of typical cases (column 4) divided by the total number of cases (column 2) multiplied by 100.
[3] CIHI ALOS is average length of stay of typical cases discharged from Canadian teaching hospitals (peer group 5) that are CIHI client hospitals.

Source: CIHI Reports, Length of Stay and Resource Intensity Weights, April 1, 1995 to March 31, 1996.

To compare LOS with the CIHI database, typical cases are reviewed. These cases represent the completion of a full course of inpatient treatment. Deaths, sign-outs, transfers and outliers are excluded. As shown in Table 1, typical ALOS ranges from 2.5 days for CMG 611 (Vaginal Delivery, no VBAC, no CC) to 6.0 days for CMG 602 (C/S with CC). With the exception of two case mix groups, CMG 603 (Repeat C/S, no CC) and CMG 604 (C/S, no CC), the remaining groups demonstrate lengths of stay longer than would be expected, although average length of stay is based on a small number of typical cases for CMG 605 (Fetal Surgery) and CMG 607 (Vaginal Delivery with Minor Procedure). For CMG 609 (Vaginal Delivery, no VBAC, with CC), ALOS is 3.5 days while CIHI ALOS is 3.2 days. Upon initial inspection, this difference of 0.3 days suggests that patients at SBGH remained in hospital 9% longer than expected (i.e. observed/expected ALOS). In other words, an additional 221 days were required to care for patients within CMG 609. Before such findings are substantiated, however, several factors require consideration. First, is a difference of 0.3 days statistically significant? If so, is this difference clinically meaningful? CIHI does not report accompanying statistics such as the standard deviation. Without information describing the variability of LOS, these questions cannot be addressed. Second, supplementary information is required that describes the clinical and demographic characteristics of the patient population, since differences among patient groups, hospital-specific characteristics, provincial geography and health services systems might explain variation in LOS. In Manitoba, for example, the province is characterized by a distinct urban/rural dichotomy with a concentration of residents in the City of Winnipeg. Women flown in from remote Northern communities to receive obstetrical care at SBGH might be expected to remain in hospital slightly longer than their Winnipeg counterparts.

CIHI does not report comprehensive demographic data; however, information describing the age distribution of SBGH patients and of those within the CIHI database or select peer group hospital is available within the CHAP 2 report. Likewise, utilization analysts may consult the CHAP 1 report for information describing the atypical case load by CMG. A higher percentage of atypical patients relative to the CIHI database might indicate differences in patient characteristics despite case-mix adjustment. Lastly, CIHI data for SBGH may be integrated with MRS data (see Figure 1) to identify other important information such as co-existing disease (e.g. diabetes), parity, aboriginal status and region of residence. Plausible explanations for higher length of stay practices may then be inferred.

After reviewing the spectrum of obstetrical CMG (for deliveries), individual CMG are presented and LOS performance is reviewed relative to peer group facilities. In Table 2, the number of cases and ALOS for CMG 602 (Cesarean Delivery with Complicating Diagnosis) is reported for selected teaching hospitals. Referring to the provincial ALOS, SBGH appears to discharge patients more efficiently, with a typical ALOS of 6.0 days (0.3 days less than the provincial average). When compared to the CIHI database average of 5.6 days, SBGH appears to discharge their patients less efficiently than would be expected (0.4 days above the CIHI average). When reporting these values, however, utilization analysts describe the composition of hospitals upon which the provincial and CIHI ALOS values have been computed. The provincial average length of stay, for example, is based upon data reported by acute-care facilities that submit discharge abstracts to CIHI (regardless of peer group status). In Manitoba, current CIHI hospitals include two teaching and five community hospitals located within the City of Winnipeg. With respect to the CIHI database, teaching hospitals across Canada are included. Given the population density and complete CIHI participation rate in several provinces (CIHI, 1994b), CIHI ALOS is likely influenced by data submitted from provinces such as Ontario, Alberta and British Columbia.

Table 2: CMG 602—Cesarean Delivery with Complicating Diagnosis: Number of Cases and Average Length of Stay (days) by Peer Group Facility, April 1, 1995 to March 31, 1996

Hospital (1)	No. Total Cases (2)	ALOS [1] (3)	No. Typical Cases (%) [2] (4)	Typical ALOS (5)	Prov. ALOS [3] (6)	CIHI ALOS [4] (7)
Atlantic						
Hospital A	357	9.2	285 (79.8)	5.5	6.5	5.6
Ontario						
Hospital B	208	7.8	126 (60.6)	5.5	5.6	5.6
Hospital C	377	8.0	275 (72.9)	5.7	5.6	5.6
Hospital D	174	7.0	138 (79.3)	5.5	5.6	5.6
Hospital E	332	8.4	233 (70.2)	5.5	5.6	5.6
Prairies						
St. Boniface	199	7.8	171 (85.9)	6.0	6.3	5.6
Hospital G	269	7.7	204 (75.8)	5.8	6.3	5.6
Hospital H	251	7.9	206 (82.1)	6.4	6.2	5.6
Hospital I	391	5.5	353 (90.3)	4.0	5.0	5.6
British Columbia						
Hospital J	696	8.9	575 (82.6)	5.4	5.5	5.6

[1] ALOS is average length of stay.
[2] For each CMG, the percent of typical cases is calculated as the number of typical cases (column 4) divided by the total number of cases (column 2) multiplied by 100.
[3] Provincial ALOS is average length of stay of typical cases discharged from provincial acute-care hospitals that are CIHI client hospitals.
[4] CIHI ALOS is average length of stay of typical cases discharged from Canadian teaching hospitals (peer group 5) that are CIHI client hospitals.

Source: CIHI CHAP 1 Report: CMG 602, April 1, 1995 to March 31, 1996.

To consider "best practice" benchmarks, the relative placement of SBGH among select hospitals may be examined by calculating and ordering the number of days below and above the CIHI database. Referring to the data presented in Table 2, Hospital I would be ranked first, reporting the best performance, with a typical ALOS of 4.0 days (1.6 days or 29% below the CIHI average), while Hospital H would rank last, with a typical ALOS of 6.4 days (0.8 days or 14% above the CIHI average). SBGH (0.4 days or 7% above the CIHI average) would rank just ahead of Hospital H and behind Hospital G[2]. Given the LOS performance at Hospital I, clinical team leaders may review their practice to determine whether a benchmark practice of 4.0 days for CMG 602 is feasible, or whether the CIHI database average is a more realistic target given the patient population at SBGH and other related factors.

[2] The relative placement of SBGH is based on the teaching hospitals selected for comparison as outlined in Table 2. Relative positioning would likely vary if each of the teaching hospitals participating with CIHI were included for review.

Surgery

Working collaboratively with the University of Manitoba and Health Sciences Centre, hospital administrators recently appointed one clinical leader (a surgeon) to manage the Departments of Surgery at each of the teaching hospitals. To provide an overall review of the surgical services and for consistency in reporting between the two hospitals, utilization analysts report LOS by doctor service for each institution. Table 3 presents the number of cases, average length of stay, and days over/under the CIHI database average for surgical services at each of the Winnipeg teaching hospitals for fiscal year 1995/96. Because case-mix groups may vary within doctor services, it is not appropriate to directly compare typical ALOS at each hospital. Instead, a case mix adjusted comparison of LOS variation is more appropriate, as reported in column 8. LOS practices are similar for urology, orthopedic, plastic and ENT surgery, with both hospitals reporting ALOS below the CIHI database average. For general surgery, patients at Hospital A are discharged more quickly than at Hospital B. Each of the remaining services demonstrates better than expected LOS relative to the CIHI average. In most instances, however, LOS differences between hospitals exceed 1 day, perhaps indicating differences in discharge efficiency. Although additional information describing clinical, demographic and hospital-specific information is required before drawing such a conclusion, the data presented in Table 3 provide an overall review of surgical services and may serve to generate questions and direct resources for further study. Also included in Table 3 (column 4) is the percent of elective cases receiving surgical services on the same day as admission. This indicator is particularly useful when identifying opportunities to reduce pre-operative LOS.

Table 3. Number of Cases and Average Length of Stay (days) by Doctor Service, Department of Surgery, Winnipeg Teaching Hospitals, April 1, 1995 to March 31, 1996

Doctor Service (1)	No. Total Cases (2)	No. Elective Cases (3)	% Elect. Op. on Admit Day (4)	No. Typical Cases (%) (5)	Typical ALOS [1] (6)	DB ALOS [2] (7)	Days Over/ Under DB (8)
General Surgery							
Hospital A	1790	910	64	1573 (87.9)	5.4	5.6	-0.2
Hospital B	2176	802	88	1712 (78.7)	5.7	5.4	+0.3
Cardiac Surgery							
Hospital A	640	366	10	433 (67.7)	10.1	10.6	-0.5
Hospital B	317	177	45	218 (68.8)	8.1	10.1	-2.0
Neurosurgery							
Hospital A	140	113	72	132 (94.3)	3.6	6.7	-3.1
Hospital B	791	308	81	458 (57.9)	6.6	7.9	-1.3
Oral Surgery							
Hospital A	62	49	96	60 (96.8)	2.3	2.9	-0.6
Hospital B	177	72	90	159 (89.8)	1.9	3.3	-1.4
Orthopedic Surgery							
Hospital A	636	231	88	521 (81.9)	7.0	7.3	-0.3
Hospital B	1337	661	95	1018 (76.1)	7.4	7.5	-0.1
Plastic Surgery							
Hospital A	342	187	91	317 (92.7)	2.9	3.4	-0.5
Hospital B	791	184	84	536 (67.8)	4.5	4.7	-0.2
Thoracic Surgery							
Hospital A	201	136	50	179 (89.1)	6.3	8.2	-1.9
Hospital B	369	176	79	293 (79.4)	8.0	8.7	-0.7
Urology							
Hospital A	876	534	66	814 (92.9)	4.0	4.9	-0.9
Hospital B	611	353	83	544 (89.0)	4.6	5.4	-0.8
ENT							
Hospital A	243	132	85	227 (93.4)	2.3	3.4	-1.1
Hospital B	221	45	84	186 (84.2)	4.2	5.5	-1.3
Vascular Surgery							
Hospital A	304	193	41	251 (82.6)	6.3	8.0	-1.7
Hospital B	682	356	64	535 (78.4)	6.5	9.1	-2.6

1 ALOS is average length of stay.
2 DB ALOS is average length of stay of typical cases discharged from Canadian teaching hospitals (peer group 5) that submit data to CIHI.

Source: CIHI CHAP 1 and 2 Report, April 1, to March 31, 1996.

By shifting surgery from inpatient to outpatient activities, hospital resources might be expended more efficiently. Included in Appendix I is an example of a comparison of inpatient to outpatient activity by doctor service at SBGH during fiscal year 1995/96. The number of one-day cases (column 6), percent outpatient activity (column 10), database percent outpatient activity (column 11) and potential inpatient cases to move (column 13) is reviewed for the following nine doctor services: general surgeon, neurosurgeon, oral surgeon, orthopaedic surgeon, plastic surgeon, thoracic surgeon, urologist, otolaryngologist, and vascular surgeon. An overall assessment obtained by reviewing the service totals indicates that five of the nine doctor services performed less surgery on an outpatient basis than the CIHI database. For example, 17.7% of procedures performed by a vascular surgeon were completed on an outpatient basis, compared with a database value of 44.1%. Further, 77.2% (61/79) of screened inpatients, the majority of which had a vascular procedure (i.e. DPG 21), reported a LOS of one day, indicating potential for greater outpatient activity. If procedures within this doctor service were performed at an outpatient activity level equal to that of the CIHI database, 25 cases overall (column 13), and more specifically, 19 cases within DPG 21 (column 13), could potentially be moved from inpatient to outpatient activities (i.e. number of inpatient and outpatient cases x database percent outpatient activity - number of outpatient cases). For DPG 21, 19 hospital days would be spared if 19 of the 52 one-day cases were moved from inpatient to outpatient activities. However, if all of the 14 cases remaining in hospital 2 to 3 days were moved to outpatient activities, 28 to 42 days would potentially be saved.

DISCUSSION

With the availability of CIHI data, LOS practices may be examined across Canadian acute-care institutions. Inpatient records are grouped by CMG, day care encounters are assigned a DPG and inter-hospital and CIHI database comparisons are presented by peer group. Limited descriptive information such as patient age and atypical case load is available to assist users in assessing the comparability of each hospital relative to each other, or with the CIHI database. With full implementation of complexity overlay and age adjustment (CIHI, 1997), more precise information will become available to describe the patient population and strengthen estimation of resource use.

Each year, CIHI revises its CMG methodology to reflect current practice patterns, coding conventions, and medical technology. In 1994/95, CIHI completely redefined Major Clinical Category (MCC) 14 (Conditions Originating during Pregnancy and Childbirth). The number of corresponding case mix groups (for delivered cases) increased from five to twelve (CIHI, 1994a). Undoubtedly, revisions to the grouping methodology more accurately reflect the current health care system. However, as health reform initiatives continue to be implemented, SBGH and other client hospitals will require information to monitor utilization over time. Unless client hospitals approach CIHI for historical regrouping of their data, hospitals will be unable to conduct these reviews.

When presenting and interpreting CIHI data, there are several measurement issues to consider. First, the user must be aware that the average is influenced by extreme observations or outliers when reporting and comparing average length of stay. Although hospital comparisons are based on typical cases, the length of stay distribution may remain skewed at one or more of the various levels of aggregation (e.g. CMG, doctor service, etc.) regardless of the number of cases. Without accompanying statistics to describe the variability of these data, the user must interpret them with some degree of caution. For this reason, CIHI might consider including additional elements within their reports to assist client hospitals in interpreting the variation in LOS. In addition to the minimum and maximum length of stay values, the 25th, 50th (median) and 75th percentile values should be included. Furthermore, the standard deviation should accompany each ALOS. At present, CIHI includes a LOS quartile comparison which is based upon the LOS distribution of cases within the CIHI database. For each client hospital, the LOS distribution is normalized accordingly, revealing short- and long-stay hospitals.

Second, statistical significance is not assessed for ALOS comparisons using traditional parametric tests. Instead, CIHI reports statistical significance based upon the binomial distribution—assigning the 75th percentile as the normative value. For this test, the LOS comparison is limited to a client hospital and the CIHI database. Similar results are not presented using the "best practice" hospital or an alternative hospital as the reference.

Lastly, any variation in LOS might be explained by patient characteristics as well as hospital-specific characteristics not currently measured or reported by CIHI. Additional questions are likely to be raised and explanations sought when reviewing CIHI data.

Although traditional paper reports will not easily support the inclusion of additional variables, computerized databases should be able to incorporate these additions with flexibility. Most recently, CIHI included the variables *date of separation* and *postal code* within its electronic version of 1996/97 data (CIHI, 1996). With upgrading to the electronic data, users could further manipulate current levels of aggregation. At SBGH, analysts would be interested in making LOS comparisons with the CIHI database for select CMG within a given doctor service. In the case of obstetrical data, LOS measured in hours rather than days might be more appropriate given continuing trends to shorten LOS. Given the increased flexibility and timeliness of electronic reporting, CIHI might consider providing client hospitals with a complete, computerized version of their paper reports. In Ontario, the Institute for Clinical and Evaluative Sciences has developed for users an electronic format of their *Practice Atlas* (Goel et al., 1996).

From a technical perspective, the addition of a unique identifying variable would undoubtedly facilitate record linkage projects. At SBGH, CIHI records have previously been merged with other databases using variables *date of admission* and *medical record number*. However, the success of future linkages would be greatly enhanced with the addition of *claim number* (i.e. Manitoba Health-assigned unique identifier for each hospital encounter) and the recently introduced *date of separation*. A current pilot project at SBGH involves the linkage of CIHI complexity data (beta version—fiscal 1995/96) with MQ and PBAB databases to assign severity of illness and cost per case for records defined as Acute Myocardial Infarction (CMG 194 and CMG 195). These data are to be examined by doctor services, specifically, medicine, family practice and geriatrics.

CIHI has made significant progress in developing improved methodologies (e.g. complexity and age adjustment enhancements) to better understand and utilize the data. However, both hospital-based expertise in data analysis and expectations of users within SBGH have evolved substantially since 1990. As a result, analysts and users are requesting additional statistics (e.g. median length of stay, standard deviation of mean length of stay) and increased flexibility in accessing and manipulating the data. The challenge for CIHI will be to provide such information on a timely and ongoing basis in order to meet the needs of their clients, whether it be at the hospital, regional, provincial or national level.

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Appendix 1. Comparison of Inpatient to Outpatient Activity by Doctor Service, St. Boniface General Hospital, Winnipeg, April 1, 1995 to March 31, 1996

	DPG		CASES	CASES 1 DAY	CASES 2-3 DAYS	OUTPT CASES	INPT + OUTPT ACTIVITY	% OUTPT	DATABASE % OUTPT	DATABASE 75 %ILE	PO IN CA TO
2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
	28	ENDOSCOPY - GI	25	8	17	460	485	94.84%	74.12%	95.99%	1(
	55	MASTECTOMY	35	6	29	209	244	85.65%	77.86%	87.87%	1(
	59	SKIN PROCEDURES	18	10	8	173	191	90.57%	88.92%	94.31%	3-
	27	HEPATOBILIARY PROCEDURES	7	1	6	109	116	93.96%	84.55%	92.30%	11
	29	ANO-RECTAL PROCEDURES	57	32	25	68	125	54.40%	68.93%	80.00%	1(
	30	MINOR ANAL PROCEDURES	18	6	12	44	62	70.96%	79.59%	87.23%	5
	23	LYMPHATIC PROCEDURES	4	2	2	40	44	90.90%	66.72%	81.63%	11
	26	HERNIA REPAIR	86	35	51	30	116	25.86%	42.10%	54.49%	1(
	01	NERVE AND OTHER PROCEDURES	2	1	1	9	11	81.81%	81.01%	94.11%	
	11	SINUS PROCEDURES	24	11	13	7	31	22.58%	52.23%	69.35%	9
	15	OTHER RESPIRATORY PROCEDURES	2	1	1	7	9	77.77%	66.55%	82.35%	1-
	17	ENDOSCOPY - ENT	1	1		7	8	87.50%	82.63%	92.85%	
	21	VASCULAR PROCEDURES				7	7	100.00%	40.19%	61.58%	4-
	22	OTHER VASCULAR PROCEDURES	4	1	3	7	11	63.63%	55.36%	78.78%	1-
	25	CHOLECYSTECTOMY	168	89	79	6	174	3.44%	5.35%	13.79%	3
	53	SOFT TISSUE PROCEDURES				6	6	100.00%	87.43%	93.63%	1-
	12	OTHER SINUS PROCEDURES	2	1	1	5	7	71.42%	68.15%	90.00%	
	14	NASAL PROCEDURES				5	5	100.00%	85.88%	92.30%	1-
	24	MINOR VASCULAR PROCEDURES				3	3	100.00%	96.84%	98.64%	
	08	EXTERNAL EYE PROCEDURES				2	2	100.00%	94.39%	97.18%	
	09	RESPIRATORY PROCEDURES				2	2	100.00%	26.52%	46.15%	1-
	16	EXTERNAL EAR PROCEDURES				1	1	100.00%	98.57%	99.24%	
	36	VASECTOMY	1	1		1	2	50.00%	91.81%	96.59%	1
	61	BIOPSY	1		1	1	2	50.00%	79.53%	91.34%	1
	34	LOWER URINARY & GENITAL PROC	1		1		1		56.49%	70.50%	1
	39	UTERUS AND ADNEXAL PROCEDURES	6	3	3		6		35.98%	46.94%	2
	40	ENDOSCOPY AND GYN PROCEDURES	24	21	3		24		91.49%	94.90%	2:
	41	MINOR GYN PROCEDURES	1	1			1		90.63%	92.85%	1
	44	CHEST WALL PROCEDURES	1		1		1		62.27%	73.91%	1
	57	BREAST PLASTIC PROCEDURES	1	1			1		75.06%	88.46%	1
			489	**232**	**257**	**1,209**	**1,698**	**71.20%**	**67.01%**		
	01	NERVE AND OTHER PROCEDURES	22	7	15	12	34	35.29%	81.01%	94.11%	1(
	02	SPINAL PROCEDURES	8	7	1		8		82.27%	94.06%	7
	20	ANGIOGRAPHY	2	2			2		57.54%	88.25%	1
	21	VASCULAR PROCEDURES	1		1		1		40.19%	61.58%	
	22	OTHER VASCULAR PROCEDURES	2	2			2		55.36%	78.78%	1
	66	MYLEOGRAM	1		1		1		69.03%	95.40%	1
			36	**18**	**18**	**12**	**48**	**25.00%**	**78.07%**		**2:**
	60	DENTAL SURGERY	3	3		52	55	94.54%	93.97%	97.50%	
	59	SKIN PROCEDURES				10	10	100.00%	88.92%	94.31%	1-
	43	MAXILLO FACIAL PROCEDURES	35	9	26	8	43	18.60%	25.67%	41.66%	3
	52	REMOVAL INTERNAL FIXATION	1	1		6	7	85.71%	78.56%	88.70%	1-
	11	SINUS PROCEDURES	2	1	1	1	3	33.33%	52.23%	69.35%	1
	13	TONSIL/ADENOID PROCEDURES	1		1		1		45.32%	72.34%	
	58	PLASTIC RECONSTRUCTION	2		2		2		59.20%	77.27%	1
			44	**14**	**30**	**77**	**121**	**63.63%**	**66.37%**		**3**
	50	KNEE PROCEDURES	25	17	8	340	365	93.15%	85.56%	94.04%	2(
	45	UPPER EXTREMITY PROCEDURES	19	6	13	134	153	87.58%	28.96%	38.03%	9(
	47	TENDON AND MUSCLE PROCEDURES	5	1	4	56	61	91.80%	64.57%	80.95%	1:
	52	REMOVAL INTERNAL FIXATION	3	1	2	48	51	94.11%	78.56%	88.70%	8-
	49	LOWER EXTREMITY PROCEDURES	47	21	26	39	86	45.34%	18.56%	28.33%	2:
	53	SOFT TISSUE PROCEDURES	1		1	26	27	96.29%	87.43%	93.63%	2-
	48	CLOSED REDUCTIONS	4	1	3	19	23	82.60%	46.92%	75.00%	8-
	44	CHEST WALL PROCEDURES	3	3		17	20	85.00%	62.27%	73.91%	5-
	46	OPEN REDUCTION & INTERNAL FIX	3	1	2	11	14	78.57%	47.59%	63.79%	4-
	51	ANKLE AND FOOT PROCEDURES	6	2	4	10	16	62.50%	48.71%	62.90%	2-
	01	NERVE AND OTHER PROCEDURES	15	1	14	9	24	37.50%	81.01%	94.11%	1(
	59	SKIN PROCEDURES	1	1		6	7	85.71%	88.92%	94.31%	
	54	MANIPULATIONS				3	3	100.00%	85.56%	93.54%	
	61	BIOPSY				1	1	100.00%	79.53%	91.34%	
			132	**55**	**77**	**719**	**851**	**84.48%**	**63.73%**		
	59	SKIN PROCEDURES	21	12	9	669	690	96.95%	88.92%	94.31%	5:
	14	NASAL PROCEDURES	2	1	1	92	94	97.87%	85.88%	92.30%	11
	53	SOFT TISSUE PROCEDURES	7	3	4	76	83	91.56%	87.43%	93.63%	3-
	01	NERVE AND OTHER PORCEDURES	19	16	3	64	83	77.10%	81.01%	94.11%	3
	08	EXTERNAL EYE PROCEDURES	1	1		57	58	98.27%	94.39%	97.18%	2-
	47	TENDON AND MUSCLE PROCEDURES	15	10	5	45	60	75.00%	64.57%	80.95%	6-
	11	SINUS PROCEDURES	3	1	2	40	43	93.02%	52.23%	69.35%	1(

DPG		CASES	CASES 1 DAY	CASES 2-3 DAYS	OUTPT CASES	INPT + OUTPT ACTIVITY	% OUTPT	DATABASE % OUTPT	DATABASE 75 %ILE	PO IN CA TO
59	SKIN PROCEDURES	21	12	9	669	690	96.95%	88.92%	94.31%	5
14	NASAL PROCEDURES	2	1	1	92	94	97.87%	85.88%	92.30%	1
53	SOFT TISSUE PROCEDURES	7	3	4	76	83	91.56%	87.43%	93.63%	3
01	NERVE AND OTHER PORCEDURES	19	16	3	64	83	77.10%	81.01%	94.11%	3
08	EXTERNAL EYE PROCEDURES	1	1		57	58	98.27%	94.39%	97.18%	2
47	TENDON AND MUSCLE PROCEDURES	15	10	5	45	60	75.00%	64.57%	80.95%	6
11	SINUS PROCEDURES	3	1	2	40	43	93.02%	52.23%	69.35%	1
56	AUGMENTATION/MAMMOPLASTY	103	32	71	27	130	20.76%	32.97%	40.00%	1
55	MASTECTOMY	3	1	2	25	28	89.28%	77.86%	87.87%	3
46	OPEN REDUCTION & INTERNAL FIX	18	11	7	12	30	40.00%	47.59%	63.79%	2
57	BREAST PLASTIC PROCEDURES	2		2	11	13	84.61%	75.06%	88.46%	1
58	PLASTIC RECONSTRUCTION	2	2		6	8	75.00%	59.20%	77.27%	1
52	REMOVAL INTERNAL FIXATION				5	5	100.00%	78.56%	88.70%	1
04	ORBITAL & OTHER EYE PROCEDURES				4	4	100.00%	57.59%	88.23%	2
51	ANKLE AND FOOT PROCEDURES				4	4	100.00%	48.71%	62.90%	2
45	UPPER EXTREMITY PROCEDURES	6	3	3	3	9	33.33%	28.96%	38.03%	
43	MAXILLO-FACIAL PROCEDURES	12	4	8	2	14	14.28%	25.67%	41.66%	2
44	CHEST WALL PROCEDURES				2	2	100.00%	62.27%	73.91%	1
10	TYMPANOPLASTY				1	1	100.00%	54.71%	78.78%	
20	ANGIOGRAPHY				1	1	100.00%	57.54%	88.25%	
23	LYMPAHATIC PROCEDURES				1	1	100.00%	66.72%	81.63%	
26	HERNIA REPAIR	1		1	1	2	50.00%	42.10%	54.49%	
22	OTHER VASCULAR PROCEDURES	3	3			3		55.36%	78.78%	2
48	CLOSED REDUCTIONS	1	1			1		46.92%	75.00%	
60	DENTAL SURGERY	1	1			1		93.97%	97.50%	1
		220	**102**	**118**	**1,148**	**1,368**	**83.91%**	**77.83%**		
17	ENDOSCOPY - ENT	39	27	12	29	68	42.64%	82.63%	92.85%	2
28	ENDOSCOPY - GI	2	2		1	3	33.33%	74.12%	95.99%	1
61	BIOPSY	3	2	1	1	4	25.00%	79.53%	91.34%	2
09	RESPIRATORY PROCEDURES	1		1		1		26.52%	46.15%	
23	LYMPHATIC PROCEDURES	3		3		3		66.72%	81.63%	2
		48	**31**	**17**	**31**	**79**	**39.24%**	**80.83%**		**3**
35	BLADDER & URETHRAL PROCEDURES	213	95	118	526	739	71.17%	79.29%	94.95%	6
34	LOWER URINARY & GENITAL PROC	40	26	14	25	65	38.46%	56.49%	70.50%	1
36	VASECTOMY	34	31	3	21	55	38.18%	91.81%	96.59%	2
37	CIRCUMCISION	1	1		12	13	92.30%	92.60%	96.39%	
33	UPPER URNIARY PROCEDURES	43	16	27	11	54	20.37%	37.99%	52.63%	1
61	BIOPSY	2	1	1	7	9	77.77%	79.53%	91.34%	
26	HERNIA REPAIR				1	1	100.00%	42.10%	54.49%	1
59	SKIN PROCEDURES				1	1	100.00%	88.92%	94.31%	
60	DENTAL SURGERY				1	1	100.00%	93.97%	97.50%	
23	LYMPHATIC PROCEDURES	4	1	3		4		66.72%	81.63%	3
31	MECHANICAL IMPLANTS	7	3	4		7		9.36%	18.18%	1
32	LITHOTRIPSY	1	1			1		97.44%	99.29%	1
41	MINOR GYN PROCEDURES	1	1			1		90.63%	92.85%	1
		346	**176**	**170**	**605**	**951**	**63.61%**	**75.74%**		**1**
11	SINUS PROCEDURES	55	50	5	288	343	83.96%	52.23%	69.35%	1
13	TONSIL/ADENOID PROCEDURES	14	13	1	146	160	91.25%	45.32%	72.34%	7
16	EXTERNAL EAR PROCEDURES	1	1		110	111	99.09%	98.57%	99.24%	1
12	OTHER SINUS PROCEDURES	2	1	1	86	88	97.72%	68.15%	90.00%	2
17	ENDOSCOPY - ENT	23	18	5	68	91	74.72%	82.63%	92.85%	7
10	TYMPANOPLASTY	21	18	3	61	82	74.39%	54.71%	78.78%	1
59	SKIN PROCEDURES	4	3	1	47	51	92.15%	88.92%	94.31%	2
14	NASAL PROCEDURES	4	1	3	12	16	75.00%	85.88%	92.30%	2
23	LYMPHATIC PROCEDURES				6	6	100.00%	66.72%	81.63%	2
61	BIOPSY	1	1		5	6	83.33%	79.53%	91.34%	
58	PLASTIC RECONSTRUCTION				2	2	100.00%	59.20%	77.27%	1
04	ORBITAL & OTHER EYE PROCEDURES				1	1	100.00%	57.59%	88.23%	
08	EXTERNAL EYE PROCEDURES				1	1	100.00%	94.39%	97.18%	
09	RESPIRATORY PROCEDURES	14	6	8	1	15	6.66%	26.52%	46.15%	3
15	OTHER RESPIRATORY PROCEDURES	2	2		1	3	33.33%	66.55%	82.35%	1
28	ENDOSCOPY - GI	2	2		1	3	33.33%	74.12%	95.99%	1
43	MAXILLO-FACIAL PROCEDURES	1	1		1	2	50.00%	25.67%	41.66%	

Source: CIHI Reports, Inpatient/Outpatient Comparison by Doctor Service, April 1, 1995 to March 31, 1996

BRENDA TIPPER, DARREN ARNDT

The Effect of Complexity and Age Adjustment on Measures of Length of Stay Performance

CHAPTER OVERVIEW

The Toronto Hospital (TTH) is a teaching hospital affiliated with the University of Toronto. It is among the largest hospitals in Canada, and is often the institution of last resort for many of the difficult cases in Ontario. An objective for improving the utilization of resources at The Toronto Hospital is to minimize length of stay as appropriate. A key indicator of length of stay performance used at this hospital is days per weighted case. This indicator is reported on a regular basis to clinicians to assist them in monitoring and improving their length of stay performance. The indicator is based on an internal comparison of the current month's actual length of stay performance against the previous year's performance. A concern with using external comparisons of length of stay performance is that it is difficult to find benchmarks of length of stay based on similar cases. Thus, the case presented in this chapter seeks to determine whether the new Complexity methodology developed by the Canadian Institute for Health Information (CIHI) is a better predictor of length of stay performance at TTH than is the CMG methodology. It is shown that the new prototype, Complexity 96 methodology is a significantly better predictor of length of stay performance for cases at TTH than the CMG 96 methodology. Thus, the Complexity methodology may be an appropriate means for making external comparisons. The details related to this finding are discussed.

INTRODUCTION

Opportunities for improving resource utilization in an institution can often be identified through comparing indicators of utilization to those of similar cases in other institutions. Comparisons of indicators through benchmarking can assist not only in determining if opportunities exist, but also where those opportunities lie, for example, particular groups of cases, certain programs, etc.

Length of stay (LOS) is a significant predictor of the use of resources such as nursing care, diagnostic and therapeutic interventions, drugs, etc. Therefore, the focus in utilization improvements is often on reducing LOS. LOS is one of the key utilization indicators used by many institutions to assess performance. However, when benchmarking this indicator against that achieved by other institutions to determine areas where performance might be improved, a key question is "what are 'similar' cases?"

Until 1997, CIHI's case mix methodology provided a way of grouping "similar" cases based on the diagnosis at discharge considered to be most responsible for the patient's stay in the institution. Although there is variation in resource utilization within any particular CMG, the Resource Intensity Weight (RIW) assigned to a CMG provides an indication of the intensity of resource utilization relative to other groups. In order to determine the RIW and also to provide further information with which to assess resource utilization performance, CIHI calculates a number of statistics based on the length of stay including average, median and 25th and 75th percentiles for all typical cases.

An institution can use this data to examine how its length of stay performance is different from that of CIHI's national database. If it is found that cases within related groups of CMG generally have a length of stay higher than the CIHI ALOS, then these cases can be further examined to find practice patterns and systems that might be changed to decrease LOS. Improvement efforts can then be focused in those areas identified, without spending effort unnecessarily where LOS performance may be better than the CIHI ALOS.

However, prior to 1997, case mix groups, based in large part on the diagnosis most responsible for length of stay, did not fully reflect factors that may lead to longer LOS (and higher resource use) for cases with the same most responsible diagnosis. Complications and comorbid conditions along with the age of the patient (very young or very old) will significantly affect length of stay and resources required to provide care for a case. Although a number of CMG reflect expected differences in resource use based on broad age groups (e.g. over 70 years, under 16 years) and the presence or absence of complications, these do not take into account extreme age differences, or the severity of complications and other conditions.

If all institutions have cases with similar age distributions and similar patterns of complications and other conditions, comparisons to the CIHI database indicators would always be valid. However, more complex cases are often referred to tertiary/quaternary institutions specializing in care for these cases. This makes it difficult to compare the length of stay performance in institutions providing this specialized care to averages calculated over all institutions. Even within the "tertiary institutions," patterns of complex cases may be different from one institution to another depending on the programs of focus. For example, Hospital A may have more complex cardiac cases than Hospital B, while Hospital B specializes in care for more complex cancer cases. It would be misleading to target areas for review using comparisons to averages based on less complex cases.

With the addition of complexity and age adjustments for most CMG, CIHI's new Complexity methodology offers the opportunity to compare utilization performance to indicators that more accurately reflect the range of an individual institution's cases. An institution's average LOS can be compared to LOS for cases with similar factors (patient age and comorbid conditions) affecting LOS.

The Situation at The Toronto Hospital

The Toronto Hospital is a teaching hospital affiliated with the University of Toronto. With nearly 40,000 inpatient cases and over 260,000 patient days per year, it is among the largest acute care facilities in Canada. It provides care for significantly complex cases and is often the institution of last resort for many of the most difficult cases in Ontario. The Toronto Hospital has priority programs in cardiac sciences, oncology, transplantation, neurosciences and primary care. In a comparison of case complexity among Toronto Academic Health Science Council (TAHSC) Hospitals, the "average complexity level" for The Toronto Hospital was higher than that of the other teaching hospitals associated with the University of Toronto with the exception of a specialized cancer treatment centre.

In order to optimize resource utilization, an objective at The Toronto Hospital is to minimize length of stay as appropriate. To this end, LOS performance is monitored internally, with monthly indicators that compare LOS to TTH historical performance. "Days per weighted case" is used as the indicator. Current performance is compared to the previous year's performance by using "comparator days." The comparator days reflect the length of stay given the current month's case mix that would have resulted with the previous year's length of stay performance by CMG[1]. A sample indicator report is shown in Figure 1. The LOS indicator can be examined by physician program (e.g. cardiology, neuro-surgery, transplantation). This high-level performance indicator is routinely provided to clinicians. Ad hoc reports and analysis may be developed if further investigation is required to identify specific opportunities for LOS reduction, or to determine why LOS may be have been increasing.

As can be seen from the sample chart in Figure 1, "patient days per weighted case" has been decreasing over the past two years. Although performance by this measure has been improving, there has been no indicator developed to compare LOS performance to external standards and identify where the largest opportunities exist for improving LOS performance. The impact of complexity on length of stay, and the issues described above around comparing performance to averages based on the previous CMG methodology, lead to questions regarding the validity of comparing TTH performance to previous national averages.

[1] The comparator days are obtained by calculating the previous year's ALOS for each CMG and predicting patient days based on this year's case mix and the previous year's ALOS.

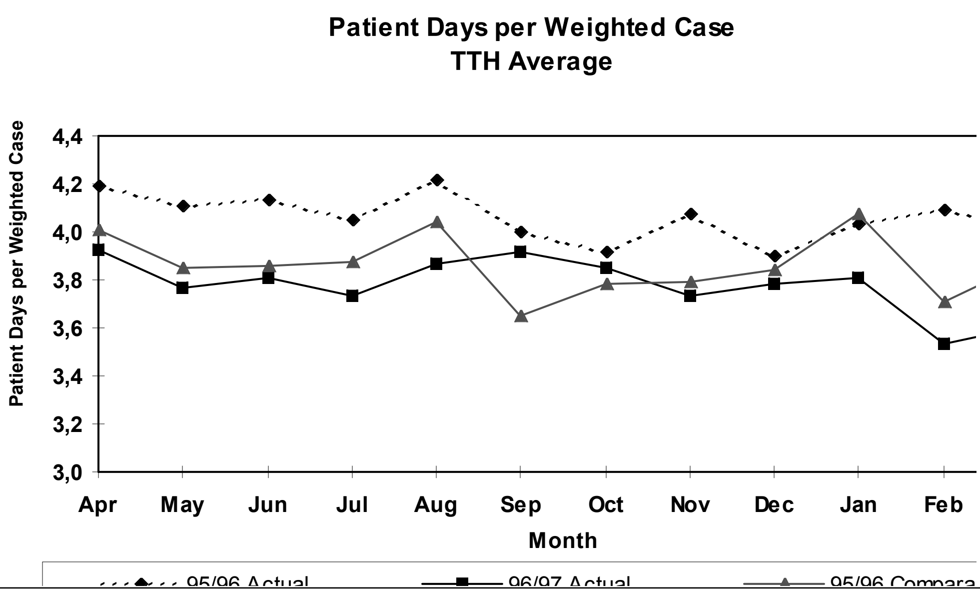


Figure 1: Sample LOS Indicator Chart

The development of CIHI's Complexity methodology presents the opportunity to review LOS performance using a grouping methodology that much more fully addresses the impact of complexity and age on length of stay performance. The case study presented in this chapter uses the 1996 pilot version of the Complexity methodology (Complexity 96) to examine the following questions:

1. How does TTH LOS performance compare to the CMG 96 database ALOS; and, how does it compare to the Complexity 96 ELOS which has been adjusted for complexity and age?

2. Does the new methodology offer an improvement in predicting LOS through a decrease in variability of the difference in actual LOS compared to the national averages ?

3. For what types of cases is the impact of the age and complexity adjustment on the CMG most significant?

4. Would performance indicators based on the Complexity methodology better identify opportunities for examining LOS performance? What would these opportunities be?

METHODS

Analysis

To determine if the Complexity methodology better reflects actual TTH length of stay, we compared actual TTH length of stay to the CIHI database length of stay for each case included in the review. The length of stays were identified and compared as follows:

1. For the CIHI CMG 96:
   a) the TTH actual LOS was compared with the CIHI database ALOS for the case, based on CMG 96
   b) the LOS difference was calculated as actual case LOS minus CIHI database ALOS

2. For the CIHI Complexity 96:
   a) the TTH actual LOS was compared with the CIHI ELOS for the case, based on Complexity 96
   b) the LOS difference was calculated as actual case LOS minus the CIHI ELOS

For both methodologies, a positive difference indicated a case LOS greater than the CIHI LOS and a negative difference indicated a case LOS less than the CIHI LOS. The LOS differences calculated using the CMG 96 methodology were compared to the LOS differences calculated using the Complexity 96 methodology.

For each set of differences, an average, median and standard deviation were determined. The average, median and standard deviation were reviewed for all cases and for cases broken into the following categories:

ð by type of admission (emergent, urgent, elective);
ð by medical or surgical partition; and
ð by Major Clinical Category.

Cases Reviewed

The cases reviewed comprised the first quarter of 1995/96 (April, 1995 through June, 1995). Only cases where complexity and/or age adjustments were applied under CIHI's pilot methodology were included. Since complexity and/or age adjustments were not used for cases in the following MCC, these were excluded from the analysis:

ð 02 Eye;
ð 03 Ear, Nose, Throat, Mouth;
ð 14 Pregnancy and Childbirth;
ð 15 Newborns; and
ð 19 Mental Diseases and Disorders.

In addition, all MNRH (May Not Require Hospitalization) CMG cases were excluded, as were cases grouped to CMG > 909. Atypical cases due to signouts, transfers and deaths were also excluded. However, LOS outliers were included in the analysis. Total cases included in the review were 6,627.

RESULTS/ANALYSIS

Overall Results

The actual TTH ALOS for all cases under review was 7.32 days. This compared to the CMG 96 ALOS of 6.49 days (average difference of 0.83 days) and to the Complexity 96 ELOS of 6.72 days (average difference of 0.60 days). These results are shown in Table 1. The CIHI LOS was 0.23 days closer to TTH's actual ALOS experience when using the Complexity 96 methodology. The percent difference improves from 11.3% under the CMG 96 methodology to 8.3% under the Complexity 96 methodology. The variability of the differences in actual LOS compared to the CIHI LOS (based on the standard deviation) decreased from 10.15 to 9.25 under the Complexity 96 methodology (see Table 2). The decreases in both the average difference and the standard deviation were significant at a=.01. Figure 2 illustrates the improvement in the mean, median and standard deviation by showing the distribution of differences in TTH actual LOS compared to the ELOS on a case by case basis.

Results by Medical/Surgical and Admission Type

To determine if the improvement was more pronounced for certain types of cases, the results for all cases were broken down by medical and surgical partitions and by admission type. Tables 1 and 2 show the results for these categories. The overall pattern of results holds for medical and surgical cases, and also for emergent, urgent and elective cases; however, the degree of improvement changes by category.

Table 1: Comparison of TTH Actual ALOS vs. Methodology Difference

Category		# Cases	TTH Actual ALOS	CMG 96 Methodology ELOS	CMG 96 Methodology Diff v. TTH	CMG 96 Methodology % Diff	Complexity 96 Methodology ELOS	Complexity 96 Methodology Diff v. TTH	Complexity 96 Methodology % Diff	Methdology Difference Days	Methdology Difference %
All Cases		6,627	7.32	6.49	0.83	11.33%	6.72	0.60	8.25%	0.23	3.08%
Medical / Surgical	Medical	2,716	3.48	4.30	-0.82	-23.54%	4.19	-0.70	-20.20%	-0.12	-3.34%
	Surgical	3,911	9.99	8.01	1.98	19.78%	8.48	1.51	15.14%	0.46	4.63%
Admission Type	Emergent	2,152	10.45	7.07	3.38	32.38%	7.71	2.75	26.27%	0.64	6.11%
	Urgent	704	9.58	7.78	1.80	18.81%	8.13	1.45	15.16%	0.35	3.65%
	Elective	3,771	5.12	5.93	-0.81	-15.80%	5.89	-0.78	-15.15%	-0.03	-0.65%

Table 2: Comparison of Mean, Median and Standard Deviation of Differences

Category		# Cases	Mean Difference CMG 96	Mean Difference Complexity 96	Median Difference CMG 96	Median Difference Complexity 96	Std. Dev. CMG 96	Std. Dev. Complexity 96
All Cases		6,627	0.83	0.60	-0.70	-0.60	10.15	9.24
Medical / Surgical	Medical	2,716	-0.82	-0.70	-0.70	-0.70	3.31	3.04
	Surgical	3,911	1.98	1.51	-0.80	-0.60	12.80	11.67
Admission Type	Emergent	2,152	3.38	2.75	0.10	0.10	13.23	12.34
	Urgent	704	1.80	1.45	-0.50	-0.40	9.80	8.74
	Elective	3,771	-0.81	-0.78	-1.10	-0.80	7.53	6.64

For medical cases, TTH actual ALOS was less than the CIHI LOS for both methodologies. However, with the Complexity methodology, the absolute difference becomes smaller, as the CIHI LOS moves closer to the TTH actual ALOS. For medical cases, the percent difference in LOS compared to the CIHI LOS improves from -23.5% to -20.2%. The ALOS for TTH surgical cases was 1.98 days higher than the CMG 96 ALOS. Using Complexity 96 ELOS, the difference drops to 1.51 days and the percent difference improves from 19.8% to 15.1%. For both medical and surgical cases, the standard deviation of the difference in actual LOS compared to the CIHI LOS was smaller under the Complexity methodology.

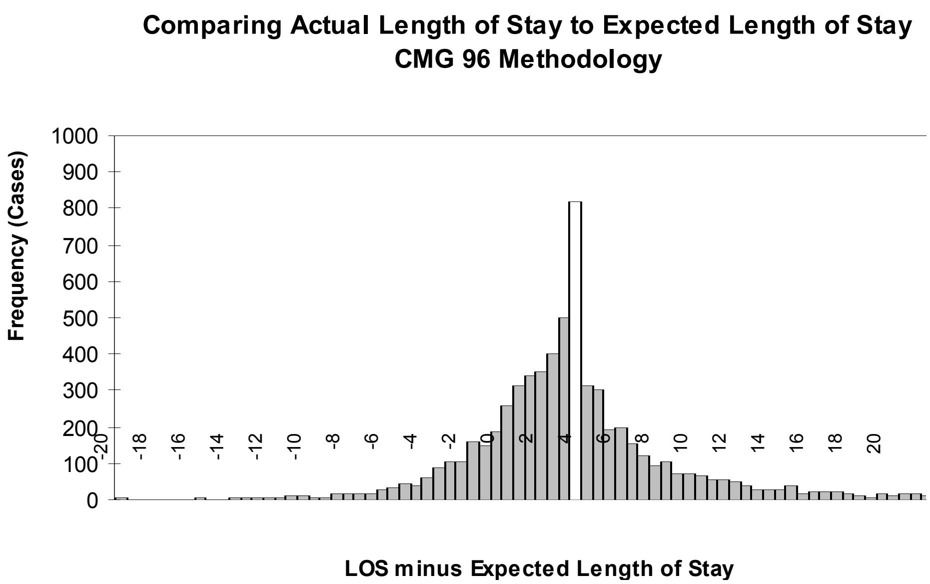


Figure 2: Comparing Actual Length of Stay to Expected Length of Stay

a) Using 1996 CMG Methodology

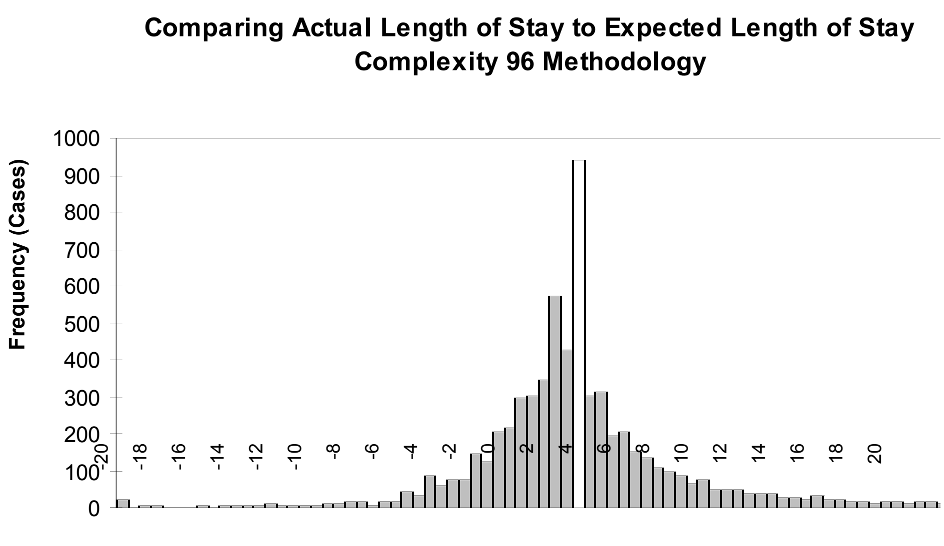


Figure 2: Comparing Actual Length of Stay to Expected Length of Stay

b) Using the 1996 pilot Complexity Methodology

For emergent admissions there was a difference of 3.38 days (32.4%) compared to the CMG 96 ALOS. This difference improved to 2.75 days (26.3%) compared to the ELOS under the Complexity 96 methodology. The difference in actual ALOS compared to the CIHI LOS for urgent admissions also showed some improvement, moving from a difference of 1.80 days (18.8%) under the CMG 96 methodology to 1.45 days (15.2%) using the Complexity 96 methodology. The difference for elective admissions was almost unchanged, moving from -0.81 days under the CMG 96 methodology to -0.78 days using the Complexity 96 methodology. The standard deviations of the difference in actual LOS compared to the CIHI LOS for emergent, urgent and elective admissions were again smaller under the Complexity 96 methodology.

Results by Major Clinical Category

Results by Major Clinical Category (MCC) are shown in Tables 3 and 4. These tables do not include MCC that were listed in the exclusions described in the methodology section. Also, MCC with fewer than 20 cases (Male Reproductive System, Burns, and Multiple Significant Traumas) are not shown in the tables.

Of the sixteen MCC shown in Table 3, thirteen had a CIHI LOS closer to the TTH ALOS under the Complexity 96 methodology. For three MCC ("Hepatobiliary System," "Endocrine, Nutritional, Metabolic Diseases" and "Lymphoma, Leukemia, or Unspecified Site Neoplasms"), the Complexity 96 ELOS was further away from TTH actual ALOS.

Table 3:
Comparison of TTH Actual ALOS vs. Methodology Difference by MCC

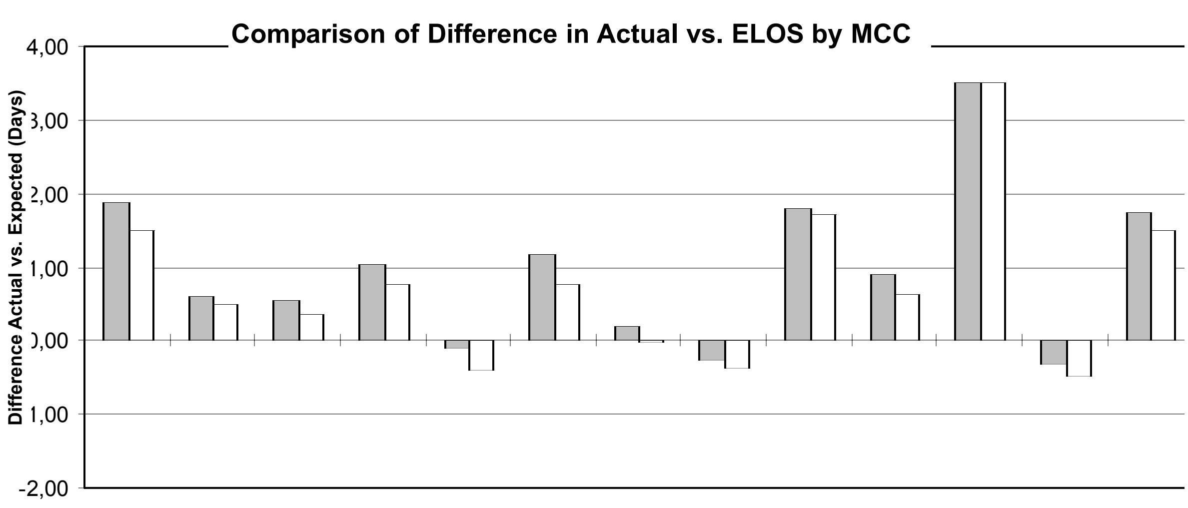
			TTH	CMG 96 Methodology			Complexity 96 Methodology			Methdology Difference	
	Major Clinical Category	# Cases	Actual ALOS	CIHI ALOS	Diff vs. TTH	% Diff	CIHI ELOS	Diff vs. TTH	% Diff	Days	%
01	Nervous System	576	10.33	8.45	1.87	18.16%	8.82	1.51	14.59%	0.37	3.56%
04	Respiratory System	432	8.32	7.71	0.61	7.30%	7.82	0.50	6.02%	0.11	1.28%
05	Cardiovascular System	1,890	6.68	6.13	0.56	8.33%	6.31	0.37	5.61%	0.18	2.73%
06	Digestive System	634	7.03	5.99	1.04	14.82%	6.27	0.76	10.88%	0.28	3.94%
07	Hepatobiliary System	474	6.02	6.12	-0.10	-1.68%	6.43	-0.41	-6.83%	0.31	5.15%
08	Musculoskeletal System	734	7.89	6.72	1.16	14.77%	7.12	0.77	9.80%	0.39	4.96%
09	Skin, Subcutaneous Tissue, Breast	207	5.14	4.94	0.20	3.90%	5.15	-0.01	-0.17%	0.21	4.07%
10	Endocrine, Nutritional, Metabolic Diseases	204	5.00	5.26	-0.27	-5.34%	5.35	-0.36	-7.18%	0.09	1.84%
11	Kidney and Urinary Tract	422	8.76	6.96	1.80	20.55%	7.05	1.72	19.59%	0.08	0.96%
12	Male Reproductive System	19	6.26	6.72	-0.46	-7.31%	7.43	-1.16	-18.57%	0.71	11.26%
13	Female Reproductive System	246	5.51	4.61	0.90	16.30%	4.89	0.62	11.25%	0.28	5.04%
16	Blood and Immunological Disorders	90	8.51	4.99	3.52	41.40%	5.01	3.50	41.11%	0.02	0.29%
17	Lymphoma, Leukemia, or Unspec. Site Neoplasms	217	9.59	9.91	-0.32	-3.35%	10.08	-0.49	-5.13%	0.17	1.78%
18	Multisystemic or Unspec. Site Infections	74	8.53	6.79	1.74	20.35%	7.02	1.51	17.67%	0.23	2.68%
21	Injury, Poisoning, Toxic Effects of Drugs	217	7.85	5.31	2.54	32.35%	6.01	1.85	23.51%	0.69	8.84%
22	Burns	4	2.25	7.18	-4.93	-218.89%	6.48	-4.23	-187.78%	-0.70	-31.11%
23	Other Reasons for Hospitalization	130	2.21	3.93	-1.72	-77.94%	3.12	-0.91	-41.11%	-0.81	-36.83%
24	HIV Infections	55	9.05	9.10	-0.05	-0.52%	9.08	-0.03	-0.28%	-0.02	-0.24%
25	Multiple Significant Trauma	2	12.50	14.00	-1.50	-12.00%	16.75	-4.25	-34.00%	2.75	22.00%

Table 4: Comparison of Mean, Median and Standard Deviation of Differences by MCC

			Mean Difference		Median Difference		Std. Dev.	
	Major Clinical Category	# Cases	CMG□ 96	Complexity 96	CMG□ 96	Complexity 96	CMG□ 96	Complexity 96
01	Nervous System	576	1.87	1.51	-1.70	-1.60	15.80	14.80
04	Respiratory System	432	0.61	0.50	-1.50	-1.55	9.44	8.46
05	Cardiovascular System	1,890	0.56	0.37	-0.50	-0.60	10.44	9.53
06	Digestive System	634	1.04	0.77	-0.45	-0.60	8.06	7.55
07	Hepatobiliary System	474	-0.10	-0.41	-0.45	-0.55	7.78	6.84
08	Musculoskeletal System	734	1.16	0.77	-0.90	-1.00	8.54	7.71
09	Skin, Subcutaneous Tissue, Breast	207	0.20	-0.01	-0.60	-0.70	8.24	7.52
10	Endocrine, Nutritional, Metabolic Diseases	204	-0.27	-0.36	-1.10	-0.95	5.13	5.15
11	Kidney and Urinary Tract	422	1.80	1.72	-1.70	-1.00	11.48	10.16
12	Male Reproductive System	19	-0.46	-1.16	-1.00	-1.50	3.57	4.90
13	Female Reproductive System	246	0.90	0.62	0.30	0.00	4.50	3.85
16	Blood and Immunological Disorders	90	3.52	3.50	1.05	0.50	13.00	13.12
17	Lymphoma, Leukemia, or Unspec. Site Neoplasms	217	-0.32	-0.49	-1.60	-1.20	9.59	8.31
18	Multisystemic or Unspec. Site Infections	74	1.74	1.51	-0.60	-0.30	7.62	7.29
21	Injury, Poisoning, Toxic Effects of Drugs	217	2.54	1.85	-0.50	-0.60	14.13	11.42
22	Burns	4	-4.93	-4.23	-3.30	-3.00	5.84	5.14
23	Other Reasons for Hospitalization	130	-1.72	-0.91	-2.10	-0.90	2.31	2.44
24	HIV Infections	55	-0.05	-0.03	-3.10	-3.10	8.31	8.23
25	Multiple Significant Trauma	2	-1.50	-4.25	-1.50	-4.25	11.74	7.85

The MCC showing the greatest improvement in the difference between actual ALOS and ELOS were "Other Reasons for Hospitalization" (MCC 23), "Injury, Poisoning, and Toxic Effects of Drugs" (MCC 21) and "Musculoskeletal System" (MCC 08) (see Figure 3).

Figure 3: Comparison of Difference in Actual vs. ELOS by MCC



CONCLUSION

Based on the cases reviewed, the ELOS calculated using the Complexity 96 methodology provides a closer estimate of TTH actual LOS experience than the CIHI database ALOS using the CMG 96 methodology. The average and median of the differences are both closer to zero and the standard deviation is smaller. However, the degree of improvement varies based on certain characteristics of the cases examined (medical or surgical partition, admission type and major clinical category). Surgical cases showed more improvement than medical cases; emergent more than urgent; and urgent more than elective. When examined by MCC, the largest improvements in the LOS difference were found in “Injury, Poisoning, Toxic Effects of Drugs”, “Other Reasons for Hospitalization” and “Nervous System.” For three MCC (“Hepatobiliary System,” “Endocrine, Nutritional, Metabolic Diseases” and “Lymphoma, Leukemia, or Unspecified Site Neoplasms”), the CIHI LOS moved further away from TTH’s actual LOS under the Complexity 96 methodology.

Given both the results of this analysis and the premise on which the complexity and age adjustment is based (specifically accounting for factors that would affect a case’s LOS), the answer to Question 4 in Section 1 (“would performance indicators based on the age and complexity adjustment better identify opportunities for examining LOS performance?”) is “yes.” The new methodology would likely identify both more realistic and better targeted opportunities for improving length of stay performance. Although the opportunities cannot be clearly identified at the MCC level of disaggregation in this analysis, the following measures, monitored on an ongoing basis, would provide better information with which to assess LOS performance:

- average difference in actual LOS compared to the ELOS for Complexity (total hospital and by physician program); and
- within each physician program, the top ten or twenty Complexity CMG with the greatest difference in actual LOS compared to ELOS for Complexity.

Ultimately, the usefulness of any indicator depends on how well it is accepted as a legitimate measure of performance by the individuals who have significant control over it. By specifically using complexity as one of the factors in identifying “similar” cases, comparisons to the ELOS are not only closer as shown in this analysis, but the ELOS can be recognized as a measure more reflective of the reality of the cases than ALOS.

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ROBERT FOX, JIANLI LI, ROBERT BEAR

Impact of the Complexity Methodology on an Ontario Teaching Hospital

CHAPTER OVERVIEW

In April 1997, the CMG methodology was changed to include the addition of adjustments for case complexity. The resulting adjustment for complexity considers diagnoses that prolong length of stay and increase the cost of treatment. Traditionally, St. Michael's Hospital (SMH) has used Resource Intensity Weights (RIW) in strategic planning, re-engineering projects, program operations and Ministry of Health discussions. This chapter explains the impact of the complexity adjustment changes on these efforts. It also identifies problems that result when a standardized grouping methodology is changed. A discussion follows that identifies the advantages and disadvantages of the methodological changes as perceived by SMH and the changes at SMH that have occurred and need to occur as a result of these methodological changes.

BACKGROUND ON ST. MICHAEL'S HOSPITAL

St. Michael's Hospital is a Teaching and Research Institute affiliated with the University of Toronto. Located in the heart of Toronto's downtown core, the hospital's patients and staff represent a rich diversity of cultures, religions, languages, lifestyles, and economic status. St. Michael's Hospital was founded by the Sisters of St. Joseph in 1892. They remain a vital influence, and are the present-day owners and sponsors. Their mission and values shape decisions, guide day-to-day actions, and inspire the hospital's future. Based on respect and dignity for everyone, the mission and values have led to the hospital's reputation as "Toronto's Urban Angel." In 1995-96, the hospital had approximately 350 beds, employed over 2,000 people, admitted 16,377 patients and saw 272,396 outpatients. Its average length of stay was 6.3 days. That same year, St. Michael's had the highest funding adjustment amongst its peer group for tertiary and teaching activity, based on the Ontario Case Cost Formula. This formula was created by the Ontario Ministry of Health to evaluate the efficiency of hospital operations in terms of cost per weighted case (for acute, newborn and day surgery patients) and was the basis for funding adjustments to hospitals. St. Michael's Hospital also ranked as number one among Ontario teaching hospitals when comparing the amount by which actual cost per weighted case was below the expected cost per weighted case. To achieve this standing, the hospital restructured the services it provided in response to the discovery of a debt that exceeded $60 million. A debt recovery plan was the initial driving force for change and it was the basis for the creation of a programmatic Strategic Plan. Later, the processes used to provide such services were re-engineered using the Patient Care Journey review. Programs continue to use information reports to monitor and continually improve utilization, quality of patient care and financial performance. The Health Services Restructuring Commission in Ontario recommended the closure of certain hospitals and the redistribution of their programs and services, based upon the same type of operational information. The combination of strategic planning, re-engineering and program reporting processes has been the backbone of the hospital's current position. In each of these processes, use of the RIW measure was instrumental.

CURRENT USE OF THE RIW IN MANAGEMENT AND OPERATIONAL DECISIONS

The RIW is used in most hospital information reports and plays a critical role in the area of decision support. Since the RIW reflects resource requirements it is important to review this measure in conjunction with other measures of quality, utilization and finance. Even though the RIW does not allow for much differentiation of resource requirements within a CMG, it does provide a basis for comparison across CMG and is an effective measure for strategic planning, process re-engineering for program operations and planning, for advocacy with the Ministry of Health regarding funding issues, and for planning regarding the Health Services Restructuring Commission's mediated hospital mergers.

Strategic Planning

Upon identification of financial issues in 1991, St. Michael's Hospital created a Strategic Plan that identified areas targeted for resource enhancements or reductions. Recognizing that the hospital could no longer be "all things to all people," a detailed review of program costs and activity was conducted so that an appropriate program configuration could be formulated. By grouping similar physician services together, clinical programs were conceived. Next, budgeting and operational planning exercises utilized program CMG volumes, RIW and lengths of stay to determine the proper financial budgets and bed allocations for the programs.

An example of such a review process was with the development of the Cardiac Services program. The program leadership began with the creation of a task force of diverse representation that reviewed the hospital activities relating to the treatment and prevention of heart disease. These activities were measured using key performance indicators that included RIW. An optimal program structure was formed based on the hospital's strengths in this particular area including clinical expertise, cost comparisons and volumes. The number of weighted cases was reviewed as part of the planning around volumes and became an essential component in the creation of the budget for the program. Estimates of resource requirements were obtained by comparing the RIW per planned case to historical estimates of case costs. The final program plans were submitted to the Board of Directors for approval.

Core and support programs were identified from the program exercises. The core programs conceived were: Inner City Health, Cardiovascular Services, and the Treatment/ Rehabilitation of Trauma Victims, Nutrition and Metabolism, Neuromusculoskeletal and Urology/ Renal/Endocrine/ENT/Ophthalmology (UREEO) Service (organized around the care of the complex diabetic). The support programs of diagnostic imaging, laboratory medicine and perioperative services were sized according to projected workload by the core programs. With the aid of these case mix tools, a streamlined and program-based organizational structure emerged. Built on the foundation of the strategic plan, the hospital programs were re-engineered to optimize their operations. The use of weighted case information was essential to this re-engineering effort and to the daily information needs of the program. The value of the weighted case assignment was fully appreciated when plans regarding outpatient clinic activity were required for complete development of the program. Unfortunately, there are no case weights assigned to outpatient clinic procedures and visits and therefore, case mix tools could not be used in resource planning.

Re-Engineering

In mid-1995, St. Michael's initiated a major process improvement project including a complete review of all patient care and support services. Entitled "The Patient Care Journey," this re-engineering effort was undertaken for a number of reasons including:

ð the announcement by the Ontario government, in 1995, of its intention to decrease hospital funding by approximately 5%, 6% and 8% in the next three consecutive years, with individual reductions to be determined by efficiency comparisons with other medium and large acute hospitals;

ð the evolution of the internal and external health care environment required a rethinking of all processes to ensure improved cost-effectiveness; and

ð the increasing pressure to control costs in the Toronto health care environment would require hospitals to improve productivity and customer satisfaction while keeping key staff.

The goals and objectives of the re-engineering project included:

ð redesign of the patient care process;
ð enhancement of the quality of care delivered;
ð enhancement of the quality of work life for physicians, staff and volunteers at SMH;
ð reduction of total patient care delivery costs by a minimum of 15% over 2 years;
ð maintenance of academic output;
ð maintenance of patient care volumes at current levels with an appropriate shift from inpatient to ambulatory and short stay services; and
ð development of an organizational capacity to continuously improve its basic processes.

The project began with an extensive start-up aimed at educating staff, physicians and other stakeholders about the planned process; interviewing and selecting consulting partners for the venture; recruiting internal project team members; and visiting other facilities that had completed similar activities. Once all team members were in place, two to three months were spent collecting benchmark information about best practices in Canada and the United States and establishing care delivery, financial, clinical and quality goals to be used in the redesign phase. This information included length of stay, case mix groups, budgets and case weight volume detail. It was important to consider estimates of the resource requirements using historical CMG weights to plan for program budgets and size.

A Clinical Resource Management group was established to review internal and external operational indices in detail. Its goal was to review lengths of stay, case volumes, weighted cases and ancillary resource utilization so that new targets and operational standards could be created. Once the targets were reached, the savings generated would constitute the achievement of a major portion of the overall goal, with the remainder of the savings to be derived from the review of all hospital processes, reduction in management staff and staff role redesign.

The process began with an assessment of the current level of operational utilization. Programs and individual physicians were compared against one another and a best practice external hospital. Standardization of resource requirements was created by normalizing based on the RIW measures. This allowed for accurate and reliable comparison measures. By totalling the number of RIW across programs, information on the amount of activity the program had conducted over a certain time period was provided. This information was categorized by CMG and reviewed on a physician by physician, service by service, or program by program basis.

With this information, initiatives for improvement were established. These included the formulation and implementation of clinical pathways, case management and the re-aggregation of beds to reduce costs and performance variability.

To monitor the effects of these initiatives, three new standard reports were developed. Each report provided new information in a format that is easily understood by the various users and each includes cost and RIW information. St. Michael's Hospital operates on the principle that, since the average cost per weighted case is determined by dividing the net cost by the total number of weighted cases, the estimated expected cost should be equal to the individual patient RIW multiplied by the hospital average cost per weighted case. This expected cost becomes the "target" cost for the inpatient or day surgery stay. Using this indicator in conjunction with other standard performance indicators, three new reports were created that included the *Balanced Scorecard*, *Program Activity Report* and the *Physician Profile*.

The Balanced Scorecard (Kaplan and Norton, 1992) was created to monitor the goals and objectives of the Patient Care Journey. The report is termed the Balanced Scorecard because it identifies financial, utilization, academic and quality indicators together. It is a very powerful report since it shows the total operational picture and variation in one specific area that may affect other areas of performance. For example, the decrease in costs of a particular area may trigger a decrease in total weighted cases or patient satisfaction ratings. The Balanced Scorecard allows management to obtain a picture of the entire hospital across all types of activities. The physician profile report and the program activity reports were developed in the Patient Care Journey redesign and have been used in program planning.

The Program Activity Report is a valuable tool for detailing utilization and financial indicators. Since information is organized by Case Mix Group (CMG), similar activities of high volume can be reviewed together. Large variations in performance indicators signal opportunities for improvement. Since there were many indicators and procedures conducted by the programs, it was important to sort the information by areas of greatest leverage potential. This allowed the programs to utilize the information in manageable units starting with those that had the greatest impact. Programs used this report to plan for and monitor their usage of ancillary resources such as of laboratory tests, operating room (OR) time and pharmacy costs. It was essential that the programs monitor the general ledger expense report against the activity credits (in terms of case weights) that were received through program activity. Total program costing at SMH was obtained through the hospital decision support/case costing program. This clinical activity database captures costs related to activities by linking hospital databases to the financial budgets and then to the individual patient information. The final product is patient level costing for tests, procedures and care received by a patient while in the hospital. Patients can then be grouped and their data summarized by case mix group, activities, physician, program, service and total hospital population. On a patient level, the expected costs are compared to the actual cost so that opportunities for improvement of resource use can be identified.

Even though program costing is important, the majority of costs are driven by physicians. Therefore, an operational report comparing individual physician practice and costs was produced on a CMG basis with the RIW totals grouped into programs. This allowed the programs to monitor the activity of each physician against every other and against an industry standard. By comparing individual physician activity adjusted for case mix and case weighting, judgements can be made on the efficiency of care, utilization of ancillary resources (laboratory, physical therapy, nursing workload, etc.) and quality of care using specified indicators. Typical and atypical case adjustments are made for outliers, so that an accurate profile of physician activity and patient flows can be tracked. A review of the cost, case weight (RIW) and volume variation per CMG revealed a number of opportunities for the development of clinical pathways to reduce and standardize resource consumption. Total hip replacements are an example of how standardization of care using a clinical pathway resulted in reduced lengths of stay and more efficient utilization of ancillary services. The creation of the pathways included the formation of a multidisciplinary team to review existing pathways at other institutions and create paths specific to SMH based on the indicators within the variance data. These data compare the eligibility of patient groups for a clinical pathway. The final report was the program report which facilitates operational program management and program planning as discussed below.

Program Planning and Operations

In conjunction with the standard program reports created for the patient care journey, corporate level operational indicators were reported in both a clinical activity report and on-line using a graphical display of the data. These reports were available hospital wide with monthly data updates. The total RIW and average RIW (RIW per discharge) were reviewed on a corporate, program, and service level to ensure that the volume of work and the acuity of patients was maintained in conjunction with financial, quality and other utilization indicators. Since the RIW is such a powerful indicator, two efficiency ratios, length of stay per RIW and total cost per RIW, were also monitored. This information allowed the hospital to see how efficiently a patient was being treated, standardized by the weighted case assignment. The ratios allowed both management and caregivers to determine the efficiency of their operations compared to their internal and external peers. Additionally, a target value for performance compared to a CIHI percentile benchmark was set. With the implementation of a cost accounting decision support system at St. Michael's Hospital, detailed costs were assigned to patients based on the activities or products received. With such a powerful system, the actual cost per patient, physician, service or program could be identified. By comparing the actual cost for a group of patients against Ministry Program funds or against expected costs (hospital average cost per weighted case x the weighted cases assigned to the patients), the hospital can identify areas that may cost more to provide than the credited value assigned by the RIW. Recently, St. Michael's Hospital has used this type of analysis to show what is believed to be inadequate compensation in the areas of Cardiovascular Surgery, Haemodialysis and Trauma. This is currently being reviewed by the Ontario Ministry of Health.

Ministry Funding Discussions

The RIW is an important measure in the calculation of actual cost per weighted case and expected cost per weighted case differentials. The expected cost per weighted case is calculated by adding premiums to a base rate depending on the services that are provided. These premiums may be for tertiary, newborn and teaching activity. For the past five years, SMH has had a positive expected minus actual cost per weighted case, and in 1995/96 it was the highest amongst Ontario teaching hospitals. The cost per case weight measure is important in that it enables SMH to highlight to the Ministry of Health that the proportionate reward for high efficiency provided by reduced funding cuts is minimal compared to the money saved by the hospital for operational effectiveness. Over the past four years, the savings achieved by reducing the cost per weighted case amount to greater than $35 million, while the savings achieved by a reduced funding cut are in the hundreds of thousands of dollars range. Therefore, even though SMH operates at a cost millions of dollars less than expected, the savings achieved by a smaller reduction in funding are small. The cost per weighted case indicator allows for change opportunity discussions with the Ministry of Health.

Restructuring Commission Directions

As SMH moves forward with the implementation of the Health Services Restructuring Commission's recommendations, the availability of appropriate tools such as utilization indicators is required. Of these, the RIW volume can provide information that is required in planning the movement of services from the Wellesley Hospital to SMH, to create appropriate program synergies. Patient acuity reviews and budget planning for patient volumes are made possible through RIW reviews of the two institutions. The addition of the complexity adjustment to the CMG methodology changes the case weight values at both institutions on a service by service basis. This information is important to consider when programs are negotiated and strategic plans are built between the two hospitals.

The RIW measures are also important to consider when physicians from both hospitals practice in the new environment. There are different utilization performance levels and standards at the two hospitals, and it is important that new expectations of the new medical staff are set regarding lengths of stay, case weights and patient volumes. The impacts of program transfers from the Wellesley hospital on resource consumption can be minimized by monitoring changes in case weights, lengths of stay and volumes compared to budget.

The RIW indicator has been used extensively at SMH in the development of a strategic plan, planning for change with the re-engineering effort and the operations of its programs. Now that an adjustment for case complexity has been incorporated into this indicator, the strategic decisions that were made with the old measures may no longer be valid. The assumptions of The Patient Care Journey that led to re-engineering recommendations may be inaccurate now that the RIW assignment has changed. Program planners will see different weighted case assignments for the CMG and may experience an increase or decrease in total weighted cases simply because the methodology has changed. SMH has reviewed all of its inpatient activity between the old and new methodologies to quantify some of these impacts.

IMPACT ANALYSIS OF A COMPLEXITY ADJUSTMENT

The data for St. Michael's Hospital inpatients from April 1996 to December 1996 were reviewed. Each patient case was summarized according to the length of stay, RIW and cost indicators (i.e. direct, indirect, total, and average cost per case). Calculated fields included summaries and averages of each indicator as well as a variance analysis comparing the old and new complexity adjusted RIW. The effects of the complexity levels were then examined from a cost, weighted case and length of stay perspective. For the overall hospital cases, the total number of weighted cases remains unchanged with the addition of complexity level adjustments to the Resource Intensity Weights (see Table 1). This is congruent with the 0.3% change reported by HMRU (1997) in the Management Practice Atlas for the TAHSC hospitals who analysed St. Michael's Hospital 1995/96 data and compared the total weighted cases calculated with and without the complexity assignment.

However, a number of significant changes were noted when the various complexity levels were examined in detail. The breakdown by individual Complexity CMG showed some groups with significant RIW increases or decreases. This is of particular interest to the programs that do high volumes of this work. By reviewing the significantly affected Complexity CMG by level, the areas of opportunity and threat could be identified. To accurately identify the impact of complexity on weighted cases, the full range of data elements needed to be reviewed concurrently. The data were therefore reviewed by Complexity Level, Complexity CMG and program. This type of analysis allowed for the identification of areas that were significantly affected by the change.

Table 1: Comparison of CMG™ 96 and Complexity 97 Methodologies in LOS and RIW™ (Apr. 1996—Dec. 1996 in SMH)

LEVEL	CASES	TOTAL LOS				TOTAL RIW™			
		ACTUAL	EXPECTED	VARIANCE	% VARIANCE	CMG™ 96	PIx™ 97	VARIANCE	% VARIANCE
	(1)	(2)	(3)	(4) = (3) - (2)	(5) = (4)/(2)	(6)	(7)	(8) = (7) - (6)	(9) = (8)/(6)
1	6,877	33,987	32,871	-1,115	-3.3	11,330	10,702	-627.11	-5.5
2	1,120	11,342	10,754	-588	-5.2	3,404	3,399	-5.34	-0.2
3	480	6,977	6,123	-854	-12.2	1,746	1,927	181.59	10.4
4	403	13,669	11,467	-2,202	-16.1	3,020	3,525	504.85	16.7
8	1,860	6,889	6,477	-412	-6.0	2,119	2,122	2.34	0.1
9	2,925	7,314	7,846	532	7.3	1,415	1,419	3.33	0.2
TOTAL	**13,665**	**80,178**	**75,539**	**-4,639**	**-5.8**	**23,035**	**23,094**	**59.58**	**0.3**

LEVEL	EXPECTED COST			ACTUAL	COST VARIANCE *			
	CMG™ 96	PIx™ 97	VARIANCE	COST *	CMG™ 96	% VARIANCE	PIx™ 97	% VARIANCE
	(10) = (6)*$3688	(11) = (7)*$3688	(12) = (11) - (10)	(13)	(14) = (13) - (10)	(15) = (14)/(10)	(16) = (13) - (11)	(17) = (16)/(11)
1	$41,783,246	$39,470,451	($2,312,795)	$32,089,653	($9,693,593)	-23.2	($7,380,798)	-23.0
2	$12,555,539	$12,535,837	($19,703)	$12,184,560	($370,979)	-3.0	($351,276)	-2.9
3	$6,438,504	$7,108,222	$669,717	$6,798,305	$359,801	5.6	($309,916)	-4.6
4	$11,138,508	$13,000,381	$1,861,873	$17,293,822	$6,155,314	55.3	$4,293,441	24.8
8	$7,816,194	$7,824,837	$8,643	$7,810,260	($5,934)	-0.1	($14,577)	-0.2
9	$5,219,807	$5,232,105	$12,298	$5,249,683	$29,876	0.6	$17,579	0.3
TOTAL	**$84,951,799**	**$85,171,832**	**$220,033**	**$81,426,285**	**($3,525,515)**	**-4.2**	**($3,745,548)**	**-4.6**

* Fictitious costs for the sake of example

Level Analysis

There are significant variations in the RIW assignments by Plx level when the Complexity 96 (pilot version) is considered. The **average RIW** is reduced only slightly for the first level complexity and increased more significantly for Plx levels three and four. Plx levels 2, 8, and 9 remain about the same (see Figure 1). When considering the actual volume of cases and **total case weights**, the variance across complexity levels changed significantly. The high volume of Plx level 1 cases with a small RIW reduction was balanced by the relatively low volume of level 3 and 4 cases with a large increase in average RIW. Interestingly, the percentage decrease for Plx level 1 is much lower than the percentage increase for either Plx level 3 or 4, but since the volume of level 1 cases is 3.5 times greater than levels 2, 3 and 4 combined, there was a balancing effect. When we consider the RIW change in terms of total weighted cases difference, we notice that the level one cases drop by 627 weighted cases due to the relatively large volume of cases. The level 3 and 4 increase in case weights of 686 balances the level 1 decrease (see Figure 2).

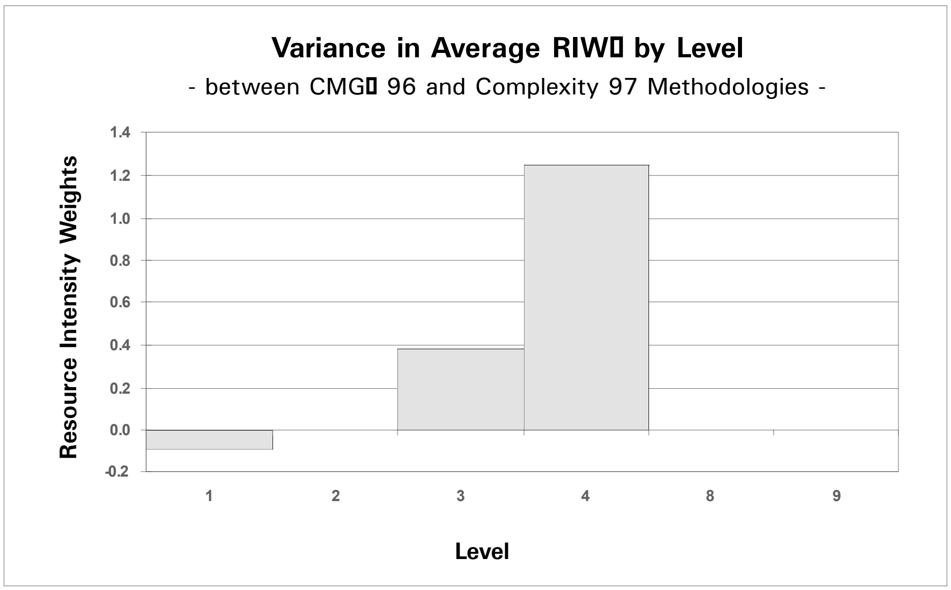

Figure 1: Variance in Average RIW™ by Level

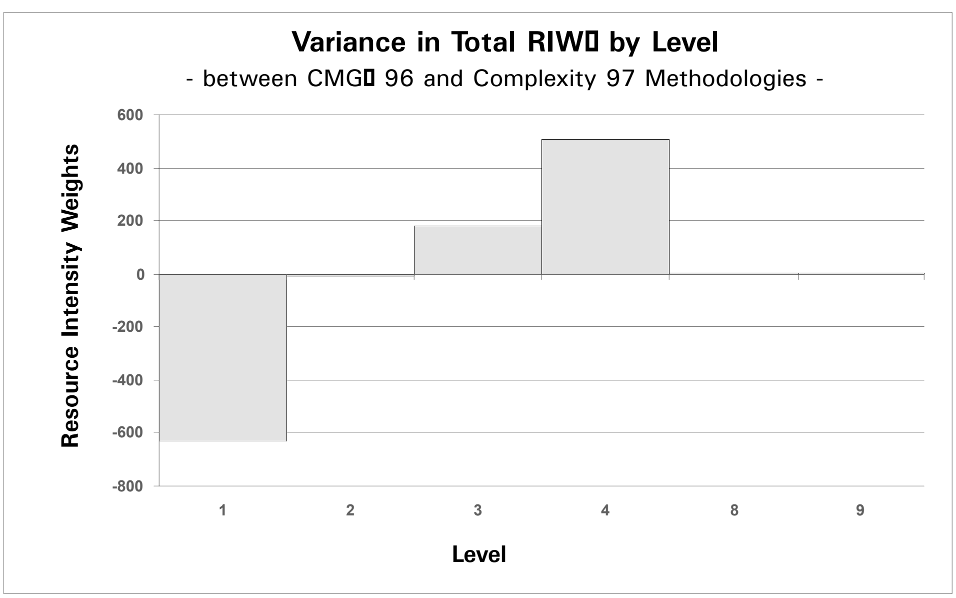

Figure 2: Variance in Total RIW™ by Level

From a cost estimation perspective, the new RIW is a better estimation of costs on Complexity Levels 1 to 4. To estimate the **expected** cost using the old and new RIW, it was assumed that the dollar value cost credit per weighted cases was equal to the average cost per weighted case for the hospital. This value multiplied by the weighted case assignment gives an estimate of the expected cost per weighted case. The expected versus actual cost comparison is a good indicator of operational efficiency, since it compares cost and activity against an institutional average. The variance between expected and average cost was highest for Plx level 1 cases at 9.6 versus 7.4 million dollars for the old and new methodologies respectively. Even though the RIW value has decreased, the actual costs remain much lower than the expected costs based on the average cost per weighted case. There is a higher expected cost to treat the more complex patients in level 4 than in the other levels. For this level the variation between actual versus expected cost is reduced from 6.1 million to 4.2 million with the implementation of the complexity methodology. The ability of the new methodology to more accurately reflect resource requirements is enhanced by introducing complexity levels, however, the cost variance—calculated as expected cost (average cost per weighted case x RIW) minus actual cost—is still high. This suggests that the level adjustment may not be large enough at the extremes. The variation between expected and actual cost is reduced with the use of the complexity adjusted RIW when individual levels are examined. A summation of all levels shows a higher variation with the new methodology from a cost estimation perspective (see Table 1).

CMG Analysis

On a more detailed level, a list of Complexity CMG with a variance of greater than 10 total case weights was reviewed. For the patient volume at St. Michael's Hospital, the greatest single CMG change as a result of the complexity adjustment was for Kidney Transplants (CMG 500). The 283 case weight increase was significant when compared to the 46 weighted case decrease in the top CMG with reduced RIW (craniotomy procedures, CMG 2). There were 17 CMG that had greater than a 10 weighted case reduction versus 12 CMG that had an increase of greater than 10 weighted cases. Generally, the case weight reductions occurred in the craniotomy and open heart procedures, while the areas of increase were kidney transplant, tracheostomy and leukemia procedures (see Table 2).

The CMG with a variation of greater than 10 case weights resulting from the new methodology were examined. Level one had 21 CMG with a decrease in total weighted cases while there were 4 CMG with an increase. Level 2 showed 3 CMG with a decrease in total weighted cases and 2 CMG with an increase. The pattern reverses for Plx levels 3 and 4. Level 3 had one CMG decrease and two increase. All seven CMG that fell into level 4 had increased weighted cases (see Table 3).

Table 2: Comparison of CMG™ 96 and Complexity 97 Methodologies in LOS, RIW™ and Cost (Apr. 1996—Dec. 1996 in SMH)

CMG™	CMG™ DESCRIPTION	SERVICE	CASES (1)	TOTAL LOS: ACTUAL (2)	TOTAL LOS: EXPECTED (3)	TOTAL LOS: VARIANCE (4) = (3) - (2)	TOTAL LOS: % VARIANCE (5) = (4)/(2)	TOTAL RIW™: CMG™ 96 (6)	TOTAL RIW™: PIx™ 97 (7)	TOTAL RIW™: VARIANCE (8) = (7) - (6)	TOTAL RIW™: % VARIANCE (9) = (8)/(6)
2	CRANIOTOMY PROCEDURES WITH CC	NS	108	1,868	1,585	-283	-15.2	555.76	510.12	-45.64	-8.2
188	PACEMAKER IMPLANT EXCEPT FOR AMI, HEART FAILURE OR SHOCK	CVS	135	906	1,146	240	26.5	388.85	352.35	-36.50	-9.4
178	CARDIAC VALVE PROCEDURES WITH CARDIAC CATH	CVS	110	1,875	1,981	106	5.6	731.62	695.93	-35.69	-4.9
189	PACEMAKER IMPLANT FOR AMI, HEART FAILURE OR SHOCK	CVS	118	509	549	40	7.9	266.33	232.91	-33.42	-12.5
503	DIALYSIS PROCEDURES	URO	59	877	514	-363	-41.4	205.37	179.87	-25.50	-12.4
177	CARDIAC VALVE PROCEDURES WITHOUT CARDIAC CATH	CVS	87	943	995	52	5.5	558.24	533.55	-24.69	-4.4
1	CRANIOTOMY PROCEDURES WITHOUT CC	NS	172	1,501	1,525	24	1.6	581.69	557.15	-24.54	-4.2
370	MAJOR LOWER EXTREMITY PROCEDURES, AGE > 70 WITH CC	ORT	42	260	198	-62	-23.8	92.55	69.00	-23.55	-25.4
372	MAJOR LOWER EXTREMITY PROCEDURES WITH CC	ORT	38	156	127	-29	-18.8	71.98	54.73	-17.24	-24.0
280	DIGESTIVE SYSTEM MALIGNANCY WITH CC	GAS	46	675	374	-301	-44.5	132.77	115.91	-16.86	-12.7
731	LYMPHOMA AND CHRONIC LEUKEMIA AGE < 70 WITH CC OR AGE > 70 WITHOUT CC	HAE	47	530	399	-131	-24.8	126.42	109.57	-16.84	-13.3
131	RESPIROLOGY NEOPLASMS	RES	91	1,425	795	-630	-44.2	288.19	271.77	-16.41	-5.7
356	FRACTURED FEMUR PROCEDURES WITH CC	ORT	48	744	724	-20	-2.7	177.96	161.81	-16.15	-9.1
194	WITHOUT CARDIOVASCULAR COMPLICATIONS	CAR	26	58	59	1	2.2	51.99	37.82	-14.17	-27.3
804	TRAUMA AGE < 70 WITH CC OR AGE > 70 W/O CC	TRA	71	413	474	61	14.7	162.66	150.73	-11.94	-7.3
8	OTHER NEUROLOGICAL PROCEDURES WITH CC	NS	10	53	39	-14	-25.8	24.20	12.42	-11.77	-48.7
56	LENS INSERTION WITHOUT CC (MNRH)	EYE	52	75	73	-2	-2.9	35.30	24.44	-10.86	-30.8

Table 2 (cont'd): Comparison of CMG™ 96 and Complexity 97 Methodologies in LOS, RIW™ and Cost (Apr. 1996—Dec. 1996 in SMH)

CMG™	EXPECTED COST			ACTUAL COST *	COST VARIANCE *			
	CMG™ 96 (10) = (6)*$3688	Plx™ 97 (11) = (7)*$3688	VARIANCE (12) = (11) - (10)	(13)	CMG™ 96 (14) = (13) - (10)	% VARIANCE (15) = (14)/(10)	Plx™ 97 (16) = (13) - (11)	% VARIANCE (17) = (16)/(11)
2	$2,049,636.5	$1,881,333.2	($168,303.4)	$1,982,300.9	($67,335.6)	-3.3	$100,967.7	5.1
188	$1,434,068.7	$1,299,466.8	($134,601.9)	$953,846.6	($480,222.1)	-33.5	($345,620.2)	-36.2
178	$2,698,206.1	$2,566,591.3	($131,614.8)	$2,619,995.7	($78,210.4)	-2.9	$53,404.4	2.0
189	$982,227.7	$858,987.9	($123,239.8)	$495,481.8	($486,745.9)	-49.6	($363,506.1)	-73.4
503	$757,409.5	$663,372.7	($94,036.7)	$835,210.8	$77,801.3	10.3	$171,838.0	20.6
177	$2,058,801.4	$1,967,736.1	($91,065.3)	$2,285,347.5	$226,546.1	11.0	$317,611.5	13.9
1	$2,145,273.6	$2,054,766.5	($90,507.1)	$1,601,828.7	($543,444.9)	-25.3	($452,937.8)	-28.3
370	$341,342.8	$254,472.4	($86,870.3)	$266,048.6	($75,294.2)	-22.1	$11,576.1	4.4
372	$265,448.2	$201,849.4	($63,598.7)	$196,060.2	($69,388.0)	-26.1	($5,789.2)	-3.0
280	$489,672.0	$427,487.5	($62,184.5)	$435,728.3	($53,943.7)	-11.0	$8,240.8	1.9
731	$466,232.2	$404,108.6	($62,123.6)	$456,239.7	($9,992.5)	-2.1	$52,131.1	11.4
131	$1,062,837.0	$1,002,300.0	($60,537.0)	$986,499.9	($76,337.0)	-7.2	($15,800.1)	-1.6
356	$656,311.2	$596,747.9	($59,563.3)	$639,968.1	($16,343.1)	-2.5	$43,220.2	6.8
194	$191,730.0	$139,465.3	($52,264.7)	$70,615.1	($121,114.8)	-63.2	($68,850.1)	-97.5
804	$599,901.6	$555,874.5	($44,027.1)	$495,785.0	($104,116.6)	-17.4	($60,089.5)	-12.1
8	$89,241.9	$45,818.2	($43,423.6)	$66,582.5	($22,659.4)	-25.4	$20,764.2	31.2
56	$130,196.7	$90,148.1	($40,048.6)	$101,443.5	($28,753.2)	-22.1	$11,295.4	11.1

* Fictitious costs for the sake of example

Generally, as the RIW are increased under the new methodology, the expected cost variance increased because the calculation for expected cost is based on the RIW multiplied by a constant. However, to obtain the cost variance the new and old expected costs are subtracted from the actual cost. There is no apparent pattern between levels and the cost variance since the actual costs are sometimes greater than or less than the expected cost (see Table 3).

Program Analysis

When the CMG are grouped by program, the total impact of the weights at each Plx level can be determined. All hospital programs experience a change in RIW due to adjustments for complexity at all levels. Each of the programs except Urology/Renal/Endocrine/ENT/Ophthalmology (UREEO) show a decrease in weighted cases for level one and an increase for level four. The UREEO program has an increase in all levels that was primarily due to the level one increase in the Kidney Transplant RIW. All programs experienced an increase in cases at Plx level 2 and level 3 except for the decrease in Plx level 2 in the heart program. This is primarily because the significant weighted case reductions in level 2 are for valve procedures with cardiac catheterization, coronary bypass without cardiac catheterization and pacemaker implant for AMI (heart failure or shock). These are all CMG belonging to the Heart program (see Table 4).

Table 3: Comparison of CMG™ and Complexity Methodologies in LOS, RIW™, and Cost (Apr. 1996—Dec. 1996 in SMH)

Top CMG™ at Level 1 with RIW™ Decrease

CMG™	CMG™ DESCRIPTION	SERVICE	CASES	TOTAL LOS				TOTAL RIW™			
			(1)	ACTUAL (2)	EXPECTED (3)	VARIANCE (4) = (3) - (2)	% VARIANCE (5) = (4)/(2)	CMG™ 96 (6)	PIx™ 97 (7)	VARIANCE (8) = (7) - (6)	% VARIANCE (9) = (8)/(6)
2	CRANIOTOMY PROCEDURES WITH CC	NS	56	818	442	-376	-45.9	274.11	229.49	-44.62	-16.3
804	OTHER PROCEDURES FOR DIAGNOSIS OF TRAUMA AGE < 70 WITH CC OR AGE > 70 W/O CC	TRA	61	230	304	74	32.2	122.25	95.04	-27.21	-22.3
188	PACEMAKER IMPLANT EXCEPT FOR AMI, HEART FAILURE OR SHOCK	CVS	96	569	737	168	29.4	256.79	230.00	-26.79	-10.4
370	MAJOR LOWER EXTREMITY PROCEDURES, AGE > 70 WITH CC	ORT	36	214	143	-71	-33.4	80.86	55.03	-25.83	-31.9
177	CARDIAC VALVE PROCEDURES WITHOUT CARDIAC CATH	CVS	31	206	273	67	32.4	172.15	147.40	-24.76	-14.4
356	FRACTURED FEMUR PROCEDURES WITH CC	ORT	27	268	258	-10	-3.8	80.54	57.93	-22.61	-28.1
189	PACEMAKER IMPLANT FOR AMI, HEART FAILURE OR SHOCK	CVS	55	191	140	-51	-26.5	117.64	96.83	-20.81	-17.7
503	DIALYSIS PROCEDURES	URO	42	227	131	-96	-42.3	88.48	67.99	-20.49	-23.2
363	BACK AND NECK PROCEDURES WITH FUSION, AGE > 65	NS	21	171	177	6	3.6	79.45	62.35	-17.11	-21.5
253	MAJOR INTESTINAL AND RECTAL PROCEDURES WITH CC	SUR	53	853	491	-362	-42.4	202.76	185.77	-16.99	-8.4
131	RESPIROLOGY NEOPLASMS	RES	50	668	340	-328	-49.1	144.15	127.36	-16.79	-11.6
13	SPECIFIC CEREBROVASCULAR DISORDERS EXCEPT TRANSIENT ISCHEMIC ATTACKS	NS	87	685	757	72	10.5	155.84	139.78	-16.05	-10.3
1	CRANIOTOMY PROCEDURES WITHOUT CC	NS	165	1,316	1,304	-13	-1.0	525.35	510.30	-15.04	-2.9
372	MAJOR LOWER EXTREMITY PROCEDURES WITH CC	ORT	33	111	81	-30	-26.8	56.03	42.31	-13.72	-24.5
731	LYMPHOMA AND CHRONIC LEUKEMIA AGE < 70 WITH CC OR AGE > 70 WITHOUT CC	HAE	27	183	173	-10	-5.4	53.40	40.41	-12.99	-24.3
222	PERCUTANEOUS TRANSLUMINAL CORONARY ANGIOPLASTY (PTCA)	CVS	42	263	237	-26	-9.9	59.04	46.05	-12.98	-22.0
125	MAJOR CHEST PROCEDURES	RES	37	349	281	-68	-19.4	111.37	98.77	-12.60	-11.3
8	PERIPHERAL, CRANITAL NERVE AND OTHER NEUROLOGICAL PROCEDURES WITH CC	NS	9	46	29	-17	-37.6	21.61	10.03	-11.58	-53.6
280	DIGESTIVE SYSTEM MALIGNANCY WITH CC	GAS	27	377	155	-222	-58.9	70.87	60.19	-10.68	-15.1
140	SIMPLE PNEUMONIA AND PLEURISY AGE 18-69 WITH CC OR AGE > 70 WITHOUT CC	RES	47	289	269	-20	-6.8	59.73	49.54	-10.19	-17.1
194	ACUTE MYOCARDIAL INFARCTION WITHOUT CARDIOVASCULAR COMPLICATIONS	CAR	24	35	46	11	30.3	42.97	32.87	-10.10	-23.5

Top CMG™ at Level 1with RIW™ Increase

CMG™	CMG™ DESCRIPTION	SERVICE	CASES	TOTAL LOS				TOTAL RIW™			
			(1)	ACTUAL (2)	EXPECTED (3)	VARIANCE (4) = (3) - (2)	% VARIANCE (5) = (4)/(2)	CMG™ 96 (6)	PIx™ 97 (7)	VARIANCE (8) = (7) - (6)	% VARIANCE (9) = (8)/(6)
500	KIDNEY TRANSPLANT	URO	26	216	264	48	22.3	150.05	289.34	139.29	92.8
803	OTHER PROCEDURES FOR DIAGNOSIS OF TRAUMA AGE < 70 WITHOUT CC	TRA	35	134	150	16	11.6	48.79	60.20	11.41	23.4
726	ACUTE LEUKEMIA WITHOUT LYMPHOMA PROCEDURES WITHOUT CC	HAE	9	126	68	-58	-46.0	32.85	43.37	10.52	32.0
357	FRACTURED FEMUR PROCEDURES WITHOUT CC	ORT	63	483	701	218	45.1	137.25	149.43	12.18	8.9

Top CMG™ at Level 2 with RIW™ Decrease

CMG™	CMG™ DESCRIPTION	SERVICE	CASES	TOTAL LOS				TOTAL RIW™			
			(1)	ACTUAL (2)	EXPECTED (3)	VARIANCE (4) = (3) - (2)	% VARIANCE (5) = (4)/(2)	CMG™ 96 (6)	PIx™ 97 (7)	VARIANCE (8) = (7) - (6)	% VARIANCE (9) = (8)/(6)
178	CARDIAC VALVE PROCEDURES WITH CARDIAC CATH	CVS	63	910	1,014	104	11.5	369.15	335.65	-33.50	-9.1
179	CORONARY BYPASS WITHOUT CARDIAC CATH	CVS	237	1,570	2,038	468	29.8	885.63	857.38	-28.26	-3.2
189	PACEMAKER IMPLANT FOR AMI, HEART FAILURE OR SHOCK	CVS	55	253	341	88	34.8	122.14	111.17	-10.97	-9.0

Top CMG™ at Level 2 with RIW™ Increase

CMG™	CMG™ DESCRIPTION	SERVICE	CASES	TOTAL LOS				TOTAL RIW™			
			(1)	ACTUAL (2)	EXPECTED (3)	VARIANCE (4) = (3) - (2)	% VARIANCE (5) = (4)/(2)	CMG™ 96 (6)	PIx™ 97 (7)	VARIANCE (8) = (7) - (6)	% VARIANCE (9) = (8)/(6)
500	KIDNEY TRANSPLANT	URO	4	44	46	2	3.9	23.08	43.33	20.24	87.7
427	SKIN GRAFT & WOUNDED DEBRIDENENT FOR SKIN ULCER OR CELLULITIS	PLA	5	57	146	89	156.7	14.27	24.32	10.05	70.4

Top CMG™ at Level 3 with RIW™ Decrease

CMG™	CMG™ DESCRIPTION	SERVICE	CASES	TOTAL LOS				TOTAL RIW™			
			(1)	ACTUAL (2)	EXPECTED (3)	VARIANCE (4) = (3) - (2)	% VARIANCE (5) = (4)/(2)	CMG™ 96 (6)	PIx™ 97 (7)	VARIANCE (8) = (7) - (6)	% VARIANCE (9) = (8)/(6)
727	ACUTE LEUKEMIA WITHOUT LYMPHOMA PROCEDURES WITH CC	HAE	9	302	148	-154	-50.9	92.32	78.49	-13.82	-15.0

Top CMG™ at Level 3 with RIW™ Increase

CMG™	CMG™ DESCRIPTION	SERVICE	CASES	TOTAL LOS				TOTAL RIW™			
			(1)	ACTUAL (2)	EXPECTED (3)	VARIANCE (4) = (3) - (2)	% VARIANCE (5) = (4)/(2)	CMG™ 96 (6)	PIx™ 97 (7)	VARIANCE (8) = (7) - (6)	% VARIANCE (9) = (8)/(6)
500	KIDNEY TRANSPLANT	URO	14	168	220	52	31.0	80.80	164.56	83.76	103.7
179	CORONARY BYPASS WITHOUT CARDIAC CATH	CVS	48	409	470	61	15.0	188.86	200.91	12.06	6.4

Top CMG™ at Level 4 with RIW™ Increase

CMG™	CMG™ DESCRIPTION	SERVICE	CASES	TOTAL LOS				TOTAL RIW™			
			(1)	ACTUAL (2)	EXPECTED (3)	VARIANCE (4) = (3) - (2)	% VARIANCE (5) = (4)/(2)	CMG™ 96 (6)	PIx™ 97 (7)	VARIANCE (8) = (7) - (6)	% VARIANCE (9) = (8)/(6)
40	TRACHEOSTOMY & GASTORSTOMY PROCEDURES	SUR	32	2,425	2,579	154	6.4	489.62	632.08	142.47	29.1
727	ACUTE LEUKEMIA WITHOUT LYMPHOMA PROCEDURES WITH CC	HAE	11	337	344	7	2.2	120.63	164.57	43.94	36.4
500	KIDNEY TRANSPLANT	URO	5	74	120	46	62.0	28.17	68.60	40.43	143.5
179	CORONARY BYPASS WITHOUT CARDIAC CATH	CVS	26	502	406	-96	-19.2	163.38	194.37	30.99	19.0
253	MAJOR INTESTINAL AND RECTAL PROCEDURES WITH CC	SUR	14.00	638	309	-329	-51.5	112.86	141.16	28.30	25.1
127	OTHER RESPAROLOGY PROCEDURES WITH CC	RES	7.00	415	356	-59	-14.2	88.24	110.74	22.50	25.5
363	BACK AND NECK PROCEDURES WITH FUSION, AGE > 65	NS	4.00	175	107	-68	-39.0	36.04	49.36	13.32	36.9

Table 3 (cont'd): Comparison of CMG™ and Complexity Methodologies in LOS, RIW™, and Cost (Apr. 1996—Dec. 1996 in SMH)

Top CMG™ at Level 1 with RIW™ Decrease

CMG™	EXPECTED COST			ACTUAL	COST VARIANCE *			
	CMG™ (10) = (6)*$3688	PIx™ (11) = (7)*$3688	VARIANCE (12) = (11) - (10)	COST * (13)	CMG™ 96 (14) = (13) - (10)	% VARIANCE (15) = (14)/(10)	PIx™ 97 (16) = (13) - (11)	% VARIANCE (17) = (16)/(11)
2	$1,010,900.9	$846,349.7	($164,551.2)	$822,562.1	($188,338.7)	-18.6	($23,787.6)	-2.9
804	$450,844.9	$350,504.6	($100,340.2)	$278,435.9	($172,408.9)	-38.2	($72,068.7)	-25.9
188	$947,050.1	$848,256.5	($98,793.6)	$626,268.0	($320,782.1)	-33.9	($221,988.6)	-35.4
370	$298,210.2	$202,961.1	($95,249.1)	$221,637.9	($76,572.3)	-25.7	$18,676.8	8.4
177	$634,895.4	$543,595.3	($91,300.1)	$634,315.3	($580.1)	-0.1	$90,719.9	14.3
356	$297,028.2	$213,639.3	($83,388.9)	$260,866.5	($36,161.8)	-12.2	$47,227.2	18.1
189	$433,872.7	$357,110.0	($76,762.8)	$187,800.5	($246,072.2)	-56.7	($169,309.4)	-90.2
503	$326,319.4	$250,745.6	($75,573.8)	$188,771.5	($137,547.9)	-42.2	($61,974.1)	-32.8
363	$293,017.5	$229,929.2	($63,088.4)	$209,854.7	($83,162.8)	-28.4	($20,074.5)	-9.6
253	$747,778.8	$685,130.6	($62,648.2)	$650,192.2	($97,586.6)	-13.1	($34,938.5)	-5.4
131	$531,621.5	$469,707.4	($61,914.1)	$419,033.4	($112,588.1)	-21.2	($50,674.0)	-12.1
13	$574,733.3	$515,525.8	($59,207.6)	$448,855.7	($125,877.6)	-21.9	($66,670.1)	-14.9
1	$1,937,472.9	$1,882,000.2	($55,472.7)	$1,350,574.7	($586,898.2)	-30.3	($531,425.5)	-39.3
372	$206,644.9	$156,028.2	($50,616.7)	$154,790.3	($51,854.6)	-25.1	($1,237.9)	-0.8
731	$196,948.4	$149,024.4	($47,923.9)	$126,570.8	($70,377.6)	-35.7	($22,453.6)	-17.7
222	$217,729.6	$169,845.0	($47,884.5)	$185,877.9	($31,851.6)	-14.6	$16,032.9	8.6
125	$410,732.6	$364,266.6	($46,466.0)	$204,985.6	($205,747.0)	-50.1	($159,281.0)	-77.7
8	$79,689.3	$36,983.2	($42,706.2)	$59,920.1	($19,769.2)	-24.8	$22,936.9	38.3
280	$261,364.1	$221,974.8	($39,389.3)	$226,402.8	($34,961.3)	-13.4	$4,428.0	2.0
140	$220,284.1	$182,706.5	($37,577.5)	$190,461.3	($29,822.7)	-13.5	$7,754.8	4.1
194	$158,455.1	$121,213.6	($37,241.4)	$44,233.6	($114,221.5)	-72.1	($76,980.1)	-174.0

Top CMG™ at Level 1with RIW™ Increase

CMG™	EXPECTED COST			ACTUAL	COST VARIANCE *			
	CMG™ 96 (10) = (6)*$3688	PIx™ 97 (11) = (7)*$3688	VARIANCE (12) = (11) - (10)	COST * (13)	CMG™ 96 (14) = (13) - (10)	% VARIANCE (15) = (14)/(10)	PIx™ 97 (16) = (13) - (11)	% VARIANCE (17) = (16)/(11)
500	$553,379.2	$1,067,080.0	$513,700.8	$327,520.9	($225,858.4)	-40.8	($739,559.2)	-225.8
803	$179,951.7	$222,030.5	$42,078.8	$154,832.0	($25,119.7)	-14.0	($67,198.5)	-43.4
726	$121,161.1	$159,945.6	$38,784.5	$67,576.0	($53,585.1)	-44.2	($92,369.6)	-136.7
357	$506,166.1	$551,103.7	$44,937.7	$398,772.1	($107,394.0)	-21.2	($152,331.6)	-38.2

Top CMG™ at Level 2 with RIW™ Decrease

CMG™	EXPECTED COST			ACTUAL	COST VARIANCE *			
	CMG™ (10) = (6)*$3688	PIx™ (11) = (7)*$3688	VARIANCE (12) = (11) - (10)	COST * (13)	CMG™ 96 (14) = (13) - (10)	% VARIANCE (15) = (14)/(10)	PIx™ 97 (16) = (13) - (11)	% VARIANCE (17) = (16)/(11)
178	$1,361,419.7	$1,237,859.1	($123,560.5)	$1,208,653.8	($152,765.9)	-11.2	($29,205.3)	-2.4
179	$3,266,207.4	$3,162,002.5	($104,205.0)	$2,873,374.6	($392,832.8)	-12.0	($288,627.8)	-10.0
189	$450,467.1	$410,000.5	($40,466.6)	$249,646.4	($200,820.6)	-44.6	($160,354.0)	-64.2

Top CMG™ at Level 2 with RIW™ Increase

CMG™	EXPECTED COST			ACTUAL	COST VARIANCE *			
	CMG™ 96 (10) = (6)*$3688	PIx™ 97 (11) = (7)*$3688	VARIANCE (12) = (11) - (10)	COST * (13)	CMG™ 96 (14) = (13) - (10)	% VARIANCE (15) = (14)/(10)	PIx™ 97 (16) = (13) - (11)	% VARIANCE (17) = (16)/(11)
500	$85,135.3	$159,793.7	$74,658.4	$59,588.4	($25,546.8)	-30.0	($100,205.2)	-168.2
427	$52,624.1	$89,686.6	$37,062.6	$70,278.4	$17,654.3	33.5	($19,408.2)	-27.6

Top CMG™ at Level 3 with RIW™ Decrease

CMG™	EXPECTED COST			ACTUAL	COST VARIANCE *			
	CMG™ 96 (10) = (6)*$3688	PIx™ 97 (11) = (7)*$3688	VARIANCE (12) = (11) - (10)	COST * (13)	CMG™ 96 (14) = (13) - (10)	% VARIANCE (15) = (14)/(10)	PIx™ 97 (16) = (13) - (11)	% VARIANCE (17) = (16)/(11)
727	$340,460.3	$289,479.7	($50,980.6)	$271,528.1	($68,932.2)	-20.2	($17,951.6)	-6.6

Top CMG™ at Level 3 with RIW™ Increase

CMG™	EXPECTED COST			ACTUAL	COST VARIANCE *			
	CMG™ 96 (10) = (6)*$3688	PIx™ 97 (11) = (7)*$3688	VARIANCE (12) = (11) - (10)	COST * (13)	CMG™ 96 (14) = (13) - (10)	% VARIANCE (15) = (14)/(10)	PIx™ 97 (16) = (13) - (11)	% VARIANCE (17) = (16)/(11)
500	$297,973.4	$606,882.5	$308,909.1	$228,246.5	($69,726.9)	-23.4	($378,636.0)	-165.9
179	$696,500.9	$740,969.4	$44,468.4	$725,608.8	$29,107.8	4.2	($15,360.6)	-2.1

Top CMG™ at Level 4 with RIW™ Increase

CMG™	EXPECTED COST			ACTUAL	COST VARIANCE *			
	CMG™ 96 (10) = (6)*$3688	PIx™ 97 (11) = (7)*$3688	VARIANCE (12) = (11) - (10)	COST * (13)	CMG™ 96 (14) = (13) - (10)	% VARIANCE (15) = (14)/(10)	PIx™ 97 (16) = (13) - (11)	% VARIANCE (17) = (16)/(11)
40	$1,805,703.8	$2,331,122.8	$525,419.0	$3,273,785.1	$1,468,081.3	81.3	$942,662.3	28.8
727	$444,884.9	$606,933.8	$162,048.9	$336,084.0	($108,800.9)	-24.5	($270,849.8)	-80.6
500	$103,883.6	$252,978.4	$149,094.8	$130,448.3	$26,564.7	25.6	($122,530.1)	-93.9
179	$602,550.6	$716,839.5	$114,288.9	$1,142,299.3	$539,748.7	89.6	$425,459.8	37.2
253	$416,226.2	$520,595.1	$104,368.9	$644,202.2	$227,976.0	54.8	$123,607.1	19.2
127	$325,439.1	$408,406.5	$82,967.5	$843,070.1	$517,631.0	159.1	$434,663.6	51.6
363	$132,927.3	$182,042.6	$49,115.3	$186,457.1	$53,529.8	40.3	$4,414.5	2.4

* Fictitious costs for the sake of example

Table 4: Comparison of CMG™ and Complexity Methodologies in LOS and RIW™ (Apr. 1996—Dec. 1996 in SMH)

Heart Program

TOTAL LOS

LEVEL	CASES	AVG LOS			AVG RIW™		
		ACTUAL	EXPECTED	VARIANCE	CMG™ 96	PIx™ 97	VARIANCE
	(1)	(2)	(3)	(4) = (3) - (2)	(5)	(6)	(7) = (6) - (5)
1	2,082	3.36	3.93	0.58	1.55	1.45	-0.10
2	541	8.17	9.68	1.51	3.69	3.54	-0.15
3	143	12.01	12.60	0.59	4.46	4.55	0.08
4	120	25.84	28.33	2.49	7.57	8.58	1.01
8	21	6.15	4.23	-1.92	1.41	1.31	-0.09
9							
TOTAL	**2,907**	**5.63**	**6.44**	**0.81**	**2.34**	**2.28**	**-0.05**

Heart Program (cont'd)

LEVEL	TOTAL LOS				TOTAL RIW™			
	ACTUAL	EXPECTED	VARIANCE	% VARIANCE	CMG™ 96	PIx™ 97	VARIANCE	% VARIANCE
	(8)	(9)	(10) = (9) - (8)	(11) = (10)/(8)	(12)	(13)	(14) = (13) - (12)	(15) = (14)/(12)
1	6,989	8,190	1,201	17.2	3,217	3,014	-203	-6.3
2	4,420	5,237	817	18.5	1,998	1,917	-81	-4.0
3	1,718	1,802	84	4.9	638	650	12	1.9
4	3,101	3,400	299	9.6	909	1,030	121	13.4
8	129	89	-40	-31.2	30	28	-2	-6.7
9								
TOTAL	**16,357**	**18,719**	**2,362**	**14.4**	**6,791**	**6,639**	**-152**	**-2.2**

LEVEL	EXPECTED COST			ACTUAL	COST VARIANCE *			
	CMG™ 96	PIx™ 97	VARIANCE	COST *	CMG™ 96	% VARIANCE	PIx™ 97	% VARIANCE
	(16) = (12)*$3688	(17) = (13)*$3688	(18) = (17) - (16)	(19)	(20) = (19) - (16)	(21) = (20)/(16)	(22) = (19) - (17)	(23) = (22)/(17)
1	$11,865,456	$11,116,811	-$748,646	$7,634,478	-$4,230,978	-35.7	-$3,482,333	-45.6
2	$7,368,104	$7,070,818	-$297,286	$6,729,484	-$638,620	-8.7	-$341,334	-5.1
3	$2,352,818	$2,397,224	$44,406	$2,230,442	-$122,376	-5.2	-$166,782	-7.5
4	$3,351,551	$3,799,245	$447,694	$5,557,728	$2,206,177	65.8	$1,758,483	31.6
8	$108,916	$101,638	-$7,278	$93,395	-$15,521	-14.3	-$8,243	-8.8
9								
TOTAL	**$25,046,845**	**$24,485,735**	**-$561,110**	**$22,245,527**	**-$2,801,318**	-11.2	**-$2,240,208**	-10.1

* Fictitious costs for the sake of example

DISCUSSION

With the help of more precise information, healthcare providers are able to more accurately plan treatment strategies that are in line with internal strategies and comparable to external benchmarks. The addition of an overlay to the CMG methodology improves the accuracy in estimating resource requirements within a CMG. However, there still remain a number of limitations in the current system and, therefore, opportunities for improving resource estimation.

Advantages

The old CMG methodology grouped dissimilar patients because it failed to recognize the secondary diagnoses that are often present. When we consider the existence of certain co-morbidities, the length of stay rises and the costs and resources required to treat these secondary diagnoses also increase. This is the logic underlying the complexity overlay adjustment. The resulting detail reflected in the RIW measure reduces variation across levels and adds credibility to this important measure. The increased resource load of patients that require more care for conditions related or unrelated to their primary diagnosis is reflected in the complexity adjustment. The new Complexity methodology adds more consistency across all CMG when complexity is considered. Previously, only some CMG were separated based on the presence or absence of a co-morbidity related to the diagnosis. Now that the complexity methodology is applied, most CMG have some type of complexity adjustment that can be from, within, or outside the major clinical category.

With such increased accuracy, the RIW value better calibrates the patient population across hospitals, programs, services and physicians. More detailed comparisons at the patient information level allow physicians and programs to determine their performance against a predetermined index of RIW per Discharge or LOS per RIW. The ability to discount the data by arguing that it serves a special population or that some patients are sicker is reduced. Interestingly, the data show that, in some cases, the RIW is reduced to better reflect the relative simplicity of uncomplicated cases. This reduction is balanced by an increase in resource weighting at the higher levels. Since teaching hospitals receive cases with higher complexity, on average, this methodology provides more of an incentive to treat highly complex cases. Based on the data review, Complexity has no significant impact on total weighted case volume at St. Michael's Hospital. However, opportunities have arisen for individual programs to better align their resources to their caseload and to emphasize specific volumes of cases based on the credits provided by the new RIW. The increased awareness of this change in RIW has provided information on the weighted case impacts to different hospitals. This allows hospitals to turn to their peers to compare performance levels and identify areas of opportunity.

In most cases, there is an improved estimate of costs or resource requirements for the various levels of complexity. The benefit of more accurate weightings is an improved estimate of expected costs for each patient. Expected costs can be compared to the actual costs incurred to determine the financial "benefit" of providing a service. When the actual cost is greater than the expected cost, it identifies an opportunity for cost containment. If the actual cost is less than the expected cost, this is of benefit to the institution because the program is providing a service at an expense level that is lower than the hospital's average. The program should be encouraged to continue and should be examined to provide ideas for other programs.

Disadvantages

Even though the adjustments for case complexity provide more accurate information about resource requirement, a number of problems and limitations still exist around the assignment of case weights to Plx groups in a way that is an accurate reflection of the resources required to treat these cases. There are limitations to the methodology used by CIHI in the area of age, database variability and an imbalance in the weights across levels.

The basic concept of the RIW assignment is to determine the most appropriate resource weighting for a highly variable patient population. Unfortunately, the calculation of RIW is not simply a matter of identifying a ratio or a general equation. It is a complex interrelationship between database derived constants and coefficients aligned with database target lengths of stay and some American based costing. If the ELOS versus age and RIW versus age graphs are compared, a similar distribution pattern results across the four complexity levels because the same variables are used to calculate the RIW (see Figures 3 and 4). These lines of best fit are not as smooth as expected when the database is examined in detail. For instance, in CMG 179, the RIW and ELOS for a 42 year old and a 46 year old patient are somewhat similar. However, the RIW and ELOS for a 44 year old is greater. On average, the RIW and ELOS for the 44 year old should be greater than or equal to the 42 year old and less than or equal to the 46 year old. However, since the numbers are drawn from a database set with inherent statistical variability, areas exist where the data are limited. This causes variation in case weight assignment that could be reduced if there was a greater data set to draw from or smoothed data.

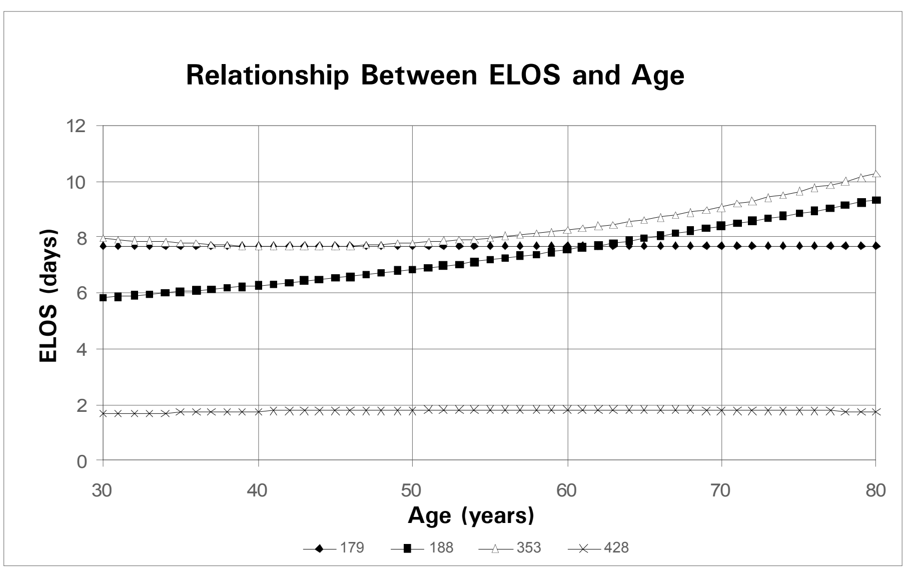

Figure 3: Relationship Between ELOS and Age

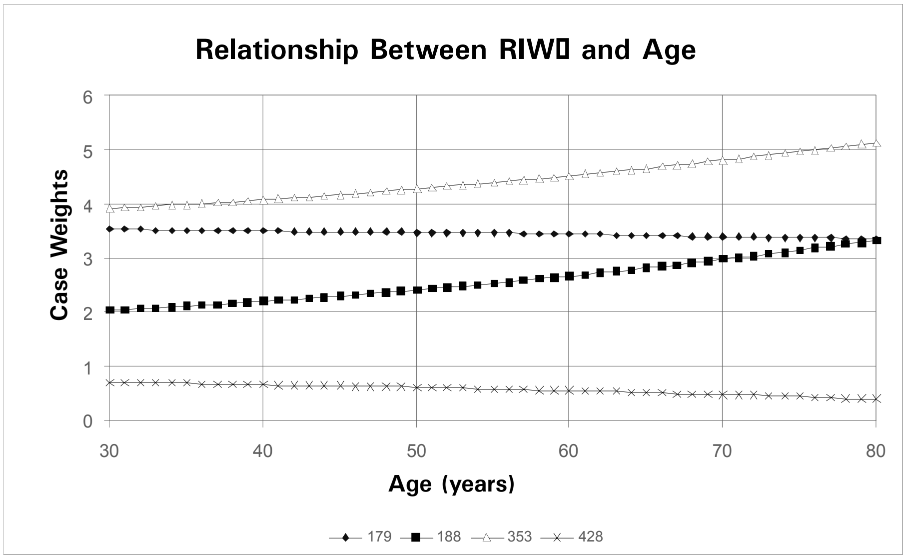

Figure 4: Relationship Between RIW™ and Age

If we consider the relationship between cost and RIW for the different complexity levels, we find that there are three distinct relationships instead of the defined four levels. The level two and three patients share very similar cost profiles. This suggests that there is a requirement for only 3 levels of complexity and the possibility to have equations to calculate the expected cost (see Figure 5).

From these 3 equations, a cost per weighted case can be obtained as a standard indicator of performance. Since weighted cases are based on costs adjusted for LOS and age, the internal total cost per RIW provides a relative indication of performance on all of these levels and can be estimated by the graph.

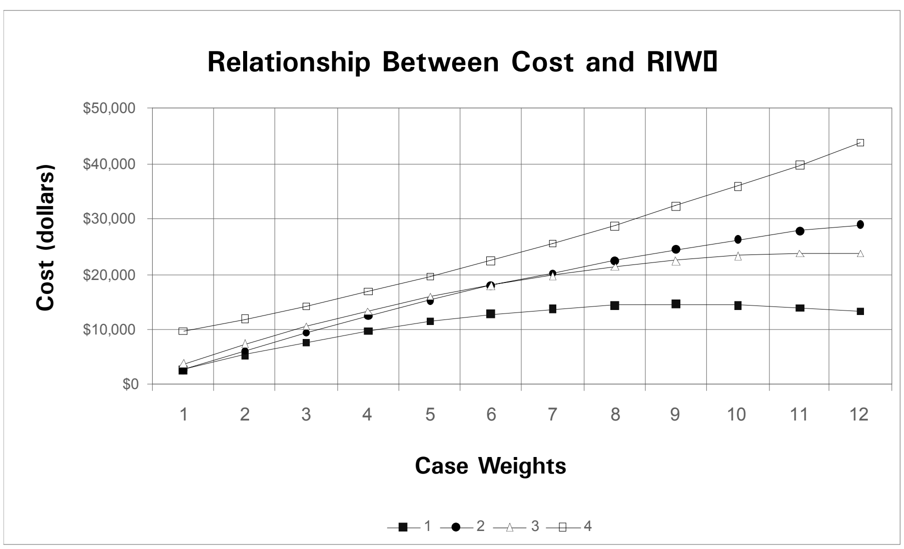

Figure 5: Relationship Between Cost and RIW™

As more changes occur in the way hospitals receive credit for activity, there will be an inclination to respond with strategies that emphasize the activities that have had increases in case weights and de-emphasize those that have not. George Pink dismisses the value of this "gaming" response, since the incentive changes are frequent and the patient population is variable (HMRU, 1996). However, this is an issue worth considering because, in these times of resource constraint, there are hospitals fighting to maintain volumes while reducing costs. The implementation of the complexity adjustment should in fact help to solve this type of problem. Before the complexity implementation, the incentive was to treat the "straight forward" cases or those that had only one diagnosis and could be treated and released. Other than the adjustment for outliers, there was no credit for the resources spent treating the complex cases with multiple complications. Since many complex cases are usually sent to teaching hospitals, it is an advantage for St. Michael's Hospital to have such an adjustment in place. It will be interesting to note how transfers from other institutions change as a result of the complexity adjustment. Previously, there was an incentive to have complex and highly resource intensive patients transferred from a community hospital to a teaching hospital. This could allow a less complex patient to take their position and provide the community hospital with the same RIW assignment as the teaching hospital. The community hospital might use fewer resources to treat the less complex cases.

Since the adjustment impacts can be reviewed on a CMG basis, there are incentives and disincentives that cannot be overlooked at this level. A reduction of almost 70 weighted cases for 280 craniotomy procedures is a significant decrease that seriously affects the needs of the program providing this service (see Table 2). The 363 open heart cases in CMG 188, 178 and 189 are reduced by 106 weighted cases which also seriously affects the performance of the Heart Program compared to the other programs competing for resources. Equally important are the significant increases in case weight adjustments. Kidney transplants and tracheostomy/gastrostomy procedures have their weighted cases increased by 284 and 151 respectively. Such a large increase in weighted cases will also significantly affect the planning of resource allocation.

The greater weighting assigned to the level 4 complexity cases is important since it is a better reflection of the resources these patients consume. However, with such large increases in case weighting, the combined funding adjustment that is made for tertiary cases must be considered. The percentage tertiary activity based on specifically identified CMG plays a large part in the expected cost per weighted case adjustment. If a hospital conducts a high volume of a level 4 complexity of a CMG that is identified as tertiary, the result may be a significant increase in the RIW allocation.

One final limitation to consider is that planning and developments continue to escalate around the inpatient case weight assignment, but the outpatient component is completely missed. The outpatient population is a very large component of a total hospital's resource allocation. As patients are shifted away from inpatient procedures and outpatient volumes rise, a standardized resource tracking and acuity assignment tool is required. We use the RIW indicator in many of our operational decisions but we are limited in the information that is available around clinic volumes and their patient types. Before the full story can be determined, resource and acuity assignments for clinic patients are required.

Operational Changes Based on the New Complexity Adjustment

The new complexity adjustment is an important step towards improved accuracy and validity in determining the allocation of weighted cases to the cases of Ontario Hospitals. A number of steps should be taken by hospitals in response to this change including education programs, charting programs or audits, information reporting and impact analyses. These responses are essential to the optimal operation of a practice, program or hospital.

As funding methodologies and performance monitoring changes, it is important that individuals who play a key role in the assignment of the RIW understand their new responsibilities. Since the complexity adjustment is dependent upon the identification and clear documentation of all secondary diagnoses related to the case, it is imperative that this be a recognized and agreed upon role. Attached to this clarified role should be responsibility and accountability mechanisms. Historically, there has been a gap in comprehension of the coding system between physicians and hospital medical records or administrative staff. It is important for the care providers to be familiar with all that is required for proper documentation. This will allow the institution to be properly credited for the resources utilized through accurate case weight assignment. In-service education on the impacts of improper charting is essential for all persons working with the chart. Similarly, the medical records personnel responsible for coding and abstracting must be sensitive to the secondary diagnoses and capture them to their fullest potential. Missed secondary diagnoses cause an inappropriate reduction in the actual case weights performed by the hospital and in turn make the operations look less efficient when compared to its peers through cost per weighted case analysis.

With such a heavy reliance on accurate documentation and coding, proper monitoring and information sharing is required. Patient charts must be monitored for accuracy while the patient is still in the hospital. Such concurrent chart reviews will allow for a complete recording of patient diagnoses and resource consumption. This role would be best assumed by case managers, part-time salaried physicians or even medical records staff.

Most medical records departments currently conduct audits on their coding and abstracting procedures. Due to the relative importance of accurate coding for all patients based on the weighted case usage in funding adjustments, more frequent and rigorous reviews are required. Random sampling should occur frequently by coders, by patient service, or by program. Even though standards exist, much of the coding process remains subjective. Minimized variation within and across coders should be the goal of audits and testing.

Since there is variation in the coding practice within individual hospitals, it is likely that the variation gets larger as we compare the institutions against one another. The RIW measure is a provincially accepted indicator used for funding allocation and management decision support. Consistent coding by all institutions is a factor that, if not properly maintained, could threaten the validity of this provincial indicator. To maximize the power of the resource indicator, comparative reviews of institutional charting should be strengthened and standardized. It is important that institutions are compared on a level playing field.

The most important factor in adjusting to the new RIW is timely, accurate and helpful information. It is important for the care and management teams of the hospital to know the impacts of the complexity changes for proper management of resources. Comparative CIHI reports allow for benchmarking the operations of other hospitals as well as having better detail provided around internal performance. It is equally important for a hospital to be aware of the key financial and utilization indicators as well as those of quality and outcomes. The integration of quality information is useful for effective and complete decision making. St. Michael's Hospital is privileged to have a cost accounting system that can provide easily accessible information to detail the operating costs ranging from the patient to the corporate level. This complete information picture is essential for informed decision making so that changes such as the complexity adjustment or other system wide shifts in policy can be planned for using appropriate opportunity and threat analysis.

In summary, all hospital programs are affected by the implementation of the complexity adjustment. Consequently, strategic planning, re-engineering recommendations and program operations will need to be revised. When a new hospital strategic plan is developed, the new expected and actual costs (calculated using the new RIW) will need to be compared to identify strengths and weaknesses. Quality, clinical resources, financial and process opportunities have changed with the new complexity levels. The impact of this change will need to be monitored from this perspective. Program planning, statistical utilization evaluation and funding will all need to be evaluated to determine how practice should change to reflect the complexity change impacts.

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Maintenance of Case Mix Tools: The CIHI Revision Process for MCC 25 (Trauma)

CHAPTER OVERVIEW

The revision project addressing the Major Clinical Category Multiple Significant Trauma (MCC 25) was a result of interest expressed across Canada to change the way cases were identified as trauma and to improve the percentage of "true" trauma cases assigned to MCC 25. The trauma field and the identification of trauma patients was not well-defined. Consequently, the variation in severity and cost of trauma was also not well-defined. This broad mix of patients decreased the utility of CMG and RIW as management tools for trauma programs. Most specifically, it was felt that the heterogeneous mix of cases resulted in RIW that systematically underestimated the resources required to treat patients seen in trauma units. In jurisdictions where RIW values were used to allocate resources, institutions treating a disproportionately large number of 'severe' trauma cases were perceived to be negatively affected. In response, CIHI established a Trauma Task Force to review and redesign MCC 25 in 1994.

The Task Force provided valuable input on the identification of indicators for significant trauma patients. However, further analysis and redesign of the MCC was limited because data to analyze the relationship between the indicators and costs was not available. Then, Ontario Case Cost information on trauma patients from the Sunnybrook Health Science Centre, available January 1996, provided an opportunity for further development of trauma patient classification methodology.

This chapter describes the MCC Multiple Significant Trauma, the revision process, and its outcome. The chapter closes by describing the revised MCC 25 and demonstrating that there is a considerable improvement in the percentage of "true" trauma cases now assigned to MCC 25.

BACKGROUND

Enhancing the CMG methodology has been an ongoing process and the primary focus of both the CMG Team and the Physician Advisory Committee. The CMG Team was composed of CIHI staff representing statistical, coding/data quality and information system expertise and the CIHI Medical Consultant. The work of the CMG Team was reviewed and approved by the Physician Advisory Committee—physicians from across Canada with a range of medical and surgical specialties. This advisory committee's mandate was to ensure that CIHI products continued to reflect the requirements and practice patterns of Canadian health care.

CIHI also relied on client input and feedback to focus on where revisions and enhancements should occur. The revision project that addressed the Major Clinical Category Multiple Significant Trauma (MCC 25) was initiated as a result of interest expressed across Canada to change the way cases were identified as trauma and improve the percentage of "true" trauma cases assigned to MCC 25. In response, CIHI established a Trauma Task Force to review and redesign MCC 25.

MCC 25—Multiple Significant Trauma, the revision process and its outcome are described in this chapter. The revision process began by determining whether there was a standard definition of significant trauma. It was hoped that a standard definition would identify diagnoses and procedures that may be used as indicators of significant trauma. A literature review and the work of the Trauma Task Force was used to develop a list of indicators for further analysis. The statistical analyses performed by CIHI and the clinical investigations of the Trauma Task Force which resulted in a revised MCC 25 are then described. The chapter is concluded with a description of the revised MCC 25 and demonstration that there was considerable improvement in the percentage of "true" trauma cases assigned to MCC 25.

DESCRIPTION OF MCC 25 MULTIPLE SIGNIFICANT TRAUMA

The trauma CMG were based on the original American DRG system and had not been altered since 1990. Only cases that exhibited multiple significant trauma were assigned to MCC 25. A case assigned to MCC 25 had to have a MRDx from one trauma site, and at least one other significant diagnosis from another trauma site. The following were possible trauma sites:

- Head;
- Chest;
- Abdomen;
- Kidney;
- Genitourinary;
- Pelvis, and Spine;
- Upper Limb; and
- Lower Limb.

The method of assignment to MCC 25 is presented by Figure 1 and an example of assignment to a CMG within MCC 25 presented by Figure 2. The methodology scanned all operative procedures to identify any matches within the surgical list for MCC 25. If a match was found, the case was assigned to the surgical partition based on the hierarchy of procedures. If no match was found within MCC 25, then the case was assigned to CMG 900-906, Unrelated O.R. Procedures. Where no operative procedures were found, the case was assigned to the medical partition based on the MRDx.

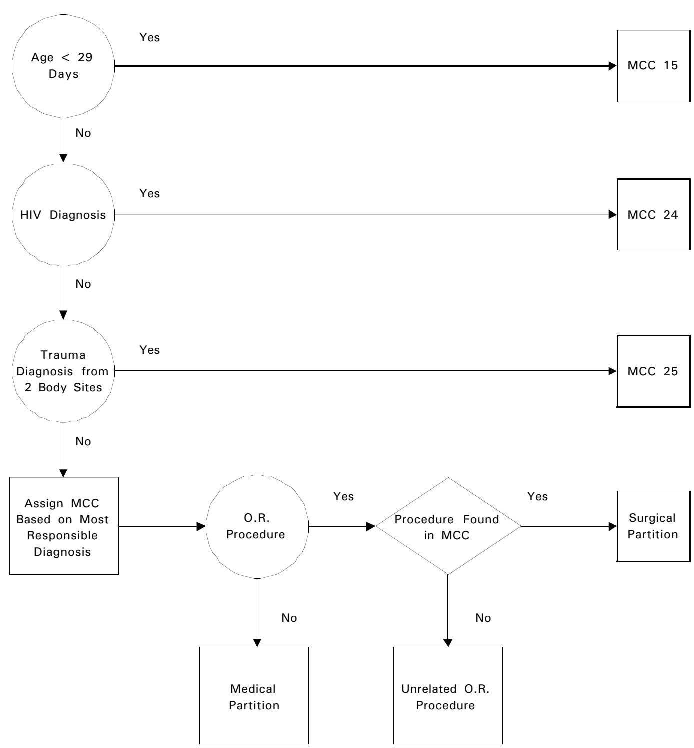

Figure 1: CMG 1995 Grouper Methodology Flowchart

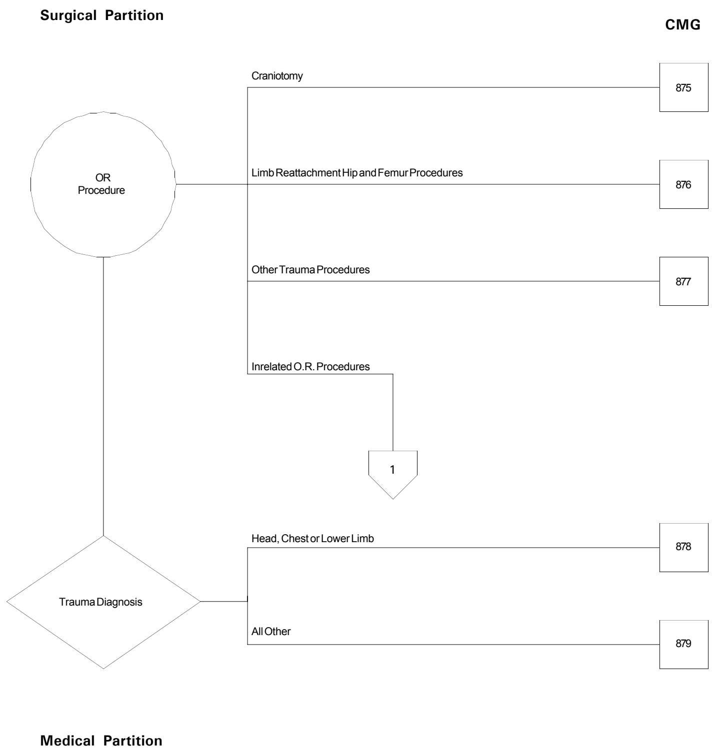

Figure 2: Example of the Grouping Logic for MCC 25 – Multiple Significant Trauma

This method of classifying trauma cases was problematic for two reasons. First, it was possible that a 'severe' trauma case could have injuries from only one site (i.e. head trauma). In this situation, the case was not assigned to MCC 25, but fell into another MCC, based upon the MRDx. This 'severe trauma' case was then included in a CMG with other less severe, non-trauma patients. As a result, only approximately 40% of 'true' trauma patients were being assigned to MCC 25. Second, the range of injuries across sites was quite broad. The trauma field and the identification of trauma patients was, and still is, not well-defined. Consequently, the variation in severity and cost of trauma was also not well-defined. In other words, MCC 25 had less homogeneity with respect to clinical conditions and resource use than it should have.

This broad mix of patients decreased the utility of CMG and RIW as management tools for trauma programs. Most specifically, it was felt that the heterogeneous mix of cases resulted in RIW that systematically underestimated the resources required to treat patients seen in trauma units. In jurisdictions where RIW values were used to allocate resources, particular institutions treating a disproportionately large number of 'severe' trauma cases were perceived to be negatively affected.

LITERATURE REVIEW OF THE DEFINITION OF A TRAUMA PATIENT

A review of the literature was conducted to explore whether classification systems or other means of categorizing trauma patients were available to provide possible indicators for a revised trauma MCC. The literature revealed that there were several methods to categorize injuries and outcomes, allowing interventions to be evaluated and compared (Baxt & Valda, 1990, Bazzoli et al, 1995, Osler, 1993 and Offner et al, 1992). One researcher suggested "an ideal scoring system should perform two separate functions. First, it should allow accurate description of clinical injuries in a manner that reflects the vocabulary of clinicians. Second, a scoring system should define severity indices for each injury" (Osler, 1993).

The classification systems and scoring systems used to identify trauma patients included the International Classification of Diseases 9th Revision, the Abbreviated Injury Scale (AIS), the Injury Severity Score (ISS), the Revised Trauma Score (RTS), the Trauma Score Injury Severity Score (TRISS) and A Severity Characterization of Trauma (ASCOT). Two common scoring systems referred to in the literature and the two systems that were later considered during the revision of the trauma MCC 25 were the Abbreviated Injury Scale (AIS), and the Injury Severity Score (ISS).

The Abbreviated Injury Scale (AIS)

The AIS was originally developed for impact injury assessment, and has been expanded to facilitate the coding of penetrating trauma. The AIS was intended to provide researchers with a simple numerical method for ranking and comparing injuries by severity, and to standardize the terminology used to describe injuries. Conversion tables have been developed which enable translation of ICD-9-CM coded discharge diagnoses into AIS body regions and severity codes. The AIS was the foundation for the Injury Severity Score.

The Injury Severity Score (ISS)

The ISS was the sum of the squares of the highest AIS code in each of the three most severely injured ISS body regions. ISS values ranged from 1 to 75, where the increase in ISS indexed more 'severe' trauma. The ISS provided a much better fit between overall severity, and probability of survival than AIS alone.

Although there were systems to classify trauma patients, there continued to be problems with categorizing injuries and identifying comparable injuries and their outcomes. According to Offner, Jurkovich, Gurney and Rivara (1992), predictors of survival included systolic blood pressure, best motor response, Injury Severity Score, and age. It was considered possible to utilize these predictors of survival as markers to define the trauma patients. However, using intubated patients was limited as a predictor of survival or as a marker for trauma patients. Patients intubated for different reasons may had have vastly different prognoses. "Intubated patients are not a homogenous group. Indications for intubation of trauma patients are variable, including head injury, combativeness, airway protection and respiratory arrest" (Offner, Jurkovich, Gurney and Rivara, 1992). Trauma patients who required intubation may recover completely from their injuries within a few weeks or conversely may never return to their premorbid state of health.

Another reason it was so difficult to categorize trauma patients was the enormous number of possible injuries. "The number of possible injuries a patient may sustain in a motor vehicle accidents is very large. Injury description is the process of subdividing the continuous landscape of human injury into individual, well-defined injuries" (Osler, 1993). Osler reported "the severity for an injury may vary with the outcome that is being measured. Thus, a gunshot wound to the aorta may have a high severity when mortality is the outcome measure, but a low severity when disability is the outcome measure. A gunshot wound to the femur might be just the reverse, infrequently resulting in death, but predictably causing prolonged disability" (Osler, 1993).

Finally, the conclusion of a study undertaken in California by Baxt and Valda (1990) to correlate Injury Severity Scoring and Resource Needs demonstrated that "there is a significant mismatch between the ISS and patient resource requirements" (Baxt and Valda, 1990). This suggested that further investigation was necessary before considering ISS as an indicator of resource use in MCC 25.

The findings in this literature review were the basis for initial discussions at CIHI regarding the identification of possible indicators for a revised trauma MCC.

THE TRAUMA TASK FORCE

In response to the concern that MCC 25 was not representative of 'true' trauma patients, CIHI convened a Trauma Task Force in 1994 (Appendix I). The objective of the task force was to review and redesign the existing MCC 25 into more appropriate groups to better reflect Canadian patterns of practice.

A considerable amount of time during the initial task force meetings was spent trying to define the scope of a Trauma MCC. Two definitions were discussed:

- an event resulting from a transfer of energy or force; this excluded poisoning and drowning, but included hangings ; and
- patients having an ISS score indicating a severe trauma, who are resource intense and who represent a large portion of transfers. (Trauma Task Force Meeting Minutes 1994)

Current ISS software required ICD-9-CM diagnosis codes. This was problematic considering the large number of CIHI client hospitals using ICD-9 codes. As well, the value of the ISS score used to identify significant trauma patients was not consistent in Canada. Therefore, implementing the collection of ISS scores on the discharge abstract may be difficult. It was recommended that ISS and AIS scores be evaluated for their ability to predict trauma cost and then be investigated for their future use with ICD-10. ICD-10, the latest revision of the International Statistical Classification of Diagnosis and Related Heath Problems, will be implemented in Canada by 2001.

The Ontario Trauma Registry, Trauma Patient Definition defined trauma according to the International Classification of Disease E codes (External Cause of Injury codes). The E codes recommended for inclusion in the trauma definition for the Minimal Data Set of the Ontario Trauma Registry were:

E Codes	Description
E800-807	railway accidents
E810-819	motor vehicle traffic accidents
E820-825	motor vehicle non-traffic accidents
E826-829	other road vehicle accidents
E830-838	water transport accidents
E840-845	air and space transport accidents
E846-848	vehicle accidents not elsewhere classifiable
E880-888	accidental falls
E890-899	accidents caused by fire and flames
E900-902, 906-909	accidents due to natural and environmental factors
E910, 913-915	accidents caused by submersion, suffocation, and foreign bodies
E916-928	other accidents
E950-952	suicide & self inflicted injury (poisonings)
E953-958	suicide and self-inflicted injury
E960-961 963-968	homicide and injury purposely inflicted by other persons
E970-976, 978	legal intervention
E983-988	injury undetermined whether accidentally or purposely inflicted
E990-998	injury resulting from operations of war

(Ontario Trauma Registry, 1992)

Identification of Potential Procedural Indicators

The Task Force identified the types of patients and variables that may be useful in identifying most severe trauma cases. It was from these variables that various models were developed to predict total cost. Examples of patients which should be identified included:

ð head injury patients that do not regain consciousness;
ð high spinal cord injury patients with incomplete mobility;
ð lower limb fracture in elderly patients with co-morbidities (cardiac diseases, COPD, arthritis);
ð unstable pelvic fracture;
ð soft tissue defects (crushing injury);
ð patients with prolonged stay in ICU; and
ð multiple organ failure.

It was also recommended that entry into the MCC should not require multiple body system diagnoses but rather one significant trauma diagnosis. Burn patients were also recommended to be included in the Trauma MCC, as these patients consume a considerable amount of resources.

The Task Force then proceeded to discuss possible means of identifying resource-intense trauma patients. It was agreed that the following variables may be useful in identifying the most resource intense trauma cases:

1. ventilation for greater than 96 hours;
2. temporary tracheostomy and gastrostomy procedures;
3. social economic factors (use V-code diagnoses);
4. age (significant in trauma patients expected LOS);
5. co-morbid and complicating diagnoses; and
6. patients with a high ISS score.

The Task Force recommended ICU days not be used as a marker because of the variability of the collection of this data. There was also a concern that patients with multiple fractures may not have any ICU days, while other less extensive cases may be admitted to the ICU.

It was suggested that E-codes be further investigated for their use as trauma indicators. However, it was found that E-codes did not give a good picture of trauma. There were a number of cases with an external cause of injury but without an injury diagnosis.

The work of the Task Force provided valuable input on the identification of indicators for significant trauma patients. However, further analysis and redesign of the MCC was limited because data to analyze the relationship of the indicators to costs were not available. The final recommendations of the Task Force were:

- the trauma MCC should include all significant trauma cases not just those with multiple significant trauma;
- the scope of the trauma MCC should include all trauma cases including burns; and
- the following severity markers should be investigated as predictors of resource use: ISS score, ventilation > 96 hours, co-morbid and complicating diagnoses (e.g. multiple organ failure) and procedure markers such as gastrostomy and tracheostomy.

DEVELOPMENT OF MCC 25 SIGNIFICANT TRAUMA

The participation of the Sunnybrook Health Science Centre (SHSC) in the Ontario Case Cost Project (OCCP) enabled the capture of patient-specific costs. The availability of this cost information in January 1996 provided an opportunity for further development of trauma patient classification methodology.

The Sunnybrook Health Science Centre is a fully affiliated teaching hospital of the University of Toronto. The trauma program operates as a regional trauma centre and represents a strategic focus for the organization. Sunnybrook was one of the original volunteer sites selected to participate in the Ontario Case Costing Project, a joint initiative of the Ontario Ministry of Health and the Ontario Hospital Association. This enabled Sunnybrook to collect patient-specific costs using a standardized methodology established and validated by the OCCP. When Sunnybrook cost data became available, Dr. Barry McLellan, Chief of the Sunnybrook Trauma Program and past member of the CIHI Trauma Task Force, supported the use of this data to answer some of the questions left by the Task Force. This data proved to be the key ingredient in completing the revision process at CIHI.

Analysis of administrative data—including patient-specific procedural, diagnostic, length of stay and cost information for patients admitted to the Regional Trauma Unit—contributed to an understanding of the statistical relationship between total patient care costs, current CMG and other indicators that may index higher costs. The objectives of analyzing this data were to identify indicators predicting total patient cost and length of stay, and to rank these indicators. These indicators could then be incorporated into a new method of assigning cases to MCC 25 and help develop new case mix groups for trauma. The first step in the development of a grouping methodology began with the identification of diagnoses which, when determined to be the MRDx, resulted in the assignment of a case to one of 25 MCC. The list of MRDx for assignment to MCC 25 was developed by a sub-group of the Trauma Task Force, discussed in the section Revised MCC 25 Significant Trauma.

The assignment of a case to a CMG within the surgical partition was determined by the presence of an operative procedure. A surgical hierarchy ordered the CMG in the surgical partition from most, to least, resource-intense. If there was more than one procedure recorded for the case, then it was assigned to the CMG highest on the hierarchy. The analyses that follow were designed to confirm which of the procedures identified by the Task Force were significant indicators of resource use and to determine the surgical hierarchy of these procedures.

If there were no procedures used for CMG assignment the case was assigned to the medical partition of the MCC. The medical partition consisted of groupings of similar diagnoses defined clinically and/or by homogeneity of resource use.

The best measure for resource use is patient-specific cost data. However, this information is not commonly collected by health care facilities in Canada. In the absence of patient-specific cost data, LOS routinely collected on the CIHI abstract is used instead. The analysis of the Sunnybrook trauma cost data assessed the validity of using LOS as a proxy for total cost.

The analysis of the Sunnybrook trauma data set, for the purposes of developing MCC 25, proceeded in two parts: 1) a preliminary analysis of trauma cases admitted to the Regional Trauma Unit; and 2) a final analysis of all Sunnybrook cases.

This section continues by describing the objectives, the method and the results for both analyses.

PRELIMINARY ANALYSIS OF SUNNYBROOK TRAUMA DATA

Preliminary analysis contributed to an understanding of the statistical relationship between total trauma patient care costs, current CMG and other indicators that may index higher cost.

The Analysis

The analysis of this database was undertaken in the following steps:

1. Summarize numbers in the Trauma database;
2. Use linear regression techniques to clarify the relationship between several indicators and the total cost of patient care;
3. Identify possible models that may be broadly applied to the Sunnybrook database to identify 'trauma' cases that may not fall into MCC 25; and
4. Identify diagnoses or procedures that may be added to the complexity grade lists to index an increased need for acute care.

The Data

The data used for this analysis contained 611 cases from the Regional Trauma Unit at the Sunnybrook Health Sciences Centre, from fiscal 1994/95. All patients admitted to the trauma program in that time period were reviewed, not just those admitted to the unit. This data included patient-specific clinical, diagnostic, and cost information. It had more detail than the CIHI discharge abstract which was used to develop the patient classification groups.

The 611 patients in the database had diverse clinical histories, mode of injuries, actual injuries, treatment plans (identified via OR procedures) and lengths of stay. Of the 611 trauma patients in the database, 329 were assigned to MCC 25 and 282 were assigned to another MCC. Table 1 shows that only 54% of the Regional Trauma Unit patients were being assigned to the trauma MCC. This was higher than the original claim of 40% but still unacceptably low.

Table 1: Percent of Trauma Patients Assigned to Trauma MCC 25, 1996 CMG Methodology

Category	Number of Cases	% of Total
MCC 25	329	54%
Other MCC	282	46%
Total	611	100%

The trauma data had detailed patient-specific information from the Record of Stay sheet. Suggested elements for analysis included: ventilator type, tracheostomy, and total parenteral nutrition (TPN). Number of days, patient ISS, and AIS values were also recorded.

Ventilator type included bag, mechanical, spontaneous, unknown, and cases not coded. In order to identify the patients with mechanical ventilation, a cross-tabulation was produced which compared the ventilator types with the number of ventilator days.

In the trauma data there were 40 cases coded as spontaneous, but which also showed ventilator days. For the study, these cases were included with the mechanical ventilation group.

The Variables

The following elements have been modeled in various combinations to predict total cost:

- age, and age-squared;
- ISS score (continuous);
- ISS greater than 16 (dummy) (ISS16);
- number of ventilator days;
- ventilator days > 4 (dummy) (vent4);
- number of mechanical ventilator days;
- mechanical ventilator days > 4 (dummy) (vent4);
- number of TPN days;
- TPN days > 0 (dummy) (TPN0);
- number of tracheostomy days; and
- Tracheostomy days > 0 (dummy) (Trach0).

The Regression Models

The general model used for analysis of total cost was:

Equation 1

Total Cost = (AvCost) + b * ISS + c * ventilator + d * TPN + e * tracheostomy

where each variable represents one of the potential variable types (continuous or dummy). For example, either ISS or ISS16.

AvCost was the average cost, by CMG, within the data set. This was used to control for the different case mix within each CMG. The AvCost acted as the 'intercept' or constant in these regression models. This is an accepted technique that allows for the magnitude, rather than the absolute value, of the independent variables to be accurately determined.

The regression models included every case except deaths from the Sunnybrook Trauma data—a total of 548 cases. Variables that measure number of days may have been skewed if death was included in the analysis.

As well, the following equation was used to model the AIS value by body area as a predictor of total cost:

Equation 2

Total Cost = (AvCost) + b * AIS_FACE + c * AIS_CHEST + ……

In the third model, the AIS and other variables were combined, based upon the strength of the variables in a more comprehensive model. Finally, the fourth model modified the significant variables that were derived in the first three models to reflect data currently captured in the CIHI standard abstract.

There were two approaches to modeling total costs with this data. First, elements that appeared to have a significant impact on the total cost of patient care were identified. This general analysis identifies elements to consider in re-designing the discharge abstract. The second approach narrowed the focus to those elements that were reliably collected on the discharge abstract under current coding practice.

Statistical Regression Results - A. General Analysis

Model One: ISS Score, Mechanical Ventilation, TPN and Tracheostomy

The following model used ISS score, ventilator, total parenteral nutrition (TPN), and tracheostomy days as independent and continuous variables to predict total patient care cost. The Average CMG cost was used to control for the differing case-mix in the database.

Note that as expected, all coefficients were positive, indicating that the total cost increases as the value of each of the variables increases (see Table 2). As well, the Average CMG Cost was the coefficient with the largest relative effect on predicting total cost (as indicated by the numbers in the beta column), followed by the number of ventilator days.

The coefficient for #TPN days was not significant at the 95% confidence level, and was dropped from the equation. The adjusted R^2 coefficient, a summary measure of the predictive ability of the model, was 0.672.

This analysis demonstrated that ISS, mechanical ventilator, and tracheostomy were associated with increased patient care cost in the trauma database.

Table 2: Total Cost Regression Model One

Adjusted R^2 coefficient 0.672

Variable	Coefficient	SE of Beta	Beta[1]	p value
Average CMG Cost	0.553	.06	.421	0.0000
ISS Score	225.80	51.75	.209	0.0000
# Ventilator Days	1819.18	188.05	.290	0.0000
# Trach Days	720.93	215.31	.094	0.0009

[1] Beta Coefficients can be used as indicators of the relative importance of variables, and do not depend on the units of measurement.

Model Two: AIS and Total Cost

A second multiple linear regression model was used to begin assessment of the importance of AIS scores in predicting total patient cost. From this analysis, it was clear that the Head and Neck AIS score was important and significant in predicting total patient cost (see Table 3). The coefficient for Extremities AIS was significant and negative, indicating that as this AIS increases, the expected patient cost decreases, within this database. It was interesting to note that although this model had a greater number of significant variables included in the model, the adjusted R^2 coefficient was lower than Model One (0.580 vs. 0.672).

Table 3: Total Cost Regression Model Two

Adjusted R^2 coefficient 0.580

Variable	Coefficient	SE of Beta	Beta	p value
Average CMG Cost	.745	.072	.551	.0000
Limbs	1414.29	557.87	.117	.0115
Head and Neck	2153.94	501.59	.206	.0000
Chest	1283.74	454.65	.106	.0049
Abdomen	1425.41	554.63	.093	.0104
Face	1825.22	807.31	.079	.0242
Extremities	-6326.95	1569.22	-.249	.0001

Model Three: Combined Model

In Model Three, the AIS indicators were combined with the Model One indicators—mechanical ventilation, tracheostomy, and TPN days. A forward selection model was used to enter variables into the model. This type of model enters variables into the equation one at a time, starting with the largest correlation with the dependent variable, until the significance criterion is no longer met.

In Model Three, only the Extremities AIS variable was significant at the 95% level (see Table 4). The other AIS variables were removed from this model. While in Model Two, the Head and Neck AIS score was significant, the relatively high correlation with the ISS value may have made Head and Neck AIS redundant in this model. As well, the number of days TPN was not significant.

Note that although this model had one more variable than Model One, the adjusted R^2 coefficient values were approximately equal (0.672 vs. 0.674). This indicates that although the Extremities AIS variable is significant, its inclusion adds relatively little predictive value to Model Three.

Table 4: Total Cost Regression Model Three

Adjusted R^2 coefficient 0.674

Variable	Coefficient	SE of Beta	Beta	p value
Average CMG Cost	.594	.064	.452	.0000
Extremities AIS	-2717.09	1311.58	-.111	.0388
ISS	307.56	64.96	.285	.0000
# Trach Days	636.27	218.51	.083	.0037
# Mech Vent Days	1781.49	188.36	.284	.0000

Statistical Regression Results - B. Using Information Currently Available on the CIHI Discharge Abstract

Finally, in Model Four, several of the previously identified important variables were modified. In this model, the variables were changed into 'dummy' variables, indicating the presence or absence of the corresponding procedure or condition. Table 5 describes the changes from continuous to dummy variable. The variable Extremities AIS was not included since it added relatively little predictive value to Model Three and because it was not an element on the discharge abstract. The variables were changed as shown in Table 5.

Table 5: Dummy Variables for Regression Model Four

Continuous Variable	Dummy Variable	Definition
ISS	ISS > 16	- ISS score of greater than 16
# Trach Days	Trach Days > 0	- Presence of tracheostomy days
# Mech Vent Days	Mech Vent Days > 4	- Greater than 4 Mechanical vent days
	Mech Vent Days >0, <=4	- Greater than 0 and less than/equal to 4 Mechanical vent days
# TPN Days	TPN Days > 0	- Presence of TPN days

These types of variables are more consistent with the current CIHI abstracting guidelines. Currently, the greater than 4 mechanical ventilation days variable is coded separately on the abstract. As well, procedure codes may be used to indicate the presence of tracheostomy and TPN, although the number of days is not available on the discharge abstract.

As in Model Three, a forward-step regression technique was also used in this modeling process. This allowed variables contributing most to the predictive value of the model to be entered first. The results from this process are shown below in Table 6.

Table 6: Total Cost Regression Model Four

Adjusted R^2 coefficient 0.65239

Variable	Coefficient	SE of Beta	Beta	p value
Average CMG Cost	.784	.037	.596	.0000
Ventilation > 4 days	23299.36	2676.36	.263	.0000
TPN	7072.45	3531.56	.055	.0457
Tracheostomy	15368.85	3957.12	.112	.0001

Both ISS > 16, and mechanical ventilation between 0 and 4 days were not significant at the 95% confidence limit. As expected, ventilation > 4 days was significant, and the absolute value of the coefficient was large. The presence of TPN became significant at the 95% level, as did tracheostomy. It is interesting to note that although the variables in this model were less specific—they were dummy variables rather than continuous—the adjusted R^2 coefficient values were relatively close (0.672 in Model One vs. 0.652 in Model Four).

Results

Analysis confirmed the importance of mechanical ventilation in this database as an indicator of increased resource use, above that expected by the CMG average cost alone. As well, tracheostomy was consistently important in predicting higher costs than the CMG average.

This preliminary analysis used four models to develop an improved understanding of possible indicators of greater resource utilization among trauma patients treated at SHSC. Models One to Three used various indicators, including ISS, AIS, TPN days and tracheostomy days, that are routinely collected at Sunnybrook for trauma patients but are not currently submitted to CIHI by any of the 600 client hospitals. Model Four used the variables identified in the first three models and redefined these variables so that they may be identified from the current standard CIHI discharge abstract. It is notable that the predictive validity of Model Four, as measured by the adjusted R^2

coefficient value, was comparable to the models that used the expanded information contained in the Sunnybrook trauma data.

In Models One to Three, the number of total parenteral nutrition days was not significant at the 95% confidence level. In contrast, in Model Four, TPN was redefined as the presence or absence of TPN, rather than the number of days of TPN. This redefined TPN variable was significant in Model Four.

It is important to note that this analysis was performed on a database of patients admitted to the trauma centre at Sunnybrook—a total of 611 patients. The relatively small size of this database prevented more detailed analysis on particular diagnoses. For this reason, and to confirm these findings, the analysis was repeated for all Sunnybrook cases.

FINAL ANALYSIS OF ALL SUNNYBROOK CASES

The purpose of this analysis was:

1) to confirm that the findings of the preliminary analysis of the Sunnybrook Trauma data were more general to all abstracts submitted by Sunnybrook to CIHI;
2) to identify additional diagnoses that may indicate increased patient cost; and
3) to asses the validity of using LOS as a proxy for total cost to measure these effects in the CIHI database.

The Analysis

Analysis of this database was undertaken in the following steps:

1. summarize numbers in the Sunnybrook database;
2. use regression techniques to clarify the relationship between several procedural indicators and the total cost of patient care;
3. identify possible models that may be broadly applied to the Sunnybrook database to identify ‘trauma’ cases that may not fall into MCC 25; and
4. identify diagnoses or procedures that may be added to the complexity grade lists to index an increased need for acute care.

The Data

The data used for this analysis contained 17,426 cases from Sunnybrook Health Sciences Centre, from fiscal 1994/95. This data included patient-specific cost information collected by the Ontario Case Cost Project, chart and register number. The chart and register number were used to match this data to the CIHI Discharge Abstract Database for SHSC. Cases admitted before April 1, 1994 were excluded from the analysis.

The Variables

Table 7 contains the administrative data elements modeled in various combinations to predict total patient cost and LOS.

Table 7: Data Elements Modeled for Predicting Total Patient Cost and LOS

Procedure	Description	CCP Code	ICD-9 CM Code
Gastrostomy	Temporary/Permanent	55.2	43.19
	Percutaneous Endoscopic	55.1	43.11
TPN		13.59	99.15
Tracheostomy	Temporary	43.1	31.1
	Permanent	43.29	31.29
	Mediastinal	43.21	31.21
Dialysis	Peritoneal	66.98	54.98
	Hemodialysis	51.95	39.95
ICP Monitor		14.88	01.18
Ventilation	< 96 hours	13.62	96.71
	> 96 hours	13.62	96.72

Eleven dummy variables were used to indicate the presence or absence of the procedure on the patient’s abstract. To avoid double-counting, all cases in CMG 40 (Tracheostomy/Gastrostomy) were assigned a dummy value of 0 for the tracheostomy and gastrostomy procedures. As well, cases in CMG 538 (Dialysis) were assigned a dummy value of 0 for the dialysis procedures. The occurrence of each procedure is summarized in the cross-tabulation table in Appendix II.

The Regression Models

Two general models were used to generate predictions for patient treatment cost (total cost), and LOS.

Equation 3

Total Cost = (AvCost) + b * Procedure1 + c * Procedure2 + …

Equation 4

LOS = (AvLOS) + q * Procedure1 + r * Procedure2 + …

AvCost and AvLOS were the average cost or LOS, by CMG, within the data set. They were used to control for the different case mix within the database. The AvCost and AvLOS acted as the 'intercepts' or constants in these regression models.

Death and Transfer cases were excluded from the analysis, as the costs or LOS of these cases did not represent a full course of treatment.

Statistical Regression Results

A stepwise regression procedure was used to enter the variables into the models. In this method, variables were added to the model, one at a time, based on the strongest partial correlation. The summary for both models is shown in Table 8 and Table 9.

The stepwise regression technique generated a series of output results, based on the variables that were in the corresponding step of the model. Table 8 summarizes the model after all significant variables were in the model. However, this is not necessarily a recommended model. While all variables may have been significant, they may not have necessarily contributed any predictive value to the model, as measured by the adjusted R^2 coefficient.

Table 8: Total Cost Regression Model

adjusted R^2 coefficient = 0.662

Variable	Coefficient	SE of Beta	Beta	p value
Average CMG Cost	0.840	.007	.619	.000
Ventilation >96 hrs	36330.1	711.838	.258	.000
Tracheostomy -Temp	21187.2	772.438	.137	.000
TPN	21264.5	2022.540	.122	.000
Gastrostomy - Percutaneous endoscopic	12591.5	934.818	.065	.000
Ventilation - <96 hrs	2390.652	262.610	.047	.000
ICP Monitor	11184.7	1251.534	.043	.000
Gastrostomy - Temp/Perm	-9460.7	2080.201	-.053	.000
Dialysis - Peritoneal	2074.197	544.065	.018	.000
Dialysis - Hemodialysis	2300.823	692.772	.016	.001

The adjusted R^2 coefficient for this model was 0.662. It is interesting to note that this R^2 value remained unchanged in the last three iterations of the model (Appendix III). Although indicators for Temp/Perm Gastrostomy, and Dialysis (Peritoneal and Hemodialysis) were statistically significant, they did not improve the predictive ability of the model. Recall that TPN and Gastrostomy (Temp/Perm) were highly correlated, indicating that the results in this model for these variables may have been confounded. Consideration should be given to removing one or more of these variables from the model. As well, it may be noted that the coefficient for Gastrostomy (Temp/Perm) was negative, indicating that the presence of a gastrostomy procedure would lead to lower expected costs.

All of the variables that were significant in the part 1 analysis of the Sunnybrook Trauma database remained significant. It is interesting to note that the absolute value of each of the coefficients was greater than in the part 1 analysis. Also, note that Ventilation <96hrs was significant in this model. Consideration should be given to the consistency and reliability of the coding practice for this procedure, as well as the others.

The same model, and process was used to predict the patient's LOS (see Table 9). Note that fewer variables remained significant in this analysis. Temp/Perm Gastrostomy, Peritoneal Dialysis and Ventilation <96hrs were not statistically significant. As well, dialysis was the last variable to enter the model and had the lowest Beta value.

In this model, the adjusted R^2 coefficient did not change after the addition of either ICP Monitor or Hemodialysis (Appendix III).

Table 9: LOS Regression Model

adjusted R^2 coefficient=0.558

Variable	Coefficient	SE of Beta	Beta	p value
Average CMG LOS	0.940	.008	.677	.000
Ventilation >96 hrs	22.629	1.250	.103	.000
Tracheostomy -Temp	20.576	1.371	.086	.000
Gastrostomy - Percutaneous endoscopic	23.029	1.661	.077	.000
TPN	15.620	1.469	.058	.000
ICP Monitor	15.016	2.219	.037	.000
Dialysis - Hemodialysis	2.684	1.231	.012	.029

Results

The results of this analysis confirmed the importance of mechanical ventilation >96 hrs, tracheostomy and TPN in predicting both patient cost and LOS. Percutaneous endoscopic gastrostomy was also a significant predictor of cost and LOS.

Indicators for ICP Monitor and Hemodialysis were also statistically significant, although they did not add value to the model, as measured by the adjusted R^2 coefficient.

The analysis confirmed that in the absence of routinely collected, detailed patient-specific cost information, LOS may be used as a valid proxy for cost.

REVISED MCC 25 SIGNIFICANT TRAUMA

In conjunction with the Sunnybrook trauma data analyses, the CIHI CMG Team and Dr. Tony Ashworth and Barry McLellan from the original Trauma Task Force proceeded with the identification of most responsible diagnoses and procedures to include in MCC 25. The ICD-9 or ICD-9-CM most responsible diagnosis assigned a case to the MCC 25 while the CCP or ICD-9-CM procedure assigned the case to a specific CMG within MCC 25.

The identification of specific diagnoses and procedures, the hierarchy of procedures (those most predictive of resource use) and the case mix groups were developed on the basis of clinical judgment. These indicators and groups were also confirmed by the following analyses on the entire CIHI Discharge Abstract Database for fiscal 1994/95:

ð calculation of average length of stay and standard deviation for each proposed CMG to ensure homogeneity of the group;

ð regression analysis of each proposed CMG to ensure a single distribution within a group - any group with a binomial distribution was split into two groups and re-analyzed; and

ð the clinical identification of procedures predictive of high resource use and their hierarchy were confirmed by regression analysis.

The final list of diagnoses and procedures selected for inclusion in MCC 25 may be found in the *1997 CMG Directory for Use with ComPlexity* (CIHI, 1997).

Assignment to the new MCC 25 Multiple Significant Trauma was now based on the presence of a single significant trauma code as the Most Responsible Diagnosis. A flow diagram representing this assignment may be found in the introduction chapter of this case book, Figure One, *CIHI Case Mix Tools*. The new list of diagnoses included ICD (800-999) Injury codes. The list was refined to demonstrate conditions of "classic trauma" (the results of accidents). The focus for the new MCC was on defining significant trauma cases. Exclusions consisted of the following conditions: foreign body, eye trauma, sprains & strains, late effect codes, some contusions, poisonings, and burns. Burns remained in MCC 22 and some minor trauma diagnosis were still found in MCC 2, 8 and 21. Many trauma diagnoses which appeared in the other MCC were now assigned to the new trauma version.

A portion of the new groupings have been created using a combination concept to illustrate the significant trauma cases (cranial, spine, femur, thoraco-abdominal, lower extremity).

There was a true Surgical Partition in the new trauma MCC, however, there was no logic for "Unrelated O.R. Procedures" (a concept similar to what has been incorporated into MCC 14). Therefore, in cases where a procedure was abstracted and the case was not included in the logic of the Surgical Partition, the case became a medical CMG based on the MRDx.

The introduction of MCC 25 Significant Trauma in 1997, coincided with the introduction of Complexity. The Plx overlay was an enhancement to those CMG methodology. It allowed diagnoses other than the labeled "most responsible" to be considered in the grouping of cases. The CIHI Complexity methodology grade 'lists' were used to index greater patient resource requirement. Mechanical ventilation > 96hr was one procedure on the Complexity grade lists for all MCC.

The problem with using procedures on these grade lists was that with the previous CMG methodology, many procedures were used in CMG assignment. If a procedure was on the CMG assignment list and the Complexity list as a grade 'A', then all cases in that CMG were assigned to Plx Level 4. Thus, although many procedures had been found to contribute to greater cost or LOS, most of these procedures were also used for CMG assignment. In the analysis of the Sunnybrook data, only two procedures, mechanical ventilation >96hrs, and TPN were not currently used for CMG assignment. Further analysis indicated that TPN was found to be insignificant in predicting greater cost. Mechanical ventilation > 96hr was then identified as a condition contributing to Complexity for MCC 25.

The new trauma MCC consisted of 44 case mix groups compared to five case mix groups previously. The resulting case mix groups arranged by surgical partition and medical partition may be found in Table 10a and Table 10b respectively. An example flow diagram of the grouping logic can be found in Figure 3 and Figure 4.

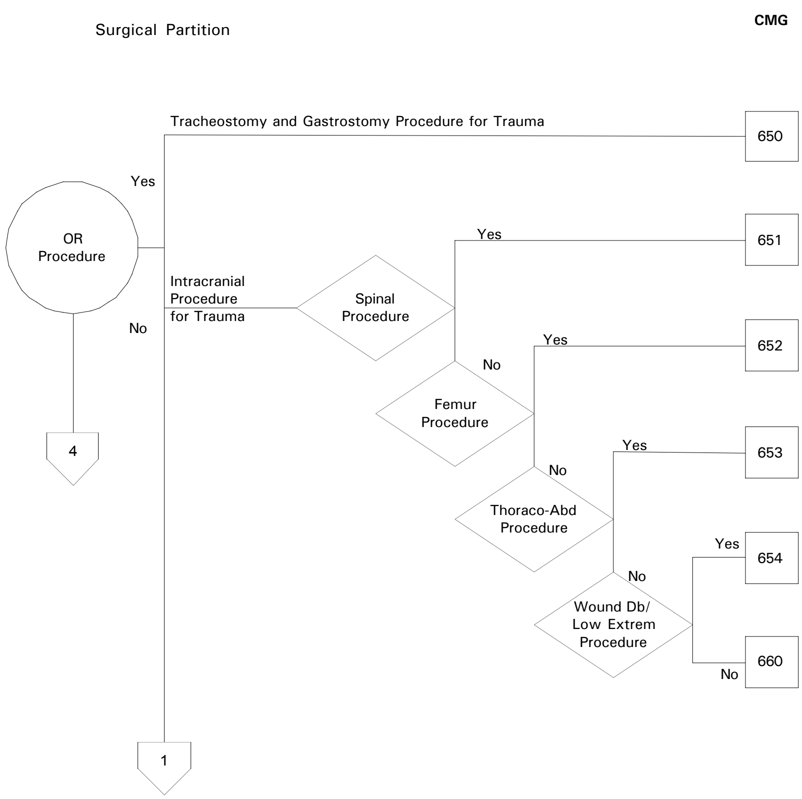

Figure 3: Example of Grouping Logic for the Surgical Partition of MCC 25

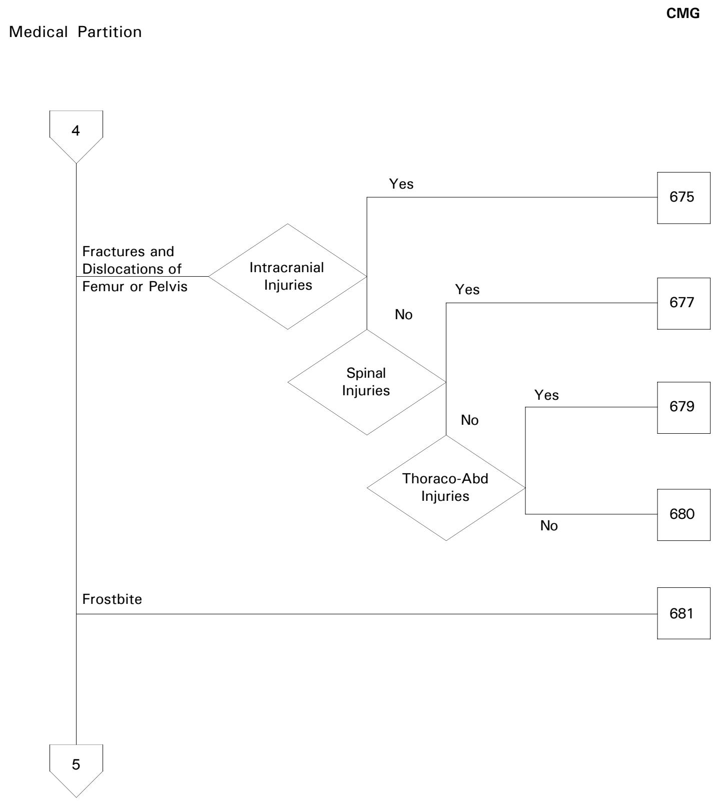

Figure 4: Example of the Grouping Logic for the Medial Partition of MCC 25

Table 10a: Comparison of 1996 MCC25 and 1997 MCC 25 by CMG using CIHI 1995/96 Abstract for All Provinces – Surgical Partition

Surgical Partition					
	MCC 25 Multiple Significant Trauma			MCC 25 Significant Trauma	
CMG	CMG Description	Cases	CMG	CMG Description	Cases
875	MULT SG TRAUMA W CRANIOTOMY	92	650	CRANIAL W SPINAL PROC TRX	9
876	MULT SG TRM,LIMB REAT/HIP,FEM	372	651	CRANIAL W FEMUR PROC TRX	10
877	MULT SG TRAUMA W OTH TRAUM PR	765	652	CRAN/FEMUR W THOR/ABD PR TRX	96
			653	CRANIAL W LE/WOUND DB TRX	26
			654	SPINAL W FEMUR PROC TRX	19
			655	SPINAL W THOR/ABD PROC TRX	16
			656	SPINAL W LE PR/WND DB TRX	35
			657	FEMUR W LE PR/WND DB TRX	480
			658	THOR/ABD W LE PR WND DB TRX	122
			660	CRANIAL PROC FOR TRX	367
			661	SPINAL PROC FOR TRX	410
			662	MAJOR JOINT/FEMUR PROC TRX	13,183
			663	THORACO/ABDOM PROC TRX	929
			664	WOUND DB/SKN GRFT TRX	2,332
			665	ELEVATED SKULL FRACTURE	79
			666	MAJOR LOW EXT PROC TRX	12,364
			667	MINOR LOW EXT PROC TRX	401
	Unrelated O.R.		668	MISC MUSCULOSKEL PROC TRX	1,578
900	EXTENSIVE UNRELATED O.R. PROC	2	669	VASCULAR REPAIR FOR TRX	856
901	NON-EXT UNRELATED O.R. PROC	2	670	UPPER EXTREMITY PROC TRX	8,323
Total Cases		1233			41,635

Table 10b: Comparison of 1996 MCC25 and 1997 MCC 25 by CMG using CIHI 1995/96 Abstract for All Provinces – Medical Partition

Medical Partition					
MCC 25 Multiple Significant Trauma			MCC 25 Significant Trauma		
CMG	CMG Description	Cases	CMG	CMG Description	Cases
878	MULT SG TRM INV HD/CH/LW LMB	737	674	INTERCRAN INJ WITH SPINAL INJ	38
879	MULT SG TRM (NOT HD/CH/LW LMB)	140	675	INTERCRAN INJ WITH FX FEMUR	26
			676	INTERCRAN INJ WITH THOR/ABD	73
			677	SPINAL INJU W FX FEMUR	134
			678	SPINAL INJ W THORACO-ABD INJ	260
			679	FRACT FEMUR W THORACO-ABD INJ	166
			680	FRACT/DISLOC OF FEMUR/PELVIS	3,517
			681	FROSTBITE	115
			682	SPINAL INJURIES	3,081
			683	INTERCRANIAL INJURIES	1,232
			684	HIP AND THIGH INJURIES	973
			685	THORACO-ABDOMINAL INJURIES	4,155
			686	MAJOR NERVE INJURIES	66
			687	FRACTURE OF HUMERUS	980
			688	WEIGHT BEARING INJURIES	3,778
			690	GENITO-URINARY INJURIES	511
			691	CRUSHING INJURIES/CONTUSIONS	2,937
			692	MINOR LOWER EXTREM FRACTURES	152
			693	WOUNDS	4,978
			694	AMPUTAT/VASC/OTH NERVE INJURY	578
			695	FACIAL INJURIES	1,625
			696	OTHER CRANIAL INJURIES	7,524
			697	UPPER EXTREMITY FRACTURES	6,221
Total Cases		877			43,120

Tables 10a and 10b also compare the number of cases assigned to the 1996 MCC Multiple Significant Trauma with the number assigned to the 1997 MCC Significant Trauma using the CIHI fiscal 1995/96 DAD for all provinces. Both the surgical and medical partition of MCC 25 Significant Trauma showed a considerable increase in the number of trauma cases captured: 41,635 cases assigned to the surgical partition of the 1997 MCC 25 compared with 1,233 cases assigned to the surgical partition of the 1996 MCC 25; and 43,120 cases assigned to the medical partition of the 1997 MCC 25 compared with 877 cases assigned to the medical partition of the 1996 MCC 25.

A similar result was found when making the same comparison with the Sunnybrook Trauma data from fiscal 1994/95 and fiscal 1995/96. Table 11 demonstrates that the revised MCC 25 captures 89% of The Regional Trauma cases compared with 54% captured by the existing MCC 25. Using the Sunnybrook Trauma Patient Service 38 data from fiscal 1995/96 the same comparison resulted in an increase from 51% to 96% (see Table 12).

Table 11: Regional Trauma 1994/95 Cases Grouped by Multiple Significant Trauma and Significant Trauma

Category	# of Cases Multiple Significant Trauma	% of Total	# of Cases Significant Trauma	% of Total
MCC 25	329	54%	541	89%
Other MCC	282	46%	68	11%
Total	611	100%	609[1]	100%

Table 12: Sunnybrook Patient Service 38 - Trauma 1995/96 Cases Grouped by Multiple Significant Trauma and Significant Trauma

Category	# of Cases Multiple Significant Trauma	% of Total	# of Cases Significant Trauma	% of Total
MCC 25	304	51%	574	96%
Other MCC	291	49%	21	4%
Total	595	100%	595	100%

Both comparisons, the CIHI DAD and the Sunnybrook Trauma data, suggest that the revised MCC 25 Significant Trauma is a better representation of significant trauma cases than the previous MCC 25 Multiple Significant Trauma.

SUMMARY

The revision of MCC 25 was a process involving both clinical input and statistical analysis. The recommendations of the Trauma Task force contributed to the definition of a significant trauma case and the identification of procedures and diagnosis for inclusion in MCC 25. The regression analysis of the Sunnybrook trauma cost data confirmed the importance of tracheostomy, gastrostomy and mechanical ventilation >96hrs as an indicator of increased resource use. Finally, the analysis also confirmed that in the absence of routinely collected, detailed patient-specific cost information, LOS may be used as a valid proxy for cost.

The revision of the Trauma MCC 25 demonstrated how client input and feedback played a significant role in the revision and/or enhancement process of the case mix grouping methodology. Without the initial interest and concern expressed across Canada to change the way cases were identified as trauma and without the availability of client cost data, the revision of MCC 25 would not have been possible. The original objective of this project, to improve the percentage of true trauma cases assigned to MCC 25, has been achieved. Ninety-six per cent of Sunnybrook's Trauma cases are now assigned to MCC 25. The case mix groups within MCC 25 are now more homogeneous yielding RIW estimates which are more reflective of resource use in true trauma.

The implementation of ICD-10 and CCI (Canadian Classification of Health Interventions) may present us with an opportunity to identify additional indicators of high resource use and, because these standards are more specific, they may assist with improving the homogeneity of the case mix groups within MCC 25. Moving to a single national diagnosis classification standard across Canada may also provide the opportunity to implement the collection of ISS scores on the discharge abstract and define a consistent ISS scoring system for the identification of significant trauma patients.

[1] 2 records could not be matched to the CIHI database and were therefore not included in the total.

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CIHI Trauma Task Force

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- Dr. David Fleiszer, Montreal General Hospital
- Ms. Tamara Stefanits, Trauma Coordinator, Victoria Hospital, London
- Dr. Tony Ashworth, Hotel Dieu, Kingston

Procedure Frequencies for the Analysis of all Sunnybrook Cases

Procedure * RIW Exclusion Category Cross-tabulation		RIW Exclusion Category					Total
		Typicals	Outliers	Transfers	Sign-outs	Deaths	
Gastrostomy - Temp/Perm	not present	14514	859	954	119	887	17333
	present	38	19	11		25	93
Total		14552	878	965	119	912	17426
Ventilation - <96 hrs	not present	13967	835	833	116	783	16534
	present	585	43	132	3	129	892
Total		14552	878	965	119	912	17426
Ventilation - > 96 hrs	not present	14493	832	943	119	853	17240
	present	59	46	22		59	186
Total		14552	878	965	119	912	17426
Gastrostomy - Percutaneous endoscopic	not present	14519	853	954	119	891	17336
	present	33	25	11		21	90
Total		14552	878	965	119	912	17426
TPN	not present	14514	853	951	119	882	17319
	present	38	25	14		30	107
Total		14552	878	965	119	912	17426
Tracheostomy - Temp	not present	14498	855	956	119	900	17328
	present	54	23	9		12	98
Total		14552	878	965	119	912	17426
Tracheostomy - Permanent	not present	14551	878	965	119	912	17425
	present	1					1
Total		14552	878	965	119	912	17426
Tracheostomy - Mediastinal	not present	14552	878	965	119	912	17426
	present						
Total		14552	878	965	119	912	17426
Dialysis - Hemodialysis	not present	14489	866	960	119	900	17334
	present	63	12	5		12	92
Total		14552	878	965	119	912	17426
ICP Monitor	not present	14529	871	960	119	896	17375
	present	23	7	5		16	51
Total		14552	878	965	119	912	17426

Complete Regression Results for Total Cost

Regression - Total Cost, CMG Average Cost and Procedures			
Model Summary [cde]			
Model	Variables Entered	Adjusted r^2 coefficient	Std. Error of the Estimate
1	AVCOST1	.542	6967.07
2	Ventilation - >96 hrs	.628	6285.87
3	Tracheostomy - Temp	.648	6106.44
4	TPN	.654	6061.28
5	Gastrostomy - Percutaneous endoscopic	.658	6025.64
6	Ventilation - <96 hrs	.660	6008.37
7	ICP Monitor	.661	5993.13
8	Gastrostomy - Temp/Perm	.662	5989.25
9	Dialysis - Peritoneal	.662	5986.38
10	Dialysis - Hemodialysis	.662	5984.40
11	Dialysis - Hemodialysis	.662	5984.40

Complete Regression Results for LOS

Regression - LOS, CMG Average LOS and Procedures			
Model Summary [fgh]			
Model	Variables Entered	Adjusted r^2 coefficient	Std. Error of the Estimate
1	AVLOST1	.519	11.09
2	Ventilation - >96 hrs	.538	10.88
3	Tracheostomy - Temp	.547	10.77
4	Gastrostomy - Percutaneous endoscopic	.553	10.70
5	TPN	.556	10.66
6	ICP Monitor	.558	10.64
7	Dialysis - Hemodialysis	.558	10.64
8	Dialysis - Hemodialysis	.558	10.64

[c] Dependent Variable: Total Cost
[d] Linear Regression through the Origin
[e] Method: Stepwise (Criteria: Probability-of-F-to-enter < =.050, Probability-of F-to-remove > =.100)
[f] Dependent Variable: LOS
[g] Linear Regression through the Origin
[h] Method: Stepwise (Criteria: Probability-of-F-to-enter < =.050, Probability-of F-to-remove > =.100)

Conclusion

Lina M. Johnson

The cases presented in this casebook provide examples of how case mix tools have been used in health care decision making in a wide range of settings and applications by Canadian health care organizations. It has been shown how case mix tools can be used in utilization management, budgeting, program planning, restructuring, care planning, case management, and hospital funding. Although only acute care applications are represented by these cases, one can expect in the near future, the range of settings for the use of case mix tools to expand into ambulatory care, chronic care, and long term care, as these tools continue to be developed and implemented.

What are some of the lessons that can be drawn from the experiences of these organizations with the use of case mix tools in health care decision making?

Lesson 1: Case Mix Tools are Dynamic & Existing Tools Change and New Tools Will Be Introduced

Existing case mix tools are updated annually by CIHI; thus, the users of these tools can expect the length of stay, resource intensity weights, and, less frequently, the groups or methodologies to change. These changes have implications for users as illustrated in some cases presented in this book. For example, the methodological change from CMG to Complexity was shown by The Toronto Hospital to produce a more useful tool for their utilization management efforts as Complexity better predicted their length of stay performance. The changes in RIW associated with the methodology change also had implications for program budgets, as discussed in the case on St. Michael's Hospital. It was found that as the RIW changed, some program budgets required relative decreases, while others required relative increases in the funds allocated. Although the new Complexity methodology was found to be a better predictor of length of stay, users should remember that the indicators produce only estimates of resource consumption at individual sites. This limitation must be recognized and taken into account when applying the tools in resource planning activities.

Until case mix tools are developed and implemented for care delivery modes other than acute care, other and perhaps less precise methods may be required for planning and utilization management. The need and desire for case mix tools that go beyond acute care, was shown in the St. Michael's Hospital case, as efforts were made by clinicians and administrators to plan programs spanning modes of care delivery from inpatient, to day surgery and ambulatory care.

Lesson 2: Users Can Influence the Enhancement of Existing Tools

Users can influence the enhancement of existing case mix tools in two ways: 1) by suggesting that CIHI undertake methodology reviews in specific clinical areas; and 2) by improving the quality of data submissions to CIHI.

In Chapter 9, it was shown that the review of MCC 25 was, in part, undertaken as a result of suggestions from hospitals that a significant percentage of trauma patients were not being assigned to the trauma clinical category (MCC 25). Thus, users who have concerns that methodologies are weak in certain areas should approach CIHI about suggestions for enhancement. CIHI has demonstrated that it is committed to continually improving its methodologies to better meet the needs of users of case mix tools and to better reflecting current patterns of practice in health care.

CIHI works with its clients to define and promote guidelines and standards for data elements submitted to the database. More accurate reporting by hospitals will in turn improve CIHI's ability to identify and introduce robust enhancements to its methodologies. The predictive value of the methodologies and associated case weights should then reflect this quality improvement. Thus, improvements to the case mix tools can begin with the efforts of Health Records Departments. Efforts aimed at assisting clinicians to increase their understanding of the tools may contribute to improving the quality of data submissions to CIHI. Increased awareness and appreciation for the significance of documenting co-morbid conditions and other factors contributing to length of stay may lead to more useful clinical information on the health record and, subsequently, on the discharge abstract. As seen in the cases written by Mt. Sinai Hospital and St. Boniface Hospital, education of clinicians on case mix tools may be primarily undertaken for the purpose of improving patient care processes and the utilization of resources within the organization. Yet, a beneficial by-product of these efforts can be improved data quality, and hence, improved methodologies in subsequent years.

Lesson 3: Computer Systems are Essential for Database Management, Timely Analysis and Reporting of Information

The organizations represented in this casebook all manage relatively large amounts of case mix data as compared to those of small community hospitals. For a large and complex caseload, computer systems are essential for data management and case mix analysis. Without computer systems to assist with the collection, analysis and reporting of data, the efforts described in these cases would not have been possible. As illustrated in the St. Boniface and Mt. Sinai cases, not only are computer systems essential for storing data, but systems with the capability to integrate data from several systems are critical for analyses used in program planning, resource allocation, and utilization management efforts. However, it is likely becoming more and more difficult for organizations with smaller data bases to meet their data and information requirements without some type of computer system. With the resource constraints that many health care organizations face, investment in computer systems can assist organizations to shift the use of their human resources away from routine data management and collection toward increased analysis and support for decision making. Such shifts in the use of human resources may assist organizations to better meet resource constraints by enabling better and more timely decisions.

Lesson 4: Multi-disciplinary Decision Support Teams are Required to Transform Data into Useful Information

Several cases in this book discussed the need for expert decision support teams to work with clinicians and administrators to transform data into useful and meaningful information for program management. Although the composition of these decision support teams and their positions within the organization varied, it is apparent that these teams must have a multi-disciplinary set of skills including, at a minimum, health records, finance, and patient care processes. More specifically, the analysts need to understand case mix methodologies, financial and costing data, budgeting and patient care processes. They also need to have some level of computer skills, quantitative skills, and the ability to communicate and collaborate with clinicians and hospital or program administrators. Since change is ongoing in case mix methodologies, methods of medical treatment, and patient care processes, decision support teams will need to continually update their knowledge to stay current and maintain their expertise in this relatively new field of health care. They will also need to continually update clinicians and administrators on the implications of case mix tool applications as they relate to their roles and responsibilities. With the combination of all these skills, decision support teams need to understand the information needs of clinicians and administrators and then transform the data into information and reports that will be useful in decision making.

Lesson 5: Decision Makers Need a Culture of Empirical-Based Decision Making

Each of the organizations presenting their experiences in this casebook, likely had corporate cultures that support empirical-based decision making. Otherwise, the organizations would not have supported the efforts described in these cases. Although most decisions should not be made on the basis of tools and purely quantitative methods only, organizational cultures that dismiss the concept of empirical-based decision making on may be foregoing opportunities for better decisions and faster adaptation to the changing health care environment. Organizations that embrace empirical-based decision making and support the use of resources for this set themselves apart as leaders in adapting to the health care environment of the future. An example of the benefits of a culture that embraces empirical-based decisions is that of the London Health Sciences Centre. Their response to the Ontario Health Services Restructuring Commission (HSRC) report was to extend the analyses done by the HSRC and look for specific opportunities to make the necessary changes to meet the set targets.

Lesson 6: Significant Improvements in Hospital Performance are Possible with the Use of Case Mix Tools in Health Care Decision Making

Some of the cases presented in this book demonstrated that improvements in hospital performance are possible with the use of case mix tools and the collaborative efforts of clinicians, administrators, and decision support teams. For example, London Health Sciences Centre demonstrated how it achieved dramatic shifts in the provision of surgical procedures from an inpatient to day surgery basis with the aid of case mix tools and the day surgery incentive model. Mt. Sinai Hospital demonstrated how it made dramatic reductions in its average length of stay for one CMG related to stroke. St. Michael's hospital demonstrated that it had ranked number one among its peer hospitals for cost per weighted case, a measure of efficiency in the delivery of acute inpatient, newborn, and day surgery care. These are a few of the many examples of improvement in hospital performance illustrated in the cases presented in this book, and made possible through the use of case mix tools in decision making.

Glossary

ALC Days—The number of days assigned to the alternate level of care (ALC) patient service during the patient's hospitalization.

ALOS—Average length of stay

APlx Cell—The analytical cell representing CMG, Complexity Level and Age Category

Atypical Cases—These cases are not used for the calculation of ELOS.

- ð Invalid length of stay
- ð Deaths
- ð Transfers to or from acute-care institutions
- ð Sign-outs
- ð Outliers (cases with lengths of stay beyond the Trim LOS)
- ð CMG 910, 912, 997, 998, 999

CCP—Canadian Classification of Procedures

Complexity Overlay—The complexity overlay is an enhancement to the CMG methodology which allows the consideration of diagnoses other that that labeled "most responsible" to be considered in the grouping of cases.

Complexity (Plx)—The name and trademark given to the grouping methodology employing both CMG and the complexity overlay. Versions released by CIHI are:

Complexity 95—preliminary or alpha version
Complexity 96—pilot or beta version
Complexity 97—product version implemented April 1, 1997

CMG—Case Mix Groups

DAD—The CIHI Discharge Abstract Database containing hospital inpatient and day procedure records.

Deaths—Cases where the patient died while in hospital.

DPG—Day Procedure Groups

ELOS—The expected length of stay for a 'typical' case in a APlx cell calculated by one of five potential models.

HSRV—Hospital Specific Relative Value

ICD-9—International Statistical Classification of Diseases, Injuries and Causes of Death, Ninth Revision

ICD-9-CM—ICD-9, Clinical Modification - prepared for use in the United States

LOS—Length of Stay, in days.

May Not Require Hospitalization (MNRH) CMG—"MNRH discriminates patients whose characteristics often allow ambulatory treatment not requiring admission. MNRH does NOT determine a sample of patient who MUST be treated as ambulatory, given that these patients may have a justifiable basis for inpatient admission."

MCC—Major Clinical Category. The CMG methodology assigns each case to one of 25 MCC.

Most Responsible Diagnoses (MRDx)—"An ICD code identifying the diagnosis, considered by the physician, to be most responsible for the patient's stay in the institution. The one diagnosis which describes the most significant condition of a patient which causes his/her stay in hospital. In the case where multiple diagnoses may be classified as the most responsible, the diagnosis which is responsible for the greatest length of stay is used."

Outlier—Cases where the total LOS is greater than the Trim LOS.

Plx Level—The Complexity Level assigned to the cases by the grouping methodology.

1. No Complexity
2. Complexity related to chronic condition(s)
3. Complexity related to serious/important condition(s)
4. Complexity related to potentially life-threatening condition(s)

Post-Admission Co-morbid (Type 2) Diagnoses—CIHI defines a post-admission co-morbid or type 2 diagnosis as:

"An ICD diagnosis describing a condition arising after the beginning of hospital observation and/or treatment which influences the patient's hospitalization (i.e. LOS) and/or significantly influences the management or treatment of the patient."

Pre-Admission Co-morbid (Type 1) Diagnoses—CIHI defines a pre-admission co-morbid or type 1 diagnosis as:

"An ICD diagnosis describing another important condition of the patient which has a significant influence on the patient's hospitalization and/or significantly influences the management or treatment of the patient."

RAPD—Routine and Ancillary Per Diem - An estimate of the variable charges found in 5 of the 8 Maryland charge buckets (nursing, drugs, lab, diagnostic imaging, physical medicine)

RIW—Resource Intensity Weight—A relative value derived from case-weighting cost or charge data.

SDS—Same Day Surgery—Used for the calculation of DPG weights

Sign-outs—Cases where the patient signs out of the hospital against medical advice.

Standardization Factor—A ratio of the sum of typical charge times the case volume to the case volumes. Used to set the average typical RIW = 1.

Typical—Typical cases are those remaining in the CIHI calibration database after the exclusion of deaths, signouts, transfers and long stay outliers. Only typical cases are used for RIW estimation.

Transfer—A cases that is transferred into or out of an acute care institution.

Trim LOS—For a given APlx cell, the LOS value at which outliers are excluded from the data.

The Trim LOS is calculated with the long stay cases included. Using the formula (Q3 + 2 * IQR)

NOTE: Cases whose calculated trim is 1 day have been assigned a trim of 3 days to avoid inappropriate rewarding of RIW. (CMG 538, 617,852)

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