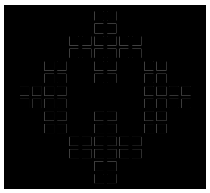
Hospital Case-Mix Costing Project:

Using the Manitoba Management Information System

A first step

July 1999



Manitoba Centre for
Health Policy and Evaluation
Department of Community Health Sciences
Faculty of Medicine, University of Manitoba

Greg Finlayson, BA, CAE
Debbie Nowicki, MSc
Noralou Roos, PhD
Marian Shanahan, RN, MA
Charlyn Black, MD, ScD

ACKNOWLEDGEMENTS

The authors wish to acknowledge the contributions of the many individuals whose efforts and expertise made it possible to produce this report. We thank the following, and apologize in advance for anyone that we might have overlooked:

- The study Working Group:
  - Barb Drain, CFO, St. Boniface General Hospital
  - Ian Fish, Corporate Information Coordinator, Health Sciences Centre
  - Mike Gehlan, CFO, Misericordia General Hospital
  - John Koschuk, MIS Coordinator/Consultant/Analyst, Manitoba Health
  - Frances Peters, Manager – Health Records, Bethesda Hospital
  - Julene Reimer, Consultant/Health Records Analyst, Manitoba Health
  - Linda Sawatzky, Manager – Health Records, Victoria General Hospital
  - Brian Schoonbaert, Assistant Executive Director – Finance and Information Services, Brandon General Hospital
  - Dawna Suchy, Vice President – Corporate Services, Interlake RHA
- Carmen Steinbach, Leonard MacWilliam and Charles Burchill provided data and analytic support;
- Jodi Plohman developed several of the charts within the report;
- Colleagues who provided feedback on drafts of the report: Carolyn DeCoster, Michael Farnworth, Mike Gehlan, John Koschuk, Verena Menec, Linda Sawatzky, Brian Schoonbaert, Evelyn Shapiro, and Fred Toll;
- Philip Jacobs, Michael Wolfson and the Canadian Institute for Health Information (CIHI) provided valuable comments as external reviewers;
- Administrative support was provided by Shannon Lussier.

We acknowledge the financial support of the Department of Health of the Province of Manitoba. The results and conclusions are those of the authors and no official endorsement by Manitoba Health was intended or should be implied. This report was prepared at the request of Manitoba Health as part of the contract between the University of Manitoba and Manitoba Health.

THE MANITOBA CENTRE FOR HEALTH POLICY AND EVALUATION

The Manitoba Centre for Health Policy and Evaluation (MCHPE) is a unit within the Department of Community Health Sciences, Faculty of Medicine, University of Manitoba. MCHPE is active in health services research, evaluation and policy analysis, concentrating on using the Manitoba health data base to describe and explain patterns of care and profiles of health and illness.

Manitoba has one of the most complete, well-organized and useful health data bases in North America. The data base provides a comprehensive, longitudinal, population-based administrative record of health care use in the province.

Members of MCHPE consult extensively with government officials, health care administrators and clinicians to develop a research agenda that is topical and relevant. This strength, along with its rigorous academic standards and its exceptional data base, uniquely positions MCHPE to contribute to improvements in the health policy process.

MCHPE undertakes several major research projects every year under contract to Manitoba Health. All projects address substantive issues in health policy, and some address basic science issues in population health research. In addition, MCHPE researchers secure major funding through the competitive grants process. Widely published and internationally recognized, they collaborate with a number of highly respected scientists from Canada, the United States and Europe.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Manitoba's 79 acute care hospitals spend approximately $880 million providing health services to people. The managers of these services, whether they are at an individual hospital, at a Regional Health Authority or Winnipeg Hospital Authority, or at Manitoba Health, need a method of classifying expenditures to allow for effective control of the allocation of scarce health care resources. The Management Information System (MIS) was introduced in 1995/96 to help achieve this.

MIS is a standardized classification system for financial and statistical records in healthcare facilities. It was developed by the Canadian Institute for Health Information (CIHI). The system was designed to permit comparisons between facilities, regions and provinces. Manitoba hospitals began using MIS in the 1995/96 fiscal year.

At the request of Manitoba Health, the Manitoba Centre for Health Policy and Evaluation (MCHPE) conducted a feasibility study to determine if MIS could be used to perform case mix costing. MCHPE has conducted several studies looking at the cost of providing care in hospitals, and this project builds upon this earlier work. Given that this was the first year of implementation of MIS, this study was designed to determine if MIS data could be used to:

- Estimate the cost of providing inpatient care to different types of patients; and
- Estimate the average cost of providing inpatient care in different types of facilities.

Although other provinces have developed a methodology for calculating “cost per weighted case” (Canadian Institute for Health Information, 1998), this project was among the first in Canada initiated specifically to see if comparisons could be made between different types of facilities. We started by limiting our review to the 18 largest facilities in Manitoba. These included the teaching hospitals, the urban community hospitals and the major rural

hospitals. Our review was further limited to only the costs of care provided to inpatients (as opposed to "outpatient" or "ambulatory care" patients). The decision to impose these limits on this study was done after a preliminary review of the data. At that time, it was determined that we should limit ourselves to reviewing a reasonable amount of data consistent with the resources that were available.

We reviewed the 1995/96 MIS data submitted by hospitals to Manitoba Health to determine how these data could be used for making cost comparisons. As a result of this review a number of issues have been identified that should be dealt with before any comparisons are made.

Historically, each facility has developed an internal reporting system that will meet its needs for managing its operation. External reports (such as the HS-1 reports that have been used in previous MCHPE costing projects) were prepared by summarizing the internal system. In 1995/96, for the first time, hospitals were required to submit detailed data to Manitoba Health in a consistent format using a chart of accounts standardized to MIS. The detailed data show that reporting, while following acceptable accounting practices, can vary greatly from facility to facility, and that hospitals are not always following the Manitoba Facility Reporting System developed by Manitoba Health.

The specific areas in which we have identified inconsistencies or potential for making inaccurate comparisons are:

- Employee benefits are not consistently distributed to the functional centre reporting the wages or salaries;
- Capital costs are handled in different ways, and capital items may be financed through use of leasing arrangements;
- Operating room costs are not consistently distributed between inpatient and ambulatory care;

- Observation units that are part of the ambulatory care functional centre sometimes provide care to inpatients without these costs being attributed to inpatient care;
- Certain costs are not reported in MIS, such as the cost for fee-for-service amounts paid to physicians, services provided by Community Therapy Services, South Central Therapy Services, Laboratory and Imaging Services Branch, and Westman Regional Laboratory, and for blood products provided to hospitals;
- Certain statistics (e.g., Inpatient Days) that are critical to estimating costs were either inaccurate or inconsistently reported.

Earlier MCHPE projects used data that had similar problems, and made adjustments to ensure that accurate comparisons could be made. We also made adjustments for the purpose of conducting this feasibility study. However, we are concerned that unadjusted data may be used by others for making comparisons. Our report, therefore, does not focus on how adjustments were made, or how individual facilities compare, but rather on what needs to be done to have the facilities collect data that can be used for comparisons.

In addition to using the new Management Information System, 1995/96 was the first year that all Manitoba inpatient cases were assigned to Case Mix Groups (CMG™) with accompanying Resource Intensity Weights (RIW™). CMG is a grouping methodology developed by the Canadian Institute for Health Information (CIHI) that classifies inpatient cases into one of 585 different groups. Each case is then assigned an RIW based on its CMG and whether it is a "typical" or "atypical" case.

In the course of completing this project, we noted some differences between the cases that receive care in Manitoba hospitals and those in the CIHI database. The CIHI database contains approximately 2.2 million cases. Manitoba hospitals contribute about 3.5% of these - all of which originate from seven acute-care urban facilities within the city of

---

™ CMG and RIW are registered trademarks of the Canadian Institute for Health Information.

Winnipeg. The average length of stay for Manitoba cases is similar to CIHI's on an overall basis, but when looking at individual CMGs, the Manitoba average length of stay for some CMGs is longer and for some it is shorter. These differences may affect the RIW that would be assigned to these cases. We have not pursued this issue further, but recognize it as something that should be addressed before making further inter-facility or inter-CMG comparisons.

Although we have identified limitations in the data used in this feasibility study, we have developed some preliminary estimates of costs for different types of cases. We have also developed a preliminary cost per weighted case for the three types of hospitals in the study. The “cost per weighted case” is the total cost of providing inpatient care divided by the sum of the resource intensity weights for all inpatient cases that received care during the fiscal year.

The current project has been successful in identifying the key components that are required to estimate the cost per weighted case for Manitoba hospitals. The Management Information System that is in place in hospitals is structured to provide the necessary financial and statistical data. We note that unless hospitals, health authorities, hospital authorities and Manitoba Health take responsibility for ensuring adherence to the established standards, inconsistent reporting will negatively affect their ability to make cross-facility comparisons. This project has helped us understand what will be necessary to make inter-facility comparisons of costs per weighted case using MIS and hospital discharge data. We understand that initiatives have been taken by health care administrators to improve the validity of MIS data. These improvements will both assist in management of the health care system and enable researchers to use these data to explore many important issues in the cost of providing health care.

1. INTRODUCTION

The Management Information System (MIS) is a new method of classifying health care expenditures, revenues and statistics. MIS was introduced in Manitoba hospitals beginning 1995/96 as part of a move to this reporting system across Canada. This system is designed to provide a standardized method of classifying financial and statistical events within institutions and consists of a "chart of accounts" with corresponding definitions, and recommendations for implementation and application. As we move towards a more integrated delivery of health care services within Manitoba, it makes sense that there is the capacity to make valid cost comparisons across facilities. A key factor in the success of the recently established Regional Health Authorities (RHA), Winnipeg Hospital Authority (WHA) and Winnipeg Community and Long Term Care Authority (WCA) will be the availability of comparable and useful financial and statistical information that can be used as a management tool to assist in evaluating services, and to make inter-facility comparisons.

This project represents the first attempt in Manitoba, and one of the first in Canada to assess how this new reporting system is working. We have looked at whether hospitals are indeed recording data in a standardized format, and how these data may be used when making comparisons of costs for providing care to inpatients across various types of hospitals.

As part of this project we required a system for describing the patient population at each hospital. In the past, our costing projects have relied upon Refined Diagnosis Related Groups (RDRG), a classification system developed in the United States. Case weights (representing the relative resources consumed by different types of cases and distinguishing simple from complex cases) were assigned to each patient record according to RDRG. The RDRG weights were created by combining charge data from the state of Maryland with length of stay data from Manitoba. Since most Canadian hospitals (including the larger

Manitoba hospitals) use Case Mix Groups (CMG™) with accompanying weights (Resource Intensity Weights - RIW™), we decided to base this project upon this classification system that was developed by the Canadian Institute for Health Information (CIHI).

This project is particularly timely given the recent introduction of MIS in Manitoba and the first-time availability of province-wide CIHI-grouped discharge data. The objectives of this project were:

1. To identify how successful the larger Manitoba hospitals (both urban and rural) have been in reporting MIS data in a standardized way, and to identify where improved reporting of MIS data would make institutional comparisons more valid;
2. To estimate the cost per weighted case for teaching, urban community and major rural hospitals in Manitoba using the MIS financial and statistical reporting system and the Canadian CMG classification system; and
3. To estimate the costs of different types of cases in Manitoba using the MIS financial and statistical reporting system, and the Canadian CMG classification system.

The present work builds upon previous hospital costing projects of the Manitoba Centre for Health Policy and Evaluation (MCHPE). The earliest studies focussed on determining the feasibility of estimating per diem inpatient costs, using available data. Michael Loyd & Associates (1992) and Wall et al. (1994) used accounting data to estimate per diem costs for Manitoba hospitals. The Loyd study developed a general methodology using a hospital's Financial Information System to isolate the direct and indirect costs of acute care services within five urban community hospitals. The purpose of estimating these costs was to permit comparisons of resource consumption across regions of Manitoba and to determine the feasiblity of calculating the cost per weighted case. Wall and colleagues compared the estimated per diem costs of five urban hospitals using two different reporting

---

™ Registered trademark of the Canadian Institute for Health Information.

systems: the Financial Information System and the HS-1 reports submitted to Statistics Canada.

Most recently, Shanahan, Loyd, Roos et al. (1994) developed a methodology for assessing the costs of care in Manitoba hospitals. In this study, hospitals were compared by combining hospital-specific cost information included on HS-1 reports with case mix information for each Manitoba hospital. The data resulting from this methodology have since been applied to two subsequent projects. Specifically, the cost of providing health care to residents of the various regions of the province was estimated in "A Project to Investigate Provincial Expenditures on Health Care to Manitobans" (Shanahan, Steinbach, Burchill et al., 1997). In this project, the cost of inpatient hospital care was calculated using data from fiscal year 1993/94. A second project entitled "Cost List for Manitoba Health Services" (Jacobs, Shanahan, Roos et al.,1999) has incorporated the case mix adjusted costing methodology to develop a list of costs for inpatient services within the province.[1]

The current project has been successful in identifying the key components that are required to estimate the cost per weighted case for Manitoba hospitals. The Management Information System that is in place in hospitals is structured to provide the necessary financial and statistical data. However, we note that unless hospitals, health authorities and Manitoba Health take responsibility for ensuring adherence to the established standards, inconsistent reporting will negatively affect their ability to make cross-facility comparisons. This project has helped us understand the process that will be necessary to make inter-facility comparisons of costs per weighted case using MIS and hospital discharge data. We understand that health care administrators are making progress. Specifically, a report entitled "Assessment of Patient Specific Case Costing and Management Information"

[1] This project uses 1993/94 data to estimate the cost of inpatient care for Refined Diagnosis Related Group (RDRG) for all hospitals in Manitoba. The RDRG classification system includes subclasses that reflect complications and comorbidities that are known to impact resource consumption.

(Manitoba Case Costing and Management Information Project, 1998) has made a number of recommendations that would assist in this process.

2. METHODS

2.1 General Overview

As this was our first experience with using both MIS and the case mix grouping system developed by the Canadian Institute for Health Information, we established a working group to advise on issues relevant to this feasibility study. This group was made up of individuals with expertise in either hospital accounting or health records and was important in helping us to understand various aspects of both datasets.

We encountered a number of problems with the financial data, and have identified some issues for further review concerning the application of CIHI resource intensity weights to Manitoba cases. These issues are discussed later in this report. While recognizing these limitations, we have used these data to develop very preliminary estimates of costs per weighted case for different types of Manitoba hospitals as well as preliminary estimates of costs for each case mix group.

The process we used was as follows:

1. ***Estimate the total expenditures for inpatient care at teaching, urban and major rural hospitals***
    - MIS data were used to estimate the full costs of inpatient care;
    - Supplemental costs were imputed for some expenditures that were not reported in a facility's MIS data.
2. ***Determine the total weighted cases for each study hospital***
    - Inpatient hospital discharge data (April 1, 1995 to March 31, 1996) were grouped by CMG using the 1995 CMG methodology developed by the Canadian Institute for Health Information. Resource Intensity Weights were assigned by CIHI to each case using the 1995 resource allocation methodology;

- Adjustments were made to the total weighted cases (i.e., the sum of all resource intensity weights) for each hospital. These adjustments are necessary to recognize that some patients were not discharged until after March 31, 1996 or had been admitted before April 1, 1995.[2] Such adjustments are necessary to match expenditures (inputs) with case-weights (outputs) in a given year[3];
- Adjusted resource intensity weights were summed to determine the total weighted cases for each facility.

3. ***Calculate the cost per weighted case (CWC)***

- The cost per weighted case for each facility was calculated using the following formula:

$$\text{Cost per Weighted Case} = \frac{\text{Total inpatient expenditures}}{\text{Total weighted cases}}$$

2.2 Estimating Total Expenditures for Inpatient Care

MIS defines "buckets" or functional centres by which revenue, expenditures and statistics are classified. Within one functional centre, several other functional centres may be defined. For example, the "Inpatient Nursing Care" functional centre may contain a functional centre defined as "Intensive Care"; this functional centre may in turn contain a group defined as "Surgical" which may also contain a functional centre defined as "Trauma." Determining the direct costs for inpatient care involves rolling up all of the costs for the functional centres that were contained within Inpatient Nursing Care. Next, costs for employee benefits were distributed to the functional centre within which the wages and salaries were reported. Costs shared by all functional centres (i.e., overhead costs) were allocated. Finally, the cost of inpatient diagnostic and therapeutic services was estimated and this cost was added to the direct, employee benefit costs and overhead.

---

[2] Cases that were not discharged as of March 31, 1996 would not have their case weight (RIW) reflected in the total weighted cases for the hospital. For cases that were admitted before April 1, 1995, a portion of their RIW needed to be attributed to the prior fiscal period.

[3] Appendix 4 describes these adjustments.

Adjustments were made to attribute costs of several services that inpatients received but were not reported in MIS. These services include laboratory, imaging, and therapy services provided to some hospitals by external agencies. Additional adjustments were made to ensure that the full cost of patient care was captured consistently.[4] Appendix 1 includes a summary of the calculation of full costs of inpatient care and a detailed description of the approach that was adopted.

2.3 Determining the Total Weighted Cases for Each Facility

2.3.1 Hospital Discharge Data

Case-specific data on all inpatients discharged during fiscal year 1995/96 (April 1, 1995 to March 31, 1996) were obtained for the eighteen largest acute-care hospitals in Manitoba using hospital abstracts submitted to Manitoba Health (N=128,256). The eighteen study hospitals (of a total of 79 acute health care facilities in Manitoba) comprised more than 80% of inpatient discharges. Based on size, specialization and function (Black, Roos, and Burchill, 1993), each of the 18 facilities was classified as: "teaching," "urban community" or "major rural" (see Appendix 2. Study Hospitals). As shown in Table 1, teaching hospitals provided care to the greatest number of inpatients (41.5%); while the urban community hospitals provided the greatest number of days of care (41.7%).

[4] All costs identified as medical remuneration (that is, payments to physicians) and associated benefits where applicable were excluded, as were "capital" related costs such as depreciation expense, interest expense and principal. These costs were excluded to ensure consistency in calculating full costs since hospitals have very different approaches to compensating physicians and to handling capital expenditures. The cost for products provided directly to hospitals by The Canadian Red Cross Society Blood Services was not available.

Table 1. Number (%) of Cases and Days by Hospital Type, 1995/96

Hospital Type	Cases		Days		Length of Stay
	(no.)	(%)	(no.)	(%)	(avg)
Teaching	53,237	41.5	458,660	40.8	8.6
Urban Community	46,137	36.0	468,568	41.6	10.2
Major Rural	28,882	22.5	197,520	17.6	6.8
TOTAL	128,256	100.0	1,124,748	100.0	8.8

2.3.2 CMG Classification

Inpatient cases were classified by CMG[5] and the accompanying resource intensity weight (RIW) was assigned using the 1995 resource allocation methodology developed by the Canadian Institute for Health Information (CIHI). In previous costing studies (Shanahan, 1996; Jacobs et al., 1999), inpatient cases were classified by Refined Diagnosis Related Group (RDRG), a US-based classification system that characterizes the complexity of each case based on the presence of complications and comorbid diagnoses. Although CIHI has recently implemented its similar complexity overlay (Canadian Institute for Health Information, 1997), this refinement was not available for the present study.[6] However, the CMG classification system was used in this study as Winnipeg hospitals utilize case mix groups to describe their patient populations. As this was the first time CIHI-grouped data were available province-wide, data checking was carried out. These procedures are described in Appendix 3, and involved comparing the data as they were grouped by CIHI for Manitoba Health with the data as they were grouped by CIHI for Winnipeg acute care hospitals. In general, the grouping results were very similar.

[5] CIHI applied the 1995 CMG grouper to 1995/96 hospital separation data at the request of Manitoba Health.
[6] The existing CMG grouping methodology includes CC splits which define the presence or absence of complications and comorbidities. For example, CMG 001 is Craniotomy procedures, No CC and CMG 002 is Craniotomy procedures, CC. Age splits are also defined for numerous CMGs.

2.3.3 Assignment of Resource Intensity Weights

Resource intensity weights describe the relative resource consumption of one case in a given CMG compared to all cases in all CMGs.

Ideally, calculating the RIW for a particular type of case (i.e., a CMG) would use, as its base, micro-costing information from a broad selection of Canadian hospitals. No such data exist. *Charge* data from the US state of Maryland[7] were used by CIHI to develop the resource intensity weights (RIW) used here. The Maryland data report the average charge for a person receiving treatment for each CMG in a hospital within that state. It is then necessary to adjust these charges to the different average length of stay for inpatients in Canadian hospitals. As a result, CIHI adjusts the Maryland charge data to reflect the different length of stay pattern in Canada.

The process of calibrating the Maryland charge data to represent CIHI resource intensity weights is described in CIHI's Resource Intensity Weights - Summary of Methodology 1995/96 (Canadian Institute for Health Information, 1995). Briefly stated, the calibration involves:

1. The 1992 Maryland charges for each CMG are adjusted upwards or downwards by adding or subtracting the Maryland routine and ancillary charges for each day difference between the average CIHI length of stay and the average Maryland length of stay;

---

[7] Maryland charge data were used in previous MCHPE studies (Shanahan et al., 1994; Jacobs et al., 1999) and CIHI describes the benefits of this database for calibrating RIWs as:

- The Maryland database documents all acute care provided in the state.
- It provides an appropriate comparison for the CIHI provincial populations' acute care cases and is not subject to sampling variability.
- Large volumes of specialized cases are found in the Maryland inpatient databases.
- As more current Maryland data becomes available each year, the calibration database can continue to be updated until such time as Canadian cost data are available in sufficient volumes for RIW calibration. (Canadian Institute for Health Information, 1995)

2. A "standardization factor" is calculated by weighting the average adjusted charges for each CMG by the CIHI frequency for each CMG, summing these weighted charges, and dividing the result by the frequency for all CMGs;
3. The average adjusted charge for each CMG (calculated in #1 above) is divided by the standardization factor;
4. Steps 1 through 3 are repeated for the 1993 Maryland charges. The results for the two years are averaged to provide the RIW that is used by CIHI to represent resource consumption.

Case weights are calculated differently depending on whether a case is classified as "typical" or "atypical." *Typical* cases define a group of patients for which a complete course of treatment occurred at a single institution, and the hospitalization did not end in death, signout or transfer. A typical case is expected to have an average level of resource consumption for their case mix group. *Atypical* cases include deaths, signouts, transfers to or from an acute care facility, and long stay outliers. Signouts are cases where the hospital stay ends prematurely against medical advice. Transfers are cases that result from a person being moved from one acute care facility to another. Long stay outliers are those cases where the length of stay exceeds a statistically-defined trim point. Resource consumption for atypical cases is expected to differ from typical cases within the same case mix group.

Of the 128,256 cases included in this study, 82.2% were typical, while 17.8% of cases were atypical (Figure 1). Transfers accounted for the largest portion of atypical cases - 9.2%. While the total number of atypical cases was small, these cases accounted for more than half of the total days in study hospitals (Figure 2). Outliers comprised the largest portion of hospital days (30.9%).

Figure 1. Percent Typical/Atypical Cases, All Study Hospitals, 1995/96

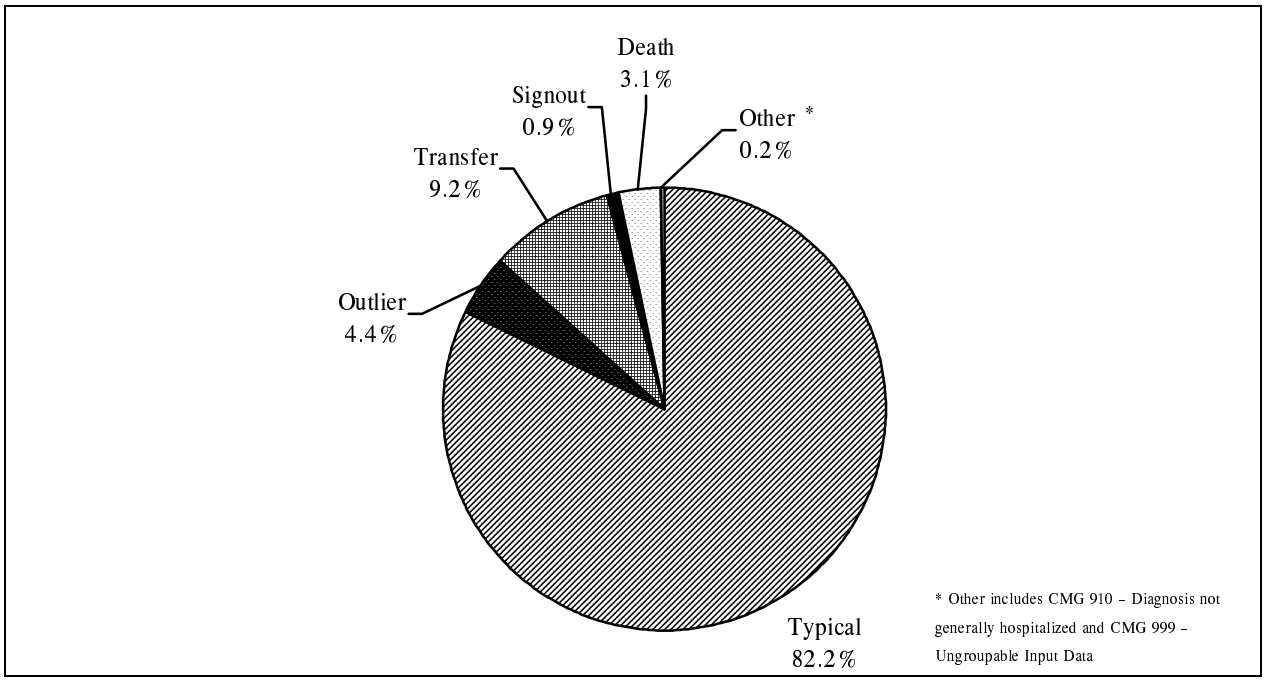
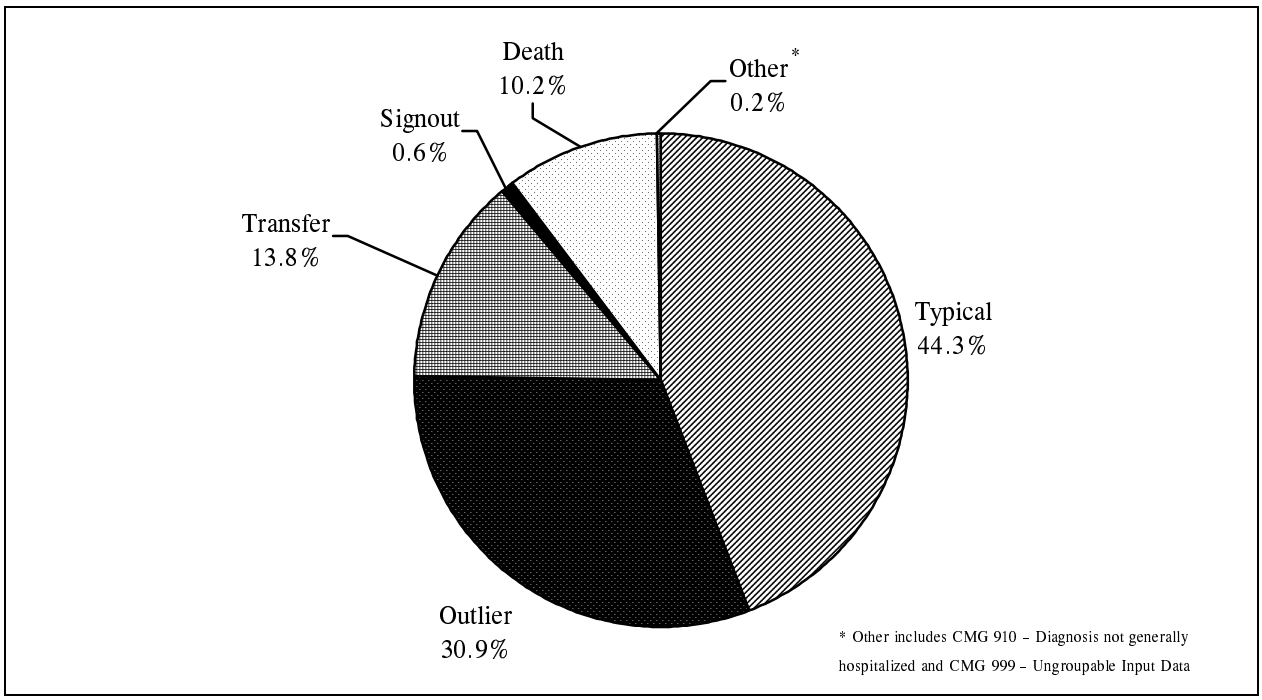


Figure 2. Percent Typical/Atypical Days, All Study Hospitals, 1995/96



For *deaths* and *transfers*, weights were developed using the per diem weight for a given CMG, length of stay for each case and a value calculated using a cost curve. For *outliers*, weights were developed using the typical weight and blended routine and ancillary weights applied to length of stay in excess of the average stay. The outlier formula was likewise used to compute the resource intensity weight when the length of stay exceeded the trim point for cases classified as deaths, transfers and signouts (Canadian Institute for Health Information, 1995). Signouts are assigned an RIW based on their length of stay relative to the average length of stay and the trim point for the CMG. Although the resource intensity weight is dependent upon the length of stay for atypical cases, all typical cases within the same case mix group are assigned the same RIW, regardless of the length of stay.

2.4 Description of Cases at the Study Hospitals

In the following section, descriptive information about the types of cases that were discharged in 1995/96 is provided.

2.4.1 Typical Cases

The distribution of typical cases was fairly similar across the three types of hospitals, exceeding 80% of inpatient discharges (Table 2). The proportion of these cases was greatest at urban community hospitals. The typical cases at urban community hospitals accounted for nearly 84% of the total cases, yet were responsible for only 40% of total inpatient days and contributed less than half of the total weighted cases (Table 3).

2.4.2 Deaths

The proportion of cases ending in death and days attributed to these cases was greatest at urban community facilities (Table 2). Across the three types of hospitals, average length of stay for these cases exceeded 25 days and roughly eight to twelve percent of total weighted cases was accounted for by cases ending in death (Table 3).

2.4.3 Transfers

Transfers comprised the second largest proportion of cases across facilities (Table 2). The teaching hospitals reported the greatest number of these cases (11.2%) as would be expected given the provision of tertiary care services at these facilities. Roughly 19% of total days and 21% of weighted cases were the direct result of acute-care transfers. At the major rural hospitals, transfers comprised nearly 10% of cases and 15% of hospital days.

2.4.4 Signouts

Overall, the proportion of cases and days accounted for by these atypical cases was small across the three types of hospitals (Table 2). Less than 1% of weighted cases were accounted for by these cases (Table 3).

Table 2. Distribution of Cases and Days by Typical/Atypical Status and Type of Hospital, 1995/96

	Teaching				Urban Community				Major Rural			
	Cases		Days		Cases		Days		Cases		Days	
Type of Case	(no.)	(%)	(no.)	(%)	(no.)	(%)	(no.)	(%)	(no.)	(%)	(no.)	(%)
Typical	43,016	80.8	212,698	46.4	38,549	83.6	188,135	40.2	23,844	82.5	96,642	48.9
Outlier	2,287	4.3	116,724	25.5	2,191	4.8	179,109	38.2	1,174	4.1	52,224	26.4
Transfer	5,981	11.2	89,179	19.4	3,089	6.7	38,057	8.1	2,790	9.7	28,552	14.4
Signout	459	0.9	2,962	0.6	295	0.6	2,416	0.5	362	1.3	983	0.5
Death	1,458	2.7	36,821	8.0	1,854	4.0	59,573	12.7	672	2.3	18,795	9.5
CMG 910	34	0.1	271	0.1	157	0.3	1,275	0.3	26	0.1	92	0.0
CMG 999	2	0.0	5	0.0	2	0.0	3	0.0	14	0.0	232	0.1
Total	53,237	100.0	458,660	100.0	46,137	100.0	468,568	100.0	28,882	100.0	197,520	100.0

Table 3. Length of Stay, Resource Intensity Weight and Weighted Cases by Type of Hospital, 1995/96

	Teaching						Urban Community						Major Rural					
	Cases		Mean	Mean	Weighted Cases		Cases		Mean	Mean	Weighted Cases		Cases		Mean	Mean	Weighted Cases	
Type of Case	(no.)	(%)	LOS	RIW	(no.)	(%)	(no.)	(%)	LOS	RIW	(no.)	(%)	(no.)	(%)	LOS	RIW	(no.)	(%)
Typical	43,016	80.8	4.9	1.1	46,379.2	50.6	38,549	83.6	4.9	1.0	39,806.1	47.2	23,844	82.5	4.1	0.8	18,851.6	52.8
Outlier	2,287	4.3	51.0	7.9	18,152.5	19.8	2,191	4.7	81.7	11.9	26,105.6	30.9	1,174	4.1	44.5	6.7	7,888.2	22.1
Transfer	5,981	11.2	14.9	3.2	19,333.8	21.1	3,089	6.7	12.3	2.4	7,558.5	9.0	2,790	9.7	10.2	1.9	5,421.1	15.2
Signout	459	0.9	6.5	0.9	424.7	0.5	295	0.6	8.2	1.2	342.7	0.4	362	1.3	2.7	0.4	161.1	0.5
Death	1,458	2.7	25.3	5.0	7,347.9	8.0	1,854	4.0	32.1	5.6	10,428.6	12.4	672	2.3	28.0	5.0	3,365.6	9.4
CMG 910	34	0.1	8.0	0.4	13.9	0.0	157	0.3	8.1	0.6	95.3	0.1	26	0.1	3.5	0.4	9.8	0.0
CMG 999	2	0.0	2.5	0.3	0.7	0.0	2	0.0	1.5	0.2	0.4	0.0	14	0.0	16.6	1.2	16.1	0.0
Total	53,237	100.0	8.6	1.7	91,652.7	100.0	46,137	100.0	10.2	1.8	84,337.2	100.0	28,882	100.0	6.8	1.2	35,713.5	100.0

2.4.5 Outliers

Across hospital types, the proportion of outlier cases ranged from 4.1% at major rural facilities to 4.7% at urban community hospitals. More than 25% of inpatient days were accounted for by these cases at teaching and major rural facilities, while roughly 38% of days were the result of outliers at urban community hospitals (Table 2). Compared to other cases, the average RIW was greatest for outliers, indicating substantial resource consumption. For urban community hospitals, approximately one-third of weighted cases were accounted for by outliers (Table 3).

2.5 Calculating the Average Cost Per Weighted Case (CWC)

The average cost per weighted case was calculated for each type of hospital by dividing the full cost of inpatient care for each hospital type by the sum of the adjusted case weights that were assigned to cases within these hospitals. The CWC represents the average cost per case, adjusted for case mix. Procedures describing the adjustment of case weights are described in Appendix 4.

3. RESULTS

As described earlier, this project represents a feasibility study to determine how effective MIS is for case mix costing in Manitoba. We have identified several problems in the use of these data, some of which appear significant, yet all of which can be corrected.

3.1 Are there differences in the way hospitals are reporting MIS data?

The MIS data used in this project reflect a summary of several million individual transactions. Each of these transactions is coded to one or more accounts. Decisions made at the accounting policy or recording level may influence the accuracy and precision by which these data measure the cost of providing hospital care.

3.1.1 Reporting Differences

There were numerous instances in which facilities recorded financial and statistical events differently. Inconsistent reporting makes it impossible to make cross-institutional comparisons without making adjustments.

3.1.1.1Financial Data

The following are the major differences in reporting methods between hospitals.

Employee benefits – In some facilities, most but not all employee benefits were charged against the functional centre used to report salaries and wages. In other facilities, employee benefits were charged to overhead or undistributed functional centres.[8] In many cases, some costs were charged to each of these centres.

Capital costs[9] – Capital costs were reported in various functional centres as well as in undistributed functional centres. Facilities approached expensing capital assets in a variety of ways. In addition, several facilities chose to lease equipment or property, rather than purchase it. Regardless of the financing approach, the definition of full costs need to *consistently* include (or exclude) capital costs.

Operating Rooms/Day Surgery – In some facilities, the costs of operating rooms were included within the Nursing Inpatient Services functional centre, although some of these costs were incurred as a result of providing services to ambulatory care patients.

---

[8] Undistributed functional centres include "the direct expenses, statistics, and revenues (if any), pertaining to those items of revenue or expense for which allocation to specific services, patients, or programs is inappropriate, or impractical, or both, for reasons relating to the source of revenue or nature of the expense, or the availability of data, or the utility of the information which would be obtained." (CIHI, 1996) Examples of items that were "undistributable" in 1995/96 are: food services clearing account, strike costs, equipment rental/lease, and plant operation – natural gas.

[9] All capital costs (including major equipment purchase) were excluded from the calculation of total inpatient costs.

Observation Units – In some cases, a person who has been admitted to the hospital (as an inpatient) receives care in an observation unit, which is classified as an Ambulatory Care functional centre. As a result, the associated costs are reported as Ambulatory Care while the case weight is reported as Inpatient Care. Existing data do not allow us to determine which patient days were spent in observation units or which observation unit costs were attributable to inpatient days.

We recognize that within smaller facilities it may not be feasible to accurately distribute costs between inpatient and ambulatory care. This issue may be resolved through the development of formulae that would distribute these costs consistently and comparably.

3.1.2 Costs Not Included Within MIS

Costs for goods and services that are provided to inpatients but **not** reported in MIS include:

- Services from Community Therapy Services (services are provided in hospitals throughout Manitoba);
- Services from South Central Therapy Services (services are provided in hospitals in the south central area of Manitoba);
- Services from Laboratory and Imaging Services Branch (services are provided in various hospitals throughout the province);
- Services from Westman Regional Laboratory (services are provided in various hospitals throughout the province);
- Products from the Canadian Red Cross Society Blood Services (products and services are provided to all hospitals).

These agencies are funded directly through Manitoba Health and in total they provide goods or services with a value exceeding $25 million, much of which is expended on inpatient care. None of these expenditures, however, are reported within hospital financial statements. Based on past research determining the use of these services in the provision of

inpatient care to Manitobans, we imputed $8.5 million dollars to the 10 major rural hospitals in this study (Shanahan, 1996). The remaining $16.5 million were either for services provided to hospitals not in this study or for costs that could not be distributed to individual hospitals, as is the case for blood products.

3.1.3 Physician Services

As described in previous MCHPE studies (Shanahan et al., 1994; Shanahan et al., 1997), physicians may be remunerated in a variety of ways. A physician may be paid a salary, on a sessional basis, or on a fee-for-service basis. In the MIS accounts, hospitals do not report the total remuneration for physicians providing services within each facility. MIS is structured to allow easy identification of physician remuneration, thereby making it possible to consistently exclude the cost of physician services.

Our decision to exclude all physician remuneration from this study was based on two factors:

1. The remuneration paid to physicians may or may not appear on a hospital's financial statements; and
2. The weights assigned to inpatient cases by CIHI do not include physician remuneration.

Approximately $30 million that was reported in MIS for medical remuneration was excluded from the calculation of full costs. In addition to this $30 million, many physicians receive fee-for-service remuneration that is not reported in MIS, for services provided to inpatients. These significant costs cannot currently be distributed to individual hospital patients. In order to understand fully all costs that are involved with providing hospital services to inpatients, it will be necessary to develop a system that will:

1. Provide micro-cost information for services provided to inpatients (i.e., costs would be determined through tariff codes for all physician provided services); or

2. Estimate the relative consumption of physician resources for CMGs to permit assignment of resource intensity weights for physician services to patients.

3.1.4 Statistical Data

Overhead – CIHI recommends a method of overhead allocation referred to as the "simultaneous equation." To be implemented, this method requires the reporting of a variety of statistical measures such as weighted square metres occupied by each functional centre, and kilograms of clean laundry used by each functional centre (Canadian Institute for Health Information, 1996). In the eighteen study hospitals, not one facility reported all of the required statistical data required for this method. The total overhead allocations for the 18 study hospitals were $169,048,940. Of this, approximately $95 million was allocated to inpatient care.

The collection of the statistical data for use in a simultaneous equation approach to overhead allocation would likely be very time consuming. Although it is theoretically more precise than other methods (Canadian Institute for Health Information, 1996), for the purpose of estimating costs at the CMG level, the more straightforward approaches may be just as effective. For this project, we used the direct method of allocating overhead, with the percent of direct expenditures as the basis for allocation. The Working Group discussed various alternatives and the implications of using this approach, but given the limitations of the data, only this method was viable. An alternative to calculating full costs would be to simply look at direct costs. This approach would require the development of an alternative resource intensity weight method, as the Maryland charge data used to calculate the CIHI RIWs does include overhead costs.

Inpatient Days – All facilities reported "inpatient days." However, when we contacted facilities to verify this information, it was discovered that there were errors in the data recorded in MIS for 10 out of 18 hospitals. These errors included a total of 7,120 inpatient days for adults and children that were not reported in MIS, and 103 days that were

included in MIS that should not have been. Newborn inpatient days were understated by 4,938 at one facility, and overstated by a total of 45 days at 2 facilities. These errors resulted in an overall difference of 3%, with differences of up to 4% for adult and child cases and up to 26% for newborn cases. As a result of our investigation, one facility discovered that a number of cases were incorrectly recorded in MIS. Our detection of these errors in MIS raised concerns that other data may be incorrectly reported.

Diagnostics and Therapeutics – To properly distribute the costs of diagnostic and therapeutic services to inpatient care, statistical data describing the proportion of services provided to inpatients was required. It was necessary to review all of the statistical data reported to determine which facility was using which indicator to report the outputs from diagnostic and therapeutic functional centres. Depending on the type of service and facility, this proportion was reported in time units, weighted time units, standardized units of service, or procedures. These inconsistent reporting approaches between facilities meant that different calculations were completed for each hospital. Approximately $67 million (47% of the full costs of Diagnostic and Therapeutic Services) were distributed to inpatient costs.

These issues will be resolved if hospitals consistently report expenditures, revenues and statistics. The CIHI MIS Guidelines present a clear description of the system, and Manitoba Facility Reporting System published by Manitoba Health itemizes these requirements for reporting in Manitoba. Because hospitals did not report consistently, this project required that the investigators review all accounts for each study hospital to assess inconsistencies and correct them where possible. This method of reclassification requires considerable time and potentially introduces misinterpretations of these data.

Steps are being taken by Manitoba Health and facility and health authority management to ensure consistent reporting. Until changes are implemented, making inter-facility comparisons should only be made after making adjustments such as those identified here.

The magnitude of the observed inconsistencies is difficult to measure. However, to illustrate how these data might be misinterpreted, the following example is presented:

> The process of estimating the "full cost" of inpatient care is complex. Simply summing the expenditures for inpatient care as reported in MIS for the 18 study hospitals results in a total of $283,388,254. After reclassification of accounts, redistribution of employee benefits, allocation of overhead, removal of excluded costs, and distribution of diagnostic and therapeutic costs, the total expenditures for inpatient care for these 18 hospitals used in this study is $459,226,388. Another way of looking at this would be to say that only 62% of the full costs of inpatient care are reported in the inpatient functional centre. This is not to say that proper accounting practices are not being followed, it just reflects the importance of looking at all other functional centres that provide services to inpatients and attributing costs appropriately to inpatient care.

3.1.5 Summary

Reporting differences have been noted in the MIS data. These differences make it impossible to estimate the cost of providing inpatient care without making adjustments. If consistent accounting approaches were adopted by facilities, MIS could be used for what it is intended.

3.2 Calculating the Average Cost per Weighted Case

In the previous section, we have identified limitations in the MIS data that were encountered when attempting to estimate the full cost for inpatient care in Manitoba hospitals. In addition, in Appendix 5 we discuss some issues relating to the calculation of resource intensity weights. Since this project was primarily a methodological study using the first year of data reported as part of the new Management Information System we have not reported data on a hospital by hospital basis, but instead summarize the case-weighted cost data for different types of institutions.

This study was restricted to teaching, urban community and major rural hospitals in Manitoba. These hospitals accounted for approximately 92.3% of the total expenditures for hospital care and 82% of all discharges in 1995/96. The other expenditures and cases were in intermediate rural, small rural, small multi-use facilities and northern isolated facilities that were not included in this study.

Having estimated the full costs for inpatient care at each type of hospital in 1995/96 and the total weighted cases for inpatient care at these facilities, the cost per weighted case (CWC) was calculated.

Figure 3 summarizes the CWC for the three types of hospitals in this study. The "average" for all 18 facilities as well as the average for each type of facility is shown. The average cost per weighted case for all study facilities was $2,182, with a range for these hospitals of $1,471 to $2,679. The average CWC for teaching hospitals was $2,624, for urban community hospitals it was $1,832 and for major rural hospitals it was $1,857.

Figure 3. Estimated Cost Per Case, Teaching, Urban Community and Major Rural Hospitals, 1995/96

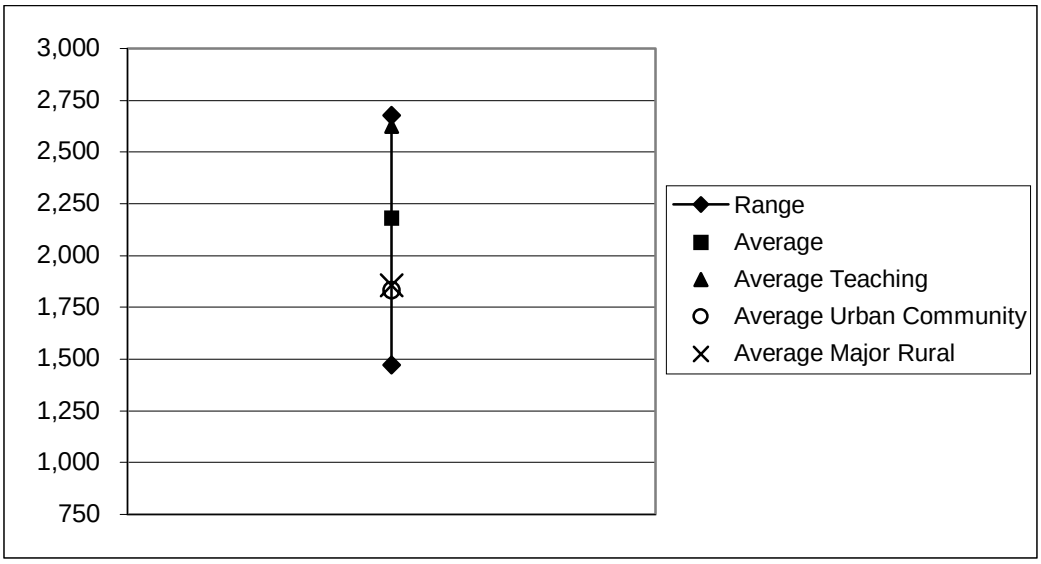


Figure 4 indexes the average for the 18 facilities at 1 and provides information on the difference between the average and the other values. This chart shows that, based on the preliminary estimates developed in this project, after adjusting for case mix, the average cost for care delivered in teaching hospitals is 20% higher than the average, at urban community hospitals it is 16% less than average and at major rural hospitals it is 15% less than the average. The most costly hospital is 23% higher than the average and the least expensive is 33% less. It is important to once again note that these are preliminary estimates and further refinement in the use of MIS is required before drawing conclusions from these data.

Figure 4. Estimated Indexed Cost Per Case, Teaching, Urban Community and Major Rural Hospitals, 1995/96

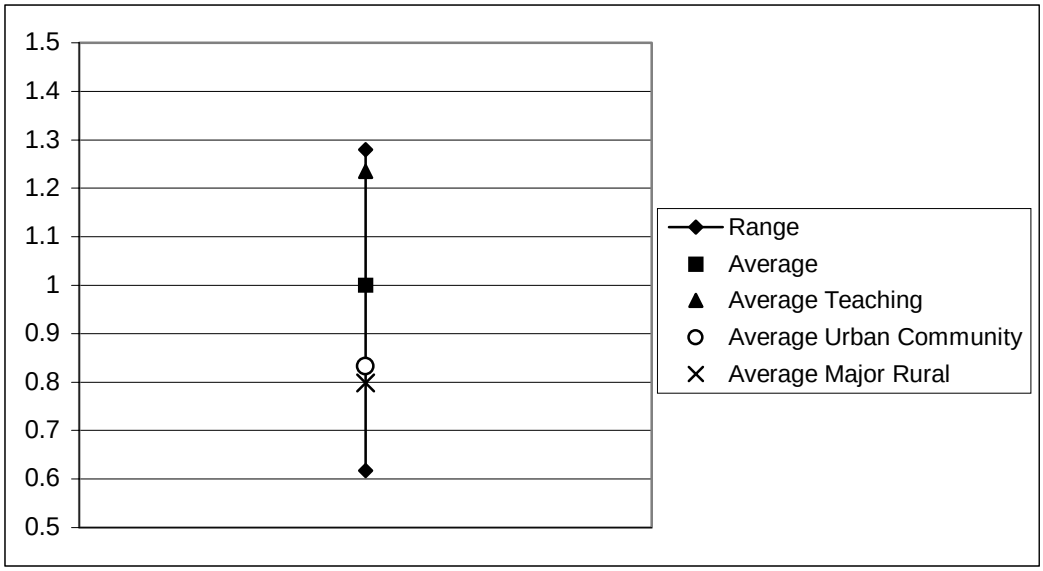


Figure 3 and Figure 4 use the CIHI RIW methodology to determine the cost per weighted case across different types of hospitals. As is discussed in Appendix 5, further investigation will be required to determine if there are issues concerning assignment of RIWs that would affect how accurately these costs are estimated. These include: 1. using a CIHI rather than Manitoba average length of stay for calibration of Maryland charge data, 2. calculating a trim point and defining outliers using CIHI rather than Manitoba data, and 3. assigning weights to outliers based on the assumption that long stay cases are

systematically different from typical cases, and that the proportion of alternate level of care days for Manitoba outlier cases is similar to that used in developing the CIHI weights. It is therefore important to recognize that these figures should only be used to illustrate that there is a range in costs per weighted case between types of facilities.

3.3 Preliminary Cost per Case Mix Group (CMG)

Once the average cost per weighted case (CWC) is calculated, the Resource Intensity Weight for Manitoba typical cases can be used to estimate the cost for typical cases within a CMG using the formula: CWC x RIW = estimated cost for a typical case in a given CMG. Table 4 reports the average Manitoba cost for the 20 most costly CMGs.[10] Table 5 lists the 20 CMGs that account for the largest portion of inpatient hospital costs. Table 6 provides information on the 20 most common CMGs. In 1995/96, these 20 CMGs accounted for 34% of all typical cases, and for 19% of the total costs for typical cases.

Table 4 lists the cases in 1995/96 that had the highest estimated cost per case. For example, the care provided to the 13 neonates with a weight of less than 750 grams is estimated at $52,484 each for a total of $682,292.

[10] A table that provides the preliminary estimated cost for all CMGs is available from MCHPE on request.

Table 4. Top 20 CMGs by Highest Cost Per Case

CMG	Description	N	CIHI ALOS	Manitoba ALOS	Estimated cost per case	Estimated cost for all cases
625	Neonate, weight < 750 grams	13	104.8	97.0	52,484	682,292
700	Bone marrow transplant	17	33.5	43.1	44,182	751,094
830	Extensive burns with skin graft, wound debridement or other burn procedure	1	35.0	21.0	36,823	36,823
626	Neonate, weight 750-999 grams	16	74.9	92.8	34,518	552,288
875	Multiple significant trauma with craniotomy	1	32.4	80.0	29,128	29,128
124	Lung transplant	8	26.9	34.3	23,574	188,592
040	Tracheostomy and gastrostomy	28	47.3	68.1	22,295	624,260
627	Neonate, weight 1000-1499 grams, catastrophic diagnosis	3	52.8	63.7	19,375	58,125
176	Cardiac valve replacement with heart pump with cardiac catheterization	24	21.1	17.3	18,517	444,408
727	Acute leukemia without major procedure, with CC	49	17.2	25.1	17,367	850,983
575	Pelvic exenteration	2	26.2	17.0	17,027	34,054
628	Neonate, weight 1000-1499 grams, no catastrophic diagnosis	64	42.2	55.3	16,779	1,073,856
876	Multiple significant trauma ,limb reattachment hip and femur procedure	12	21.1	28.5	15,831	189,972
877	Multiple significant trauma with other trauma procedures	28	18.2	14.6	14,756	413,168
500	Kidney transplant	44	14.4	10.8	14,555	640,420
350	Multiple or bilateral joint replace	10	17.9	22.1	14,137	141,370
768	Bipolar mood disorder, manic with ECT	5	45.6	44.4	13,909	69,545
180	Coronary bypass, with cardiac catheterization	141	17.3	16.6	13,896	1,959,336
075	Radical laryngectomy/glossectomy	15	25.4	19.9	13,834	207,510
250	Extensive gastro-intestinal procedures	28	19.3	17.6	13,628	381,584

NOTE: CC = complications and comorbidities

Table 5 lists the cases that have the greatest total cost. The 8,630 vaginal deliveries at study hospitals in 1995/96 cost an estimated $11,288,040. The cost per case is low ($1,308) but the large volume of cases of this type results in a large total cost.

Table 5. Top 20 CMGs by Total Cost

CMG	Description	N	CIHI ALOS	Manitoba ALOS	Estimated cost per case	Estimated cost for all cases
611	Vaginal delivery	8,630	2.4	2.4	1,308	11,288,040
354	Knee replacement	602	10.4	9.3	7,652	4,606,504
199	Heart failure and shock	1,544	7.0	6.7	2,739	4,229,016
648	Neonate, weight >2500 grams, normal newborn	9,751	2.2	2.2	423	4,124,673
580	Major gynecological procedures, uterine/adnexal, (no malignancies), age < 50	1,648	4.1	3.9	2,356	3,882,688
609	Vaginal delivery with complicating diagnosis	2,188	3.2	3.2	1,688	3,693,344
253	Major intestinal/rectal procedure with CC	536	12.7	13.1	6,593	3,533,848
013	Specific cerebrovascular disorders except transient ischemic attack	685	12.3	13.2	4,712	3,227,720
851	Other factors causing hospitalization	1,953	4.0	3.1	1,634	3,191,202
353	Hip replacement no CC	388	9.4	9.7	7,666	2,974,408
136	Chronic obstructive pulmonary disease	1,024	7.2	6.9	2,759	2,825,216
179	Coronary bypass, no cardiac catheterization	331	9.1	8.4	8,177	2,706,587
356	Fractured femur procedures with CC	325	18.0	23.6	7,923	2,574,975
194	Acute myocardial infarction, no cardiovascular complications	649	7.4	7.4	3,914	2,540,186
319	Laproscopic cholecystectomy, age < 70 no CC	1,428	1.6	1.5	1,754	2,504,712
184	Major cardio-thoracic procedures with CC	306	12.0	11.2	8,071	2,469,726
777	Schizophrenia/psychotic no ECT/Axis 3	468	19.0	21.5	4,994	2,337,192
125	Major chest procedures	406	9.9	9.1	5,736	2,328,816
736	Chemotherapy	1,454	2.6	2.4	1,566	2,276,964
180	Coronary bypass, with cardiac catheterization	141	17.3	16.6	13,896	1,959,336

Note: CC = complications and comorbidities

Table 6 lists the most common CMGs. Normal newborns at an estimated cost of $423 per case are the most frequent cause for hospitalization, with 9,751 cases at study hospitals in 1995/96.

Table 6. Top 20 CMGs by Frequency

CMG	Description	N	CIHI ALOS	Manitoba ALOS	Estimated cost per case	Estimated cost for all cases
648	Neonate, weight > 2500 grams, normal newborn	9,751	2.2	2.2	423	4,124,673
611	Vaginal delivery	8,630	2.4	2.4	1,308	11,288,040
609	Vaginal delivery with complicating diagnosis	2,188	3.2	3.2	1,688	3,693,344
851	Other factors cause hospitalization	1,953	4.0	3.1	1,634	3,191,202
646	Neonate, weight > 2500 grams, caesarean delivery	1,772	4.2	4.1	746	1,321,912
580	Major gynecological procedures, uterine/adnexal, (no malignancies), age < 50	1,648	4.1	3.9	2,356	3,882,688
624	Antepartum diagnoses	1,619	1.5	1.4	730	1,181,870
199	Heart failure and shock	1,544	7.0	6.7	2,739	4,229,016
294	Esophago gastro miscellaneous digestive, age<70, no CC	1,506	2.4	2.3	1,031	1,552,686
647	Neonate, weight > 2500grams, minor problem diagnosis	1,498	2.9	2.6	618	925,764
736	Chemotherapy	1,454	2.6	2.4	1,566	2,276,964
319	Lap cholecystectomy, age < 70 no CC	1,428	1.6	1.5	1,754	2,504,712
619	False labour, length of stay < 3days(MNRH)	1,371	1.1	1.0	492	674,532
146	Bronchitis/asthma, age < 70 no CC	1,364	2.8	2.9	1,097	1,496,308
295	Esophago gastro miscellaneous digestive, age > 70, no CC/age < 70 with CC	1,324	3.5	3.4	1,405	1,860,220
093	Tonsillectomy/adenoidectomy (MNRH)	1,053	1.0	1.0	799	841,347
136	Chronic obstructive pulmonary disease	1,024	7.2	6.9	2,759	2,825,216
617	Abortive outcome with dilation &curettage	880	1.2	1.2	747	657,360
604	Caesarean delivery	876	4.7	4.6	2,200	1,927,200
215	Angina	811	4.2	3.8	1,847	1,497,917

NOTE: CC = complications and comorbidities, MHRH = may not require hospitalization

4. DISCUSSION AND RECOMMENDATIONS

This project was initiated to determine the feasibility of using the newly available MIS data to estimate the cost of inpatient care for each case mix group in Manitoba hospitals. The ability to estimate these costs is dependent upon the accuracy of the data as reported by facilities. Early in the project, it became apparent that there would be limits to which the data could be "pushed" for costing purposes. These limits were the result of two factors:

1. statistical data were incomplete; and
2. accounting rules were applied differently by facilities.

Since this was the first year of implementation of the MIS reporting system, established mechanisms for reporting statistics may not have been fully functioning. For example, in one facility, all admissions, discharges and deaths were reported in the Executive Office functional centre, rather than in the functional centre in which the activity occurred.

The issue of different accounting approaches, however, is more fundamental. The purpose of any management information system is to provide information that will assist in making operational decisions. Each facility has independently determined its management information needs, and has developed procedures for collecting data and disseminating reports that will meet these needs.

Having an understanding of these different reporting methods and the steps that are needed to estimate the full costs of care, and subsequently the costs for CMGs is very important. For the 18 study hospitals, we added $175.9 million to the costs that were directly attributed to inpatient care in order to determine the full costs.

In the past, facilities were required to submit consolidated data using the HS-1 report. This required facilities to summarize data from their financial information system into the

prescribed format. With the introduction of MIS, Manitoba Health established a standardized chart of financial and statistical accounts and designated a required level of reporting, yet not all facilities have complied with these standards. There are three alternatives that may be implemented to improve standardization:

1. Develop consistent accounting standards with a commitment by facilities to meet these standards. This would require all facilities to use an identical chart of accounts and definitions;
2. Establish minimum reporting standards with a commitment by facilities to meet these standards. This would permit facilities flexibility in continuing to meet their internal reporting needs, and at the same time ensure that external needs can be met;
3. If recommendations #1 or #2 cannot be implemented it will be necessary to develop conversion tables to convert each facility's data to the prescribed format.

In all cases, a method of checking data quality would need to be developed and implemented. As was noted earlier, Manitoba Health has established minimum reporting standards.

To perform case mix costing for inpatient care for all Manitoba facilities, the following MIS data are required:

1. Statistical data
    - diagnostic and therapeutic utilization (including services provided by outside organizations), separated according to whether services are provided to inpatients or ambulatory care patients;
    - total number of inpatient days.

2. Financial data

- clearly defined separation between costs for inpatient and ambulatory care, including the cost for inpatients receiving care in observation units and for day surgery patients receiving care in operating rooms for which costs are reported as inpatient care. If the financial data are not reported separately, it may be possible to estimate the costs if statistical data are reported accurately;
- complete costs for physician services;
- unit costs for Laboratory and Imaging Services, Community Therapy Services, South Central Therapy Services, Westman Regional Laboratory, Blood Services, and any other third party providing services that are not currently captured in a facility's chart of accounts.

4.1 Specific Recommendations

1. That continued effort be put into standardizing MIS reporting so that accurate comparisons can be made between facilities.
2. That procedures be developed to ensure that the costs for providing care to inpatients are reported in inpatient functional centres and those for ambulatory care are reported in ambulatory care functional centres. This is a particular issue for inpatients who are receiving care in observation units and for day surgery patients receiving care in operating rooms.
3. That the cost for goods and services received from government funded third party health providers be reflected in facilities' MIS accounts.
4. That the feasibility of a "global dimension"[11] reporting system be determined. Additional data concerning the cost of treating individual patients (even just on a sample basis) would contribute greatly to our ability to accurately estimate the costs of providing care to different types of patients.
5. That further study be done on the effect of using Canadian standard resource intensity weights to reflect relative resource consumption, especially in environments (i.e., a single province, type of facility or individual facility) where the profile of the cases is different from that of the Canadian standard.
6. That a "Canadian Calibration Database" of the cost of providing hospital care be developed and used rather than the current Maryland charge-based database.

4.2 Conclusion

Previous MCHPE studies developed a method of using the available financial data to determine the cost of inpatient care in hospitals. The MIS data that are now available are much richer than this earlier data. With this richness comes more opportunities for variability. MIS is a tool for management - the introduction of the regional health authorities and the Winnipeg Hospital Authority has broadened the management of facilities

[11] The global dimension reporting framework reports data on individual patients rather than on functional centres.

beyond the facility itself and now includes officials who will be making comparisons between facilities. It is incumbent upon all those who are involved in this to ensure that the data are a useful tool. The working group that was involved with this project has confirmed that initiatives are being taken to improve the quality of the data.

The HS-1 forms that were used in earlier MCHPE studies were not management tools, they were merely statistical reporting forms. In some ways, when compared to the 1995/96 MIS data, the HS-1 data made the case mix costing process easier (but not necessarily more accurate) because there was less data and hence the potential for less variability. None the less, the researchers that worked with the HS-1 forms were required to make many of the same decisions that resulted in identifying the full cost for inpatient care as were made in this study, and in fact those decisions became the basis for classifying MIS items in this study. With adequate steps being taken to ensure consistency in reporting, MIS has the potential to be an excellent tool for both management accounting and research.

The case weights that were used previous to this study were "made in Manitoba." The relatively small data set (when compared to the CIHI data set) required researchers to make adjustments that were not made by CIHI in developing the weights used in this study. The strength of the earlier weights was that they dealt specifically with the experience in Manitoba hospitals and were dependent only on the relative distribution of charges for cases in Maryland. The use of the CIHI weights has introduced another variable that will require further study to understand its impact.

The process of estimating the cost for inpatient cases could be and should be straightforward. It is, however, necessary to have accurate statistics and financial data to ensure that the results are correct. MIS is specifically designed to enable this type of cost estimation to occur. With commitment to this system by those who are involved in collecting MIS data, it will be possible to use these data for their intended purpose.

Appendix 1. Calculation of Full Costs of Inpatient Care

Full Costs

This project estimates the full cost of providing inpatient care within Manitoba hospitals during 1995/96. In this context, full costs are described as all costs, both fixed and variable, and including a share of overhead costs that are incurred in providing services. It is important to note that in this project, all costs for physician services as well as the capital costs of facilities have been excluded.

The approach to calculating the full cost of inpatient care for each facility was:

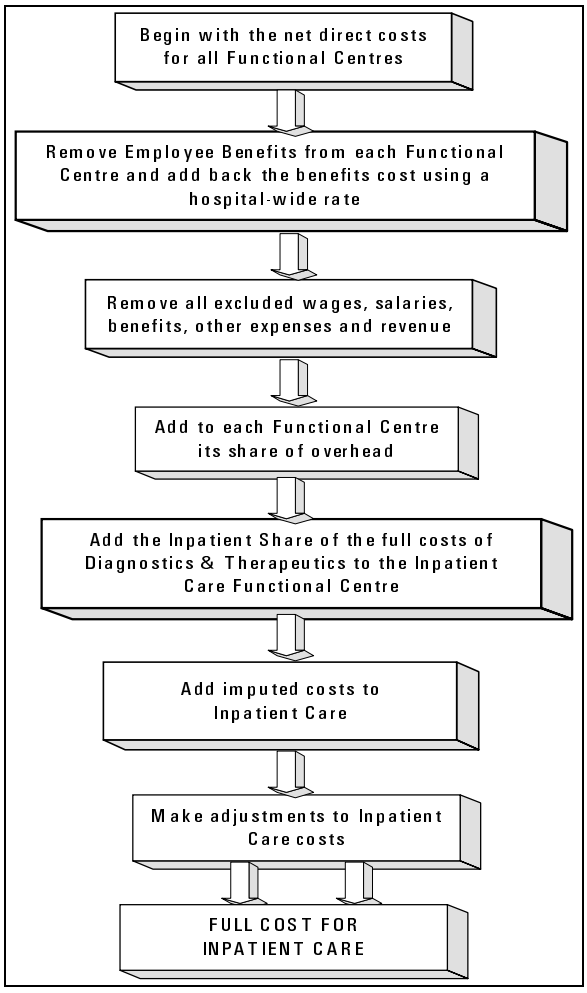


Figure 5. Flow Chart for Calculation of Full Costs

Definitions and Description of Calculation of Full Costs

Net Direct Costs: The sum of all revenue and expense accounts.

Employee Benefits and Share of Hospital Wide Employee Benefits: Several facilities charged most employee benefits against the functional centre that reported the salaries and wages; other facilities charged employee benefits to an overhead or unallocated functional centre. In many cases, some costs were charged to each of these areas. As a result, we decided to remove all benefits from all functional centres, calculate the hospital-wide benefits rate and apply that rate to the wages and salaries within each of the functional centres.

Excluded Wages, Salaries and Benefits: All medical remuneration and corresponding benefits were removed. Medical remuneration includes fee-for-service payments and physician salaries. Benefit expenses that were removed were determined by applying the hospital-wide benefits rate to the salary items (i.e., benefit costs were not applied to fee-for-service payments). All termination benefits were also excluded.

Other Excluded Expenses: Expenses relating to capital items were excluded. For the purpose of this project, capital items were defined as depreciation, interest expense, principal and transfers to reserve.

Excluded Revenue: The starting point for this calculation was the net of revenue and expense accounts. As a result, it was necessary to remove patient services revenue. Non-patient related revenue was included in recognition that certain non-patient care expenditures of hospitals are offset by this revenue. Recoveries that resulted from sales of goods or services also remained.

Share of overhead allocation: The equitable distribution of overhead costs remains an ongoing source of disagreement. In a survey of the Chief Financial Officers of the study hospitals, there was no consistent opinion on the best way to handle overhead costs. These costs, however, are a critical component in the cost of providing hospital care. Two fundamental questions were raised when deciding on an approach to allocate overhead:

- What method of allocation should be used (i.e., direct, step-down, double distribution/double apportionment or simultaneous equation[12]); and
- What "driver" of allocations should be used?

After consultation with the Working Group, we decided to use the direct method with total direct costs being the driver. In spite of its limitations, the direct method offers a straightforward approach to allocation and does not require additional data that are necessary for the other methods. Two drivers were considered for use: worked hours and direct expenses. Both methods were tested with the data and although the difference was very small for teaching and urban community hospitals, the difference was greater in major rural hospitals where wage expense was distributed between inpatient and ambulatory care but worked hours was not. As a result, total direct expenses was used as the driver.

Overhead was allocated to all functional centres that were not in the Administrative and Support Services Section, including inpatient care, ambulatory care, diagnostics and therapeutics, research and formal education programs.

Share of Full Costs of Diagnostics and Therapeutics: Utilization statistics from MIS were used to distribute full costs (including overhead) between inpatient and ambulatory care for each diagnostic and therapeutics functional centre. Because of the inconsistencies in

[12] see the CIHI MIS manual for a full description of these methods (Canadian Institute for Health Information, 1996)

reporting, 70 different types of statistics were used to calculate the distribution of these costs.

Imputed Costs: Costs for services received from Community Therapy Services, South Central Therapy Services, Lab and Imaging Services and Westman Regional Laboratory were added to those facilities that receive services from these agencies. In previous MCHPE costing projects, cost and utilization information was obtained from each of these organizations. For this project, we imputed these costs by applying the proportion of total expenditures that were attributed to these organizations in the 1993/94 MCHPE study.

Adjustments: Past MCHPE costing projects had made adjustments to account for Observation Units (where costs are reported in the Ambulatory Care functional centre and weights are reported in Inpatient Care) and for Operating Rooms (where costs are reported in Inpatient Care but services are provided to Ambulatory Care patients). It was important to recognize that these issues need to be resolved. We have found no evidence to suggest that MIS has improved the reporting of these costs. However, the adjustments were, in most cases, relatively small and would be unlikely to affect the cost per weighted case substantially. Table 7 describes the adjustments to total inpatient expenditures that were made in the Update Hospital Case Mix Costing 1993/94 report (Shanahan, 1996). We have earlier discussed the importance of ensuring that MIS contains data that reflects resources consumed in providing care for inpatients (see page 20). Information that would have permitted these adjustments to be made was not consistently reported in MIS, and in smaller facilities it may not be feasible to accurately record this information. As a result, the cost per weighted case estimated in this report does not reflect these adjustments.

Table 7. Percent Adjustment to Study Hospitals in 1993/94 Case Mix Costing Update

Percent of Total Inpatient Expenses	Urban Facilities (no.)	Major Rural Facilities (no.)
No adjustment	0	7
<1% adjustment	3	0
1% to 4% adjustment	4	3
8.4% adjustment	1	0

Appendix 2. Study Hospitals

Hospital Type	Hospital
Teaching Hospitals	Health Sciences Centre St. Boniface General Hospital
Urban Community Hospitals	Brandon General Hospital Concordia General Hospital Grace General Hospital Misericordia General Hospital Seven Oaks General Hospital Victoria General Hospital
Major Rural Hospitals	Bethel Hospital, Winkler Bethesda Hospital, Steinbach Dauphin Regional Health Centre Flin Flon General Hospital Inc. Morden District General Hospital The Pas Health Complex Inc. Portage District General Hospital Selkirk and District General Hospital Swan River Valley Hospital Thompson General Hospital

Appendix 3. Checking Discharge Data

In Manitoba, seven Winnipeg hospitals[13] have established partnerships with CIHI such that separation data are forwarded monthly to CIHI. With the exception of Health Sciences Centre, discharge data are forwarded to CIHI after first undergoing a conversion process (i.e., data formats, etc.) at Manitoba Health; at Health Sciences Centre, the conversion is carried out in-house. On a quarterly and annual basis, CIHI returns grouped data directly to each facility in electronic format (for most hospitals) with accompanying paper reports describing case mix and resource utilization.

For this project, CMG data were obtained directly from Manitoba Health after all inpatient separation data were grouped by CIHI at the close of the fiscal year. Since the determination of total weighted cases would likely be influenced by differences in processing, we asked the following question: Did the CIHI application of the grouper to province-wide data produce results consistent with the CIHI application of the grouper to the Winnipeg hospitals? Using CIHI reports[14] provided by each Winnipeg facility, we compared weighted cases overall and by typical and atypical category with figures produced using Manitoba data.

Table 8 compares the number of cases and the total weighted cases for each category as reported in the province-wide data (that was used in this study - columns labeled "MB N" and "Manitoba Weighted Cases") with the reports Winnipeg hospitals received directly from CIHI. Differences are noted within categories, but the overall differences are small.

---

[13] St. Boniface General Hospital, Health Sciences Centre, Grace General Hospital, Misericordia General Hospital (now known as Misericordia Health Centre), Victoria General Hospital, Concordia General Hospital, and Seven Oaks General Hospital.

[14] Report #IT12002: CIHI Resource Intensity Weight Report of Activity - Top 40 Case Mix Groups (April 1995 to March 1996; Report #IT12009: CIHI Resource Intensity Weight Report, Atypical Case Summary - Top 40 Case Mix Groups (April 1995 to March 1996).

We have concluded that the variations are an interesting artifact of the data, but are unlikely to contribute significantly to the cost per weighted case. The differences most likely result from adjustments that are made and not reported to both Manitoba Health and CIHI.

Table 8. Weighted Cases by Facility and Typical/Atypical Status, 1995/96

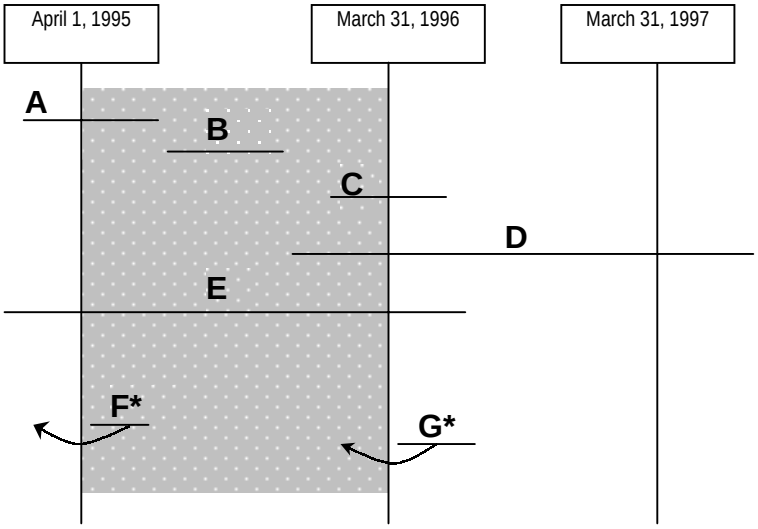
Hospital	CIHI N	CIHI Weighted Cases	MB N	Manitoba Weighted Cases	MB/CIHI	CIHI N	CIHI Weighted Cases	MB N	Manitoba Weighted Cases	MB/CIHI
	Deaths					**Outliers**				
Grace	394	2,170.7	394	2,188.4	1.008	418	4,906.8	420	4,904.4	1.000
Misericordia	349	2,126.9	350	2,130.5	1.002	441	4,690.2	442	4,662.0	0.994
St. Boniface	722	3,970.5	720	3,973.7	1.001	1,082	9,718.7	1,068	9,651.1	0.993
Victoria	230	918.0	230	916.7	0.999	313	3,286.4	312	3,279.2	0.998
Concordia	257	1,407.5	257	1,409.2	1.001	216	2,341.2	218	2,355.6	1.006
Seven Oaks	351	2,172.6	351	2,177.3	1.002	472	7,059.7	477	7,098.7	1.006
HSC - adults	683	3,205.3	694	3,236.1	1.010	1,126	9,288.2	1,095	8,020.2	0.863
HSC - pediatrics	56	185.0	44	138.2	0.747	161	645.5	124	481.3	0.746
HSC - overall	739	3,390.3	738	3,374.3	0.995	1,287	9,933.7	1,219	8,501.5	0.856
	Transfers					**Signouts**				
Grace	370	931.9	386	962.1	1.032	41	33.7	41	33.7	1.000
Misericordia	401	1,146.4	410	1,207.8	1.054	73	64.8	73	65.0	1.003
St. Boniface	1,585	4,487.8	1,580	4,585.1	1.022	88	93.2	86	92.9	0.997
Victoria	414	1,171.4	420	1,202.8	1.027	19	25.2	19	25.2	1.000
Concordia	186	469.8	187	470.3	1.001	33	17.8	33	17.2	0.966
Seven Oaks	419	1,304.6	424	1,320.6	1.012	59	154.9	59	154.8	0.999
HSC - adults	2,736	9,782.3	3,232	12,277.0	1.255	258	212.7	358	324.6	1.526
HSC - pediatrics	911	2,105.2	1,169	2,471.7	1.174	8	4.0	15	7.1	1.775
HSC - overall	3,647	11,887.5	4,401	14,748.7	1.241	266	216.7	373	331.7	1.531
	Typical Cases					**Total**				
Grace	8,555	9,292.0	8,535	9,264.5	0.997	**9,778**	**17,334.8**	**9,776**	**17,353.0**	**1.001**
Misericordia	6,616	6,928.1	6,601	6,907.9	0.997	**7,880**	**14,956.4**	**7,879**	**14,973.5**	**1.001**
St. Boniface	18,533	18,907.1	18,329	18,897.5	0.999	**22,011**	**37,177.7**	**21,787**	**37,202.2**	**1.001**
Victoria	8,514	7,257.4	8,504	7,275.3	1.002	**9,490**	**12,658.3**	**9,489**	**12,700.9**	**1.003**
Concordia	3,423	3,862.2	3,420	3,877.3	1.004	**4,115**	**8,098.4**	**4,115**	**8,129.6**	**1.004**
Seven Oaks	4,344	5,473.3	4,198	5,366.3	0.980	**5,645**	**16,165.1**	**5,645**	**16,205.3**	**1.002**
HSC - adults	19,957	22,991.6	19,598	23,032.0	1.002	**24,784**	**45,485.0**	**24,992**	**46,895.8**	**1.031**
HSC - pediatrics	5,546	5,479.0	5,089	4,449.7	0.812	**6,682**	**8,418.7**	**6,458**	**7,554.7**	**0.897**
HSC - overall	25,503	28,470.6	24,687	2,7481	0.965	**31,466**	**53,903.7**	**31,450**	**54,450.5**	**1.010**

Appendix 4. Matching Costs with Cases

To calculate the average cost per weighted case (CWC), it was necessary to match each facility's inpatient expenditures (as reported in the MIS data for April 1, 1995 to March 31, 1996) with cases and days that occurred within the same reporting period (i.e., "in-year days"). Although hospital data includes information on inpatients discharged between April 1, 1995 and March 31, 1996, it does **not** include information about stays in progress. At the same time, discharge data includes information about inpatients admitted before April 1, 1995 and discharged during fiscal year 1995/96. In this case, the assigned RIW reflects resources consumed throughout the course of the hospital stay – not just the portion that occurred during the fiscal year.

There are seven possible scenarios that describe the time-sequence of patient care; Figure 6 illustrates each.

Figure 6. Possible Time-Sequences of Patient Care



* Cases in these scenarios relate to the previous fiscal year (i.e., they were filed after the year-end cut-off)

	Admission Date	Discharge Date
A	Before April 1/95	Between April 1/95 and March 31/96
B	Between April 1/95 and March 31/96	Between April 1/95 and March 31/96
C	Between April 1/95 and March 31/96	After March 31/96
D	Before March 31/96	After March 31/97
E	Before April 1/95	After March 31/96
F	Before April 1/95	Before April 1/95
G	Before March 31/96	Before March 31/96

For scenarios A, B and F, CMG-grouped data and RIW values are available in the Manitoba data (fiscal 1995/96). Scenarios C, D, E and G each have hospital days within 1995/96. Since hospital data for fiscal 1996/97 are available, it is possible to count hospital days for cases in scenarios C, E and G; but the RIW values assigned to these cases are unknown as the data have not been grouped. Scenario D represents cases not yet discharged as of March 31, 1997. Consequently, the number of days associated with these cases is unavailable.

To resolve the issue of in-year days, previous costing studies (Loyd, Shanahan, Brownell et al., 1995; Shanahan, 1996) have used two full years of separation data to capture the majority of each facility's cases and days. However, this process delayed each study's

completion, as it was necessary to wait for a subsequent year of data. In this project, three methods were developed to match costs with cases. First, the total number of in-year days was determined using three approaches: (1) the total number of **MIS days** (as confirmed by each facility) was determined for each facility; (2) the total number of **in-year separation days** was computed for each facility using cases and days from 1995/96 and 1996/97; and, (3) based on the past discharge experience of each hospital (over a three-year period), an **"adjusted" in-year** total was calculated. Separation days and weights as reported in the 1995/96 data were subsequently adjusted to match the total number of in-year days for each of the three approaches. If the CWC for a facility was similar using each in-year total, there would be evidence to support the use of one year of hospital data and the timeliness of costing studies would be improved.

There was a difference of less than 1% between the three methods of calculating the total weighted cases for the 18 study hospitals. On an individual hospital level, there was greater variation so we selected the method that was the least variable from the other two. Using the inpatient days that were verified with the hospitals (method 1) provided results that were within 2% of at least one of the other methods for all facilities. The other methods produced results of up to 15% difference between two of the methods. Inpatient days as verified by the facilities was used for adjusting for in-year days.

The calculation of in-year days is subject to three caveats:

- It is necessary to assume the hospital reported and confirmed the correct MIS total;
- Days for a particular case will not be included if the person remains in hospital; and
- The true in-year values may vary year to year in the rural hospitals because of factors such as the loss of a physician, a long holiday taken by a physician, or discharge of just one or two patients with a very long length of stay.

Methods used to adjust separation days and weights are described in the following sections.

Adjusting the RIW when the Length of Stay of a Case Exceeds 365 Days

Because the RIW reflects resources consumed throughout a complete hospital stay, the following adjustment was made:

1. When LOS exceeds 365 days, truncate at 365 days;
2. Adj RIW = RIW - ((LOS-365) x daily blended outlier weight for the particular CMG)

When Total Days for a Facility are Less Than the Total Separation Days (truncated at 365 days)

1. Select outlier cases (based on the trim point for the CMG);
2. Place selected cases in random order;
3. Remove 1 day from each case until the total days equal the total separation days for the facility;
4. Loop as necessary BUT do NOT remove days from any cases once the trim point for the CMG has been reached;
5. Subtract the CMG-specific daily blended outlier weight for each hospital day that has been removed to recalculate the RIW.

When Total Days for a Facility are Greater Than the Total Separation Days

1. For each facility, calculate the average daily weight for cases classified as outliers:
   (total weights/total days);
2. Add days and associated daily weights as follows:
   (total days - total separation days) x average daily weight for outliers

Appendix 5. Calculating Resource Intensity Weights

As part of the validation of our method of calculating costs for CMGs, we compared Manitoba cases with those in the CIHI database. In doing this, we noted differences in the average length of stay of Manitoba cases and the trim point that is calculated when applying the CIHI methodology to Manitoba data. This has caused us to recommend the need for further investigation to determine if the potential exists for introducing an aggregation bias when using Canada-wide data (rather than Manitoba specific or hospital type specific length of stay data) for estimating relative weights of cases in Manitoba.

Earlier in this document we described the method used by CIHI to calculate RIWs using average length of stay and distribution of CMGs to calibrate the Maryland charge database. In facilities where the average length of stay and distribution of cases is similar to the CIHI database, the RIW should accurately describe relative resource consumption. In fact, in a study that evaluated the RIWs assigned to CMGs (Poole, Robinson, MacKinnon, 1998), researchers found that RIWs could be used to accurately described costs for inpatient cases at the Greater Victoria Hospital Society. In the following sections, we make some observations that lead us to believe that a further review of the impact of using CIHI RIWs for assigning case weights to Manitoba cases should be conducted before they are used more widely in Manitoba.

Do CIHI-Developed Resource Intensity Weights Describe Resource Consumption in Individual Manitoba Hospitals?

To determine the exact cost of each hospitalization it would be necessary to keep track of every service that each patient receives and every product provided to him or her. A

"micro-costing"[15] approach would provide the most accurate reporting of cost for an individual case, but such data are not available in Manitoba (or in most other Canadian jurisdictions). In order to *estimate* the cost of providing care to a patient, it is necessary to determine the proportion of all resources that are available to a facility that are consumed by a particular type of case. "Resource Intensity Weights" (RIW) are used to represent this relative resource consumption. CIHI has developed RIWs for all typical cases in its database. Following is a discussion of some of the important issues that should be considered when answering the question "Do CIHI-developed RIWs describe resource consumption in individual Manitoba hospitals?"

Using CIHI Length of Stay to Calibrate Resource Intensity Weight

Resource Intensity Weights were developed by CIHI using charge data from the state of Maryland for two calendar years (1992 and 1993). The charge data were adjusted to reflect the typical Canadian length of stay experience as reported by CIHI-participating hospitals. Previous projects of MCHPE have also used Maryland charge data to develop case-weights (for RDRGs), but these weights were adjusted to reflect the length of stay of inpatients discharged from Manitoba acute-care hospitals (Jacobs et al., 1999; Shanahan et al. 1994). This shift from weights standardized using Manitoba length of stay to those reflecting the Canadian experience may mean that the RIW that is computed and assigned to each case is inaccurate when the average length of stay differs substantially between Manitoba and CIHI: to the extent that Manitoba length of stay exceeds or is less than CIHI length of stay, the RIW may under- or over-estimate the relative resource consumption of one type of case compared to another in Manitoba.

An assumption underlying the estimation of the RIW and the adjustment of Maryland charge data is that the length of time a patient remains in hospital is an important factor in determining the cost of a particular case. To make the adjustment between Maryland cases

[15] True micro-costing requires the collection of data that reflects the actual cost of goods and services. In fact, charge data (i.e., the price charged to a payor for health care) is often used as a measure of cost.

and Canadian cases, CIHI used length of stay data from its large database of typical[16] cases (N=2,189,804). Manitoba hospitals contributed roughly 3.5% of these cases – all of which originated from seven urban facilities within the city of Winnipeg. In total, Ontario hospitals contributed more than half of typical inpatient discharges within the CIHI database, while British Columbia and Alberta hospitals contributed 15.8% and 14.0% of CIHI cases respectively (Canadian Institute for Health Information, 1994).

In support of the perspective that Manitoba cases are different from those in the CIHI database, we have found that the average length of stay for many CMGs is quite different for cases in Manitoba when compared to the CIHI average length of stay.

Figure 7 illustrates the difference in days for the average length of stay in Manitoba hospitals compared to the CIHI database for all CMGs where there were greater than 30 cases in Manitoba in 1995/96. Bars above zero are CMGs where the Manitoba average is greater than the CIHI average; bars below zero are CMGs were the Manitoba average is less than the CIHI average.

Figure 18 multiplies the number of days difference between the CIHI data and Manitoba data by the number of typical Manitoba cases. This shows that a small difference per CMG, if multiplied by a large number of cases, can have a large impact.

In both these figures, the labels include an abbreviated CMG description along with the CMG number. The further a CMG is shown from the 0, the greater the difference from the CIHI standard. In Figure 7, the range of differences is -3.97 days to 13.14 days. Figure 8 shows a range of -2,121 to 1,830 days.

[16] Only typical cases are used to calibrate the RIW database.

In this study, we have not performed any analysis to determine whether these differences would significantly affect the RIW that is assigned to any particular CMG. We encourage further investigation of these issues.

Figure 7. Difference in Average Length of Stay by CMG for CIHI Defined Typical Cases with n > 30, 1995/96

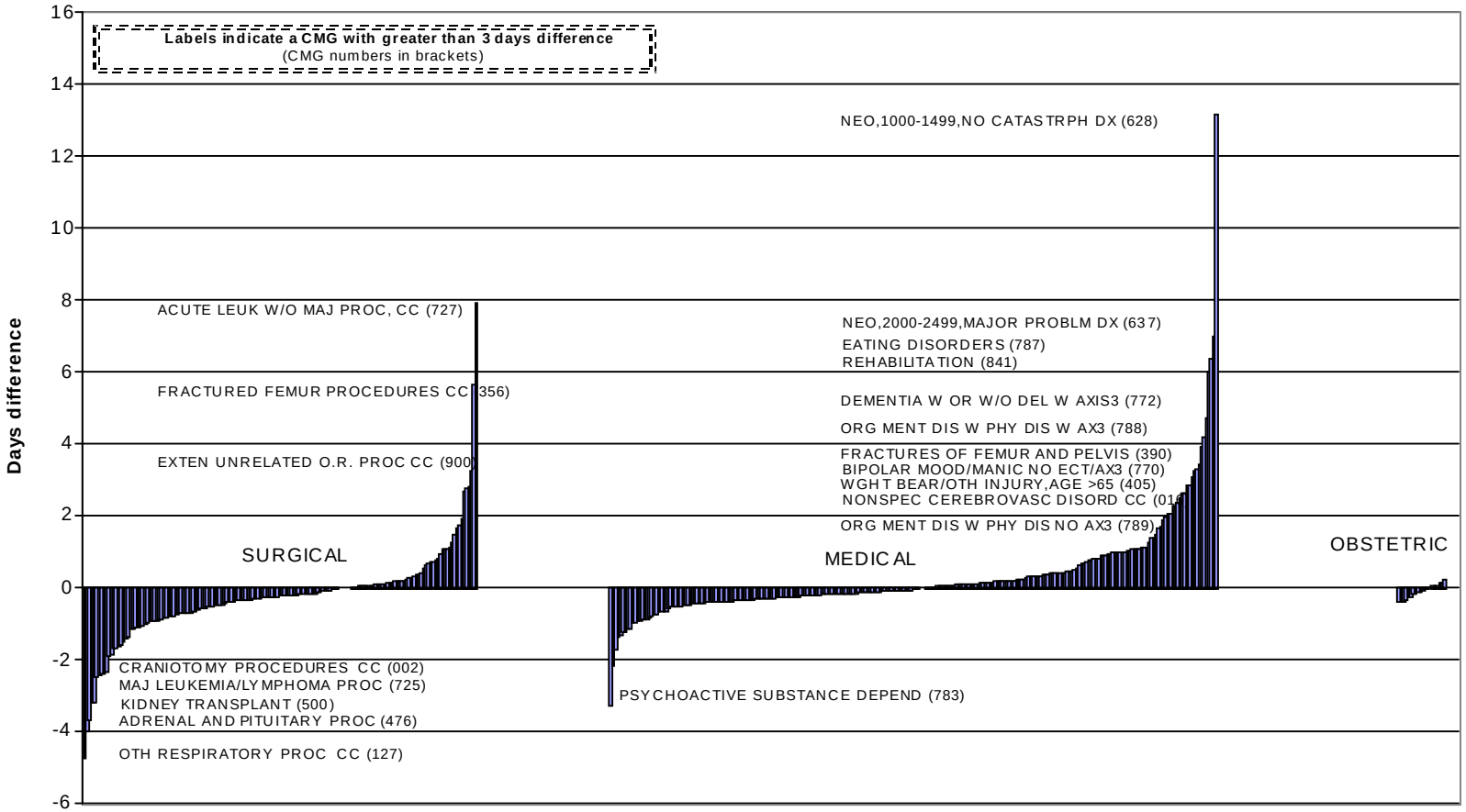
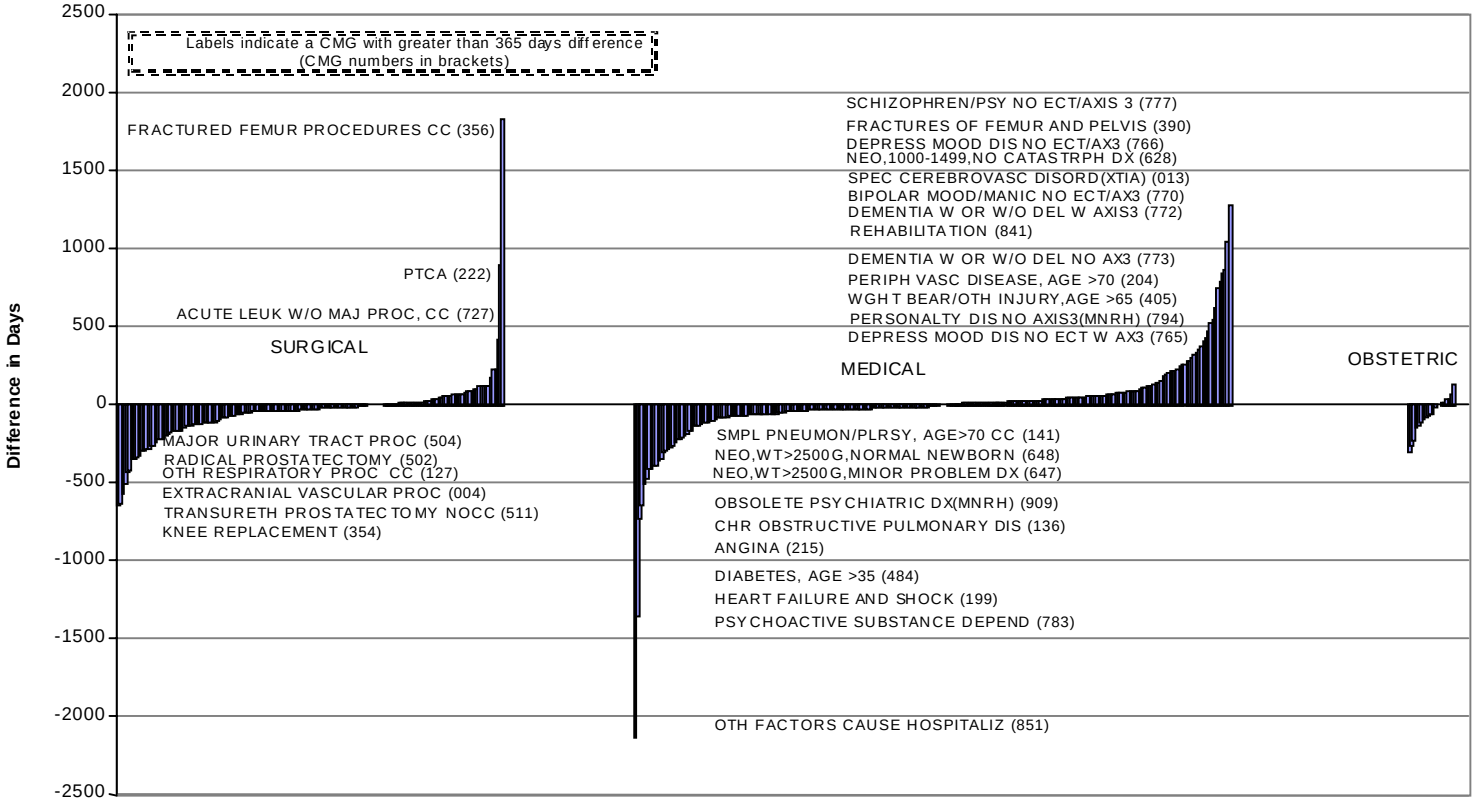


Figure 8. Difference in Inpatient Days by CMG for CIHI Defined Typical Cases with n > 30, 1995/96



These findings suggest that a CIHI average length of stay may not adjust the Maryland charge data to provide a RIW that reflects the relative resource consumption for many types of inpatient cases in Manitoba. Adjusting to the CIHI average length of stay accepts this length of stay as the "standard."

Table 9 shows the distribution of cases defined by CIHI as being "typical." Not surprisingly, few CMGs have an identical average length of stay between Manitoba and CIHI. Interestingly, the number of inpatient days difference for CMGs where the Manitoba length of stay is greater than the CIHI length of stay (7.21%) almost balances the number of days difference where the reverse is true (7.9%). This would suggest that on an overall basis, it may be possible to apply the CIHI weights to all typical Manitoba cases. However, when moving to an individual CMG or when looking at the cost per weighted case for a facility where the distribution of CMGs or length of stay is different, it will be important to determine if the CIHI assigned RIW is representative of actual relative resource consumption for that CMG or type of facility.

Table 9. Differences in Manitoba and CIHI Average Length of Stay for CIHI Defined Typical Cases

Manitoba ALOS=CIHI ALOS				
Hospital Type	% of CMGs	No. of CMGs	% of Cases	No. of Cases
Teaching	1.20%	7	1.57%	674
Urban	0.68%	4	0.89%	344
Major Rural	1.20%	7	0.96%	229
Intermediate	1.20%	7	1.32%	92
Small Rural	1.37%	8	0.51%	67
Small Multi-Use	0.85%	5	2.29%	19
Northern Isolated	0.17%	1	0.10%	1
Total			1.12%	1,426

Manitoba ALOS>CIHI ALOS						
Hospital Type	% of CMGs	No. of CMGs	% of Cases	No. of Cases	% of Inpatient Days Difference	No. of Inpatient Days Difference
Teaching	51.45%	301	32.99%	14,193	8.76%	18,641.7
Urban	43.08%	252	27.32%	10,531	7.14%	13,430.0
Major Rural	35.90%	210	53.88%	12,848	6.30%	6,088.4
Intermediate	28.03%	164	47.61%	3,323	6.71%	2,148.0
Small Rural	21.54%	126	24.09%	3,165	3.39%	1,951.4
Small Multi-Use	8.89%	52	32.05%	266	10.48%	380.0
Northern	4.27%	25	10.40%	100	3.93%	93.2
Total			34.89%	44,426	7.21%	42,732.7

Manitoba ALOS<CIHI ALOS						
Hospital Type	% of CMGs	No. of CMGs	% of Cases	No. of Cases	% of Inpatient Days Difference	No. of Inpatient Days Difference
Teaching	43.59%	255	65.44%	28,149	6.81%	14,490.3
Urban	45.64%	267	71.79%	27,674	6.14%	11,542.5
Major Rural	43.76%	256	45.16%	10,767	7.45%	7,200.3
Intermediate	35.90%	210	51.07%	3,565	10.05%	3,213.7
Small Rural	40.17%	235	75.40%	9,907	14.28%	8,228.9
Small Multi-Use	19.83%	116	65.66%	545	22.32%	809.3
Northern	24.79%	145	89.50%	861	57.47%	1363.2
Total			63.99%	81,468	7.90%	46,848.2

Calculating the Trim Point to Define Outliers

Earlier MCHPE studies developed a method of defining outliers that is different from the CIHI method. The work of Loyd et al. (1995) described "non-acute days" in which a patient was receiving care in an acute care facility, but was not receiving acute care. The CIHI method incorporates this concept by providing a "daily blended outlier weight" that reflects the mix of acute and non-acute[17] patients whose hospital stay extends beyond the trim point. The calculation of the daily blended outlier weight uses "the relative propensity of each CMG to contain low severity days in the outlier day totals" (Canadian Institute for Health Information, 1995) from a sample of Ontario cases. The extent that Manitoba and the Ontario sample differ in the composition of non-acute cases in acute care facilities will affect the weight that is assigned to outliers.

To distinguish between typical cases and outliers, CIHI calculates a trim point based on the length of stay distribution for each CMG. In this case, length of stay data from the CIHI database are used. The trim point is defined as:

TRIM = third quartile + (2 x interquartile range)

When this same formula is used to develop trim points for Manitoba data, the calculated trim point differs substantially from the CIHI-defined trim point – with Manitoba trim points exceeding CIHI values for the majority of CMGs.[18] As a result, cases in Manitoba are classified as outliers using the CIHI definition when, in fact, the provincial length of stay experience (using the CIHI approach to classifying outliers) would suggest that these

[17] CIHI defines non-acute cases as "low severity" or "alternate level of care (ALC)" days.

[18] Previous MCHPE studies used the following approach to defining outliers:

- All cases with a length of stay of greater than 75 days were considered outliers.
- All cases with a length of stay that exceeded the mean length of stay plus 1.5 times the interquartile range for a given RDRG were considered outliers.

cases are typical. This difference in classification may have a substantial impact on the estimation of total weighted cases in a given facility.[19]

[19] The CIHI approach has the benefit of basing the definition of outliers on a large number of cases, unlike the Manitoba approach, which used relatively fewer cases, and made additional adjustments. This current study has not performed the sensitivity tests on the CIHI approach that were used to validate the Manitoba approach.

Figure 9. Difference in Days for Trim Point by CMG For All Manitoba Cases with n > 30, 1995/96

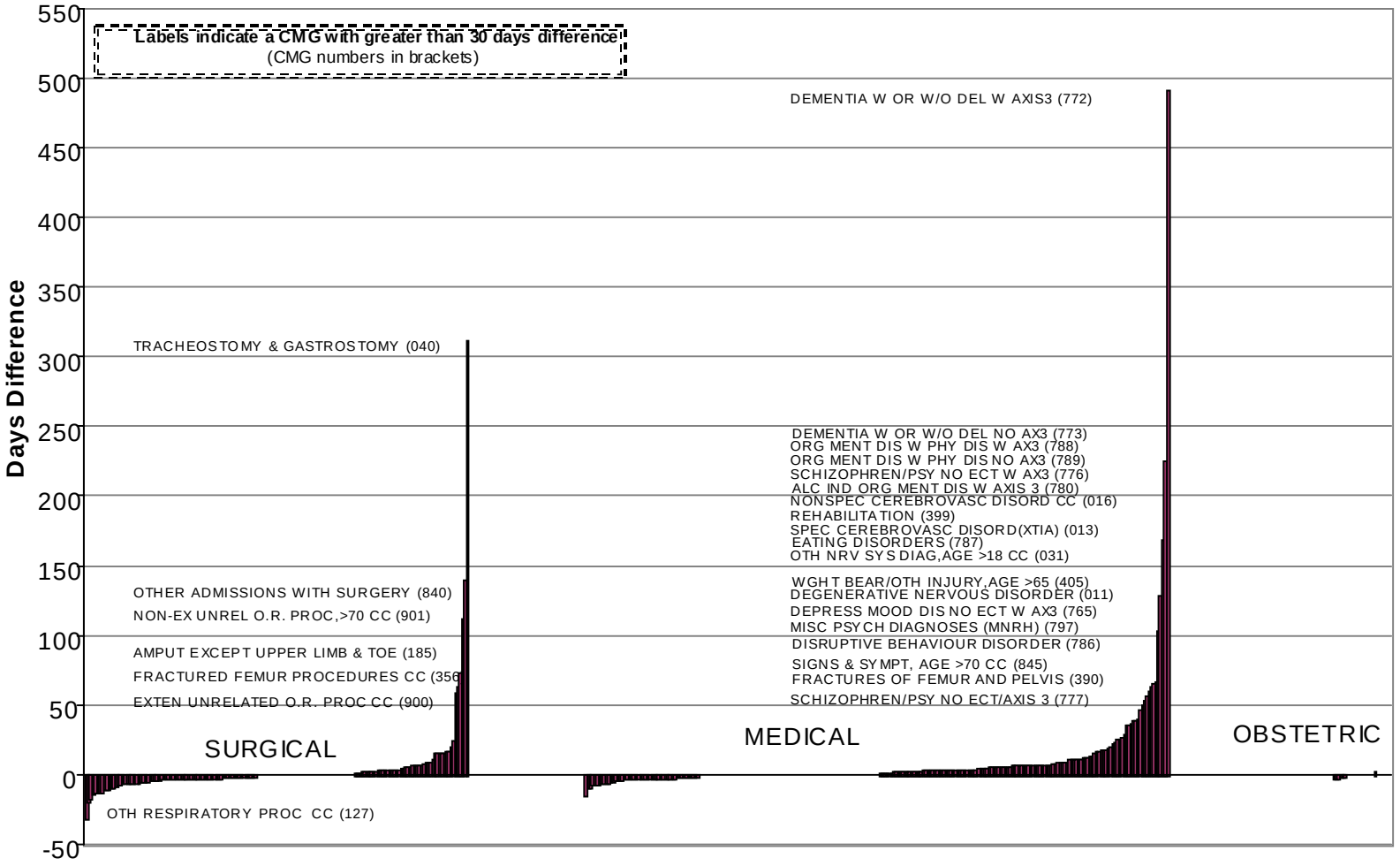


Figure 9 illustrates the difference in trim point, using the CIHI method of calculating the trim, between CIHI and Manitoba. Earlier MCHPE studies considered all stays in excess of 75 days to be outliers. To provide a direct comparison with the CIHI data, we have not made this adjustment. Given the importance of defining those cases that are outliers, if the CIHI outlier definition does not correctly define outliers in Manitoba, it will be necessary to determine the best way to assign an outlier classification to Manitoba cases.

Using the 1995 CIHI Length of Stay Reference Database to Calibrate RIWs

The CIHI Length of Stay Reference Database is comprised of the most current single year of available data - October 1, 1993 to September 30, 1994. To determine whether differences in length of stay could be explained, in part, by our use of these CIHI reference data and 1995/96 Manitoba length of stay, we carried out additional analyses. First, we compared average length of stay for 29 common CMGs (with case volumes of 500 or more) in Manitoba between 1993/94[20] and 1995/96. In all but two case mix groups, length of stay was less in 1995/96. Second, we compared these same case mix groups using 1993/94 data from Manitoba and CIHI. Average length of stay was greater in Manitoba in all but five case mix groups. Lastly, we compared average length of stay between CIHI and 1995/96 data from Manitoba. In all but four case mix groups, 1995/96 averages in Manitoba were less than the CIHI averages. We recognize that these analyses are preliminary at best, yet these observations are suggestive of two issues deserving further attention. First, since length of stay is used to calibrate the Maryland charge data to represent relative resource consumption in Canadian hospitals and is a fundamental component of the RIW methodology, any implementation of a case mix costing system will require testing – especially in light of declining lengths of stay.

---

[20] 1993/94 (April 1, 1993 to March 31, 1994) hospital data were grouped using the 1993 CMG methodology. MCHPE had previously purchased the 1993 grouping software from CIHI and grouped these data for research purposes. Manitoba hospital data for October 1, 1993 to September 30, 1994 (the same time period used by CIHI) could not be re-grouped using this software.

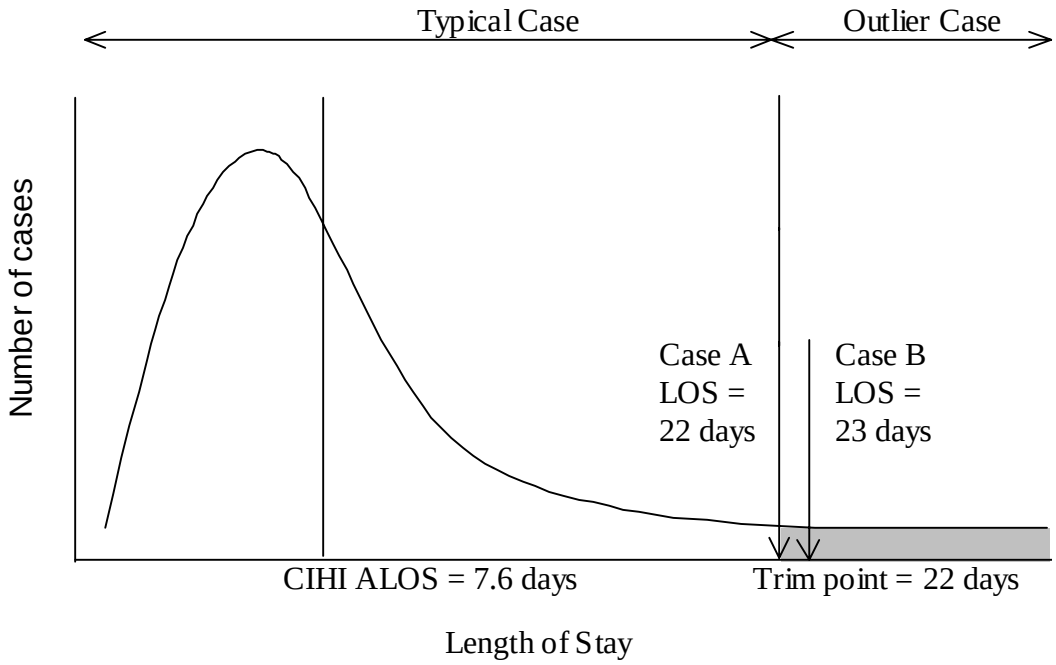
Second, when similar time periods are compared between Manitoba and CIHI, differences in average length of stay persist. Given that the length of stay experience appears to differ, Manitoba-specific or facility-type-specific case weights may be more representative of resource consumption than those calculated using Canada-wide data.

Calculating the RIW for Outliers

When calculating the RIW for outliers, CIHI assigns a weight equal to the typical RIW for the CMG and adds a blended "routine and ancillary" weight for each day in excess of the average length of stay. This method assumes that outliers are systematically different from typical cases and provides additional weight to recognize the additional resources consumed by these cases (Canadian Institute for Health Information, 1995, pp. 26-28). In previous studies carried out by MCHPE, this same weighting allocation was applied to outliers (Shanahan et al., 1994; Shanahan, 1996). An alternative approach is to assume that outliers have a similar resource consumption pattern to typical cases, and that the only difference is that they stay in the hospital for an unusually long time. Under the alternative approach, routine and ancillary weights would be added for every day a person was hospitalized beyond the trim point.

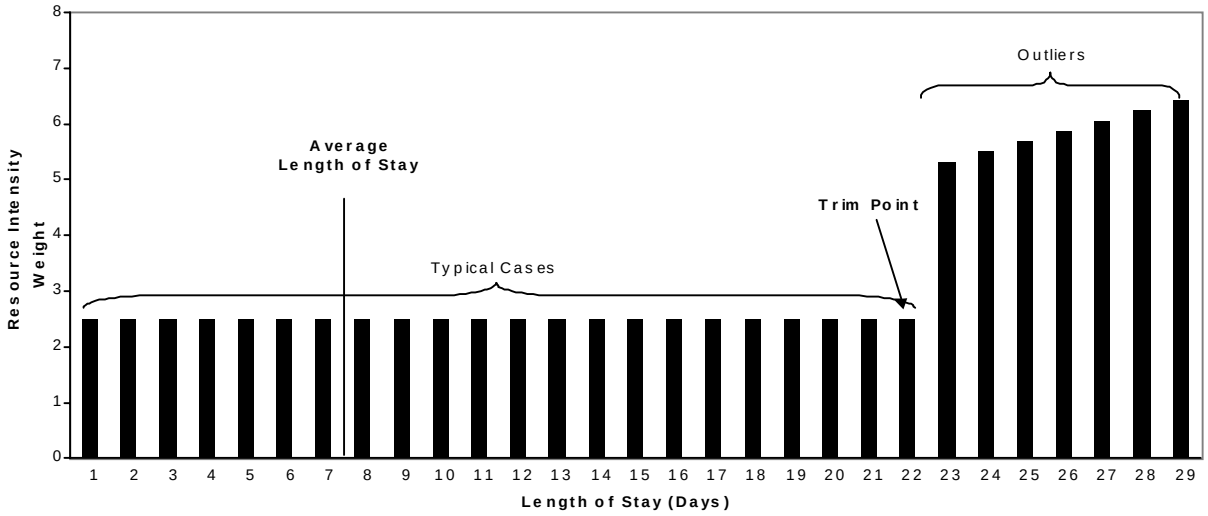
Figure 10 illustrates a hypothetical length of stay distribution for CMG 001 - Craniotomy Procedures with no complications or comorbidities. The CIHI average length of stay is 7.6 days and the trim point is 22 days. A typical RIW of 2.49 would be assigned if a patient remained in hospital for 22 days (Case A); whereas an outlier RIW of 5.32 would be assigned if a patient were to be discharge at 23 days (Case B). For the outlier case, additional credit is assigned to days between the average length of stay and the trim point.

Figure 10. Hypothetical Length of Stay Distribution for CMG 001 - Craniotomy Procedures No CC



Another way of looking at this issue is depicted in Figure 11. In this example, we see that all typical cases, regardless of length of stay, receive the same RIW. However, cases that stay beyond the trim point receive both the typical weight and incremental weights from the average length of stay.

Figure 11. Resource Intensity Weight by Length of Stay - CMG 001 - Craniotomy Procedures No CC



The outlier formula that provides additional weight to cases simply because they are outliers assumes that cases that stay a longer time have a higher rate of consumption than do typical cases. This assumption requires further investigation to determine if outlier cases in Manitoba are systematically different from typical cases. As was noted in previous MCHPE studies (Shanahan et al., 1994), there are alternative methods of assigning weights to outliers. Evaluation of alternative methods would benefit from micro-costing data that is not currently available in Manitoba. The collection of micro-costing data would confirm or refute the assumption that outliers have a different pattern of resource consumption. Given the high proportion of outliers at certain Manitoba hospitals, this data collection should be a priority.

REFERENCES

Black CD, Roos NP, Burchill CA. *Utilization of Hospital Resources, Volume I: Key Findings*. Winnipeg: Manitoba Centre for Health Policy and Evaluation. University of Manitoba; December, 1993.

Canadian Institute for Health Information. *Length of Stay Database by CMG.* Canadian Institute for Health Information; 1994.

Canadian Institute for Health Information. *Resource Intensity Weights: Summary of Methodology 1995/96;* 1995.

Canadian Institute for Health Information. *MIS Guidelines;* 1996.

Canadian Institute for Health Information. *CIHI Directions* 1997;4(1):3

Canadian Institute for Health Information. Personal communication. 1998.

Jacobs P, Shanahan M, Roos N, Farnworth M. *Cost List for Manitoba Health Services,* Winnipeg: Manitoba Centre for Health Policy and Evaluation. University of Manitoba; January, 1999.

Loyd M, Shanahan M, Brownell MD, and Roos NP. *Hospital Case Mix Costing Project 1991/92: Methodological Appendix*. Winnipeg: Manitoba Centre for Health Policy and Evaluation. University of Manitoba; April, 1995.

Manitoba Case Costing and Management Information Project. *Assessment of Patient Specific Case Costing and Management Information - Final Report;* 1998.

Michael Loyd & Associates. *Hospital Cost Allocation Methodology for Manitoba Centre for Health Policy and Evaluation*. Unpublished manuscript; November, 1992.

Poole B, Robinson S, and MacKinnon M. Resource Intensity Weights and Canadian Hospital Costs: Some Preliminary Data. *Healthcare Management Forum* 1998;11(1):22-26.

Shanahan M. *Update Hospital Case Mix Costing 1993/94.* Winnipeg: Manitoba Centre for Health Policy and Evaluation. University of Manitoba; March, 1996.

Shanahan M, Loyd M, Roos NP, and Brownell MD. *Hospital Case Mix Costing Project 1991/92*. Winnipeg: Manitoba Centre for Health Policy and Evaluation. University of Manitoba; December, 1994.

Shanahan M, Steinbach C, Burchill CA, Friesen D, and Black CD. *A Project to Investigate Provincial Expenditures on Health Care to Manitobans: A POPULIS Project*. Winnipeg: Manitoba Centre for Health Policy and Evaluation. University of Manitoba; June, 1997.

Wall R, DeCoster C, and Roos NP. *Estimating Per Diem Costs for Manitoba Hospitals: A First Step*. Winnipeg: Manitoba Centre for Health Policy and Evaluation. University of Manitoba; February, 1994.