Patient Cost Estimator
Methodological Notes and Glossary

MIS and Costing, Health Spending and Strategic Initiatives

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Introduction

The Patient Cost Estimator is an interactive tool developed by CIHI to estimate the average cost of various services provided in hospitals. This tool provides information nationally, by jurisdiction and by patient age group. The cost estimates represent the estimated average cost of services provided to the average patient. They include the costs incurred by the hospital in providing services and exclude physician fees, since physicians are normally paid directly by the jurisdiction and not by the hospital.

Overall, the Patient Cost Estimator showcases

- Estimated average costs per Case Mix Group (CMG) by jurisdiction and age group;
- Average length of stay by CMG by jurisdiction and age group;
- Volumes by CMG by jurisdiction and age group; and
- Summary reports.

This tool focuses on typical inpatients, representing more than 83% of all inpatient cases submitted by hospitals to CIHI in 2010–2011. Typical means the hospital patient received a
normal and expected course of treatment. Unexpected outcomes, such as deaths, transfers or long stays, are not normally included in the estimated average cost calculations. Please note that some CMGs contain a majority of cases that are not typical (4% of CMGs contained less than 50% typical cases in 2010–2011).

As well, users are cautioned that comparisons of cost estimates or length of stay averages across jurisdictions may not provide comparable results. This is due to differences in care delivery models across the country (for example, jurisdictions may employ different provider mixes). As well, the financial data provided to CIHI varies across the jurisdictions (for example, widely different wage rates have a significant impact on the cost estimates).

**How Does CIHI Calculate the Estimates?**

The Patient Cost Estimator methodology relies on financial and clinical data provided to CIHI, as well as the CIHI tools discussed below:

**Case Mix Groups**

Each case submitted to CIHI is assigned a major clinical category (MCC) and CMG based on the nature of the activity and the amount of resources required to provide services within the hospital. Similar activities are grouped together; for example, CMG 110 equals all services provided to an inpatient related to a lung transplant. More information on the CMG+ methodology can be found at [http://www.cihi.ca/CIHI-portal/internet/en/document/standards+and+data+submission/standards/case+mix/casemix_cmg](http://www.cihi.ca/CIHI-portal/internet/en/document/standards+and+data+submission/standards/case+mix/casemix_cmg).

**Resource Intensity Weight**

Each inpatient case submitted to CIHI has a Resource Intensity Weight (RIW) assigned to it. This is a value that represents the relative resources used by a patient. Specifically, RIWs are relative values that describe the expected resource consumption of an average patient within a CMG. The RIW can also be adjusted to account for age (for example, on average, an older patient with more health problems who would tend to consume more resources would have a higher RIW than a younger patient in the same CMG). More information on the RIW methodology can be found at [http://www.cihi.ca/CIHI-portal/internet/en/document/standards+and+data+submission/standards/case+mix/casemix_ri](http://www.cihi.ca/CIHI-portal/internet/en/document/standards+and+data+submission/standards/case+mix/casemix_ri).

**Cost per Weighted Case**

Each jurisdiction has an average cost per weighted case (CPWC) that was calculated using the total costs provided by the hospitals. The CPWC at the jurisdictional level represents the average cost of one patient receiving services in a hospital within that specific jurisdiction. More information on the CPWC methodology and the data used to calculate the CPWC can be found at [http://www.cihi.ca/CIHI-portal/EN/Quick_Stats/quick+stats/quick_stats_main?xTopic=Spending&pageNumber=1&resultCount=10&filterTypeBy=undefined&filterTopicBy=14&autorefresh=1](https://secure.cihi.ca/estore/productFamily.htm?locale=en&pf=PFC2257&lang=en).
Please note the CPWC methodology has been modified for 2009–2010 and 2010–2011; therefore, results are not comparable with those from previous years.

**Cost Estimates**

The CPWC for a selected jurisdiction is calculated by taking the financial data held in CIHI’s Canadian MIS Database (CMDB) for 2010–2011 and the weighted cases from the Discharge Abstract Database (DAD) for 2010–2011 grouped using the CMG+ 2012 grouping methodology.

\[
\text{CPWC} = \frac{\text{Total Inpatient Costs}}{\text{Total Weighted Cases}}
\]

The cost estimates do not include payments made to physicians or amortization expense on land, buildings and building service equipment.

The estimated average cost for services provided to a typical hospital inpatient is the weighted average generated by multiplying the CPWC for the selected jurisdiction by the average RIW of all typical cases within a specific CMG and age group.

**Length of Stay Averages**

There are three measures of length of stay (LOS) associated with inpatient stays found in the DAD:
- Total LOS;
- Acute LOS; and
- Alternate level of care (ALC) LOS.

The total LOS represents the patient’s days of stay in the facility:

\[
\text{Total LOS} = \text{Discharge Date} - \text{Admission Date}
\]

The total LOS is partitioned into two components: the acute LOS and ALC LOS.

\[
\text{Total LOS} = \text{Acute LOS} + \text{ALC LOS}
\]

The acute portion of the LOS is related to the number of days the patient spends in hospital receiving acute care. If applicable, an ALC portion may also be provided, representing the number of days spent waiting for a placement in alternate care during the patient’s hospitalization. Both average acute LOS and average ALC LOS are reported.

The average LOS for a typical hospital inpatient is the average of all the typical cases within a specific jurisdiction within a specific CMG and age group (in other words, the average of the lengths of stay observed within a defined group of typical patients).

**Estimated Average Cost Limitations**

The weights used to produce the Patient Cost Estimator (PCE) averages are estimates from the CMG+ methodology and so are based on a system of statistical models. While these produce results that fit most cases reasonably well, there will always be cases that are exceptional. Administrative or clinical issues that are not included in the CMG+ grouping methodology may result in instances where
the assigned group or indicators do not appear to fit the data very well. As well, within a CMG, the amount of care required may vary from patient to patient, which means that some cases’ actual costs will be below the PCE estimated average cost and some will be above the estimated average cost.

**Estimated Average Cost Variability**

The estimated average costs are arrived at through a multi-step process of statistical modelling, adjustment and aggregation. As such, there are multiple sources of variability that affect the final estimate, but not all of these sources may be of interest to a particular user.

The estimate for a particular age group and CMG is the average of the estimated costs of the patients in that group. The variability of these estimates arises through differences in the comorbidities, interventions and other factors of these patients and through the differences in the CPWC of the facilities at which they were treated. For many purposes, these differences may be viewed as more systematic than random. This is the case when the interest is in the average cost—given the observed mix of comorbidities, other factors and facilities involved—rather than in the average cost—where the mix of comorbidities, factors and facilities observed is seen as one example of many possibilities. When one is not interested in the variability that could be introduced through changes to the mix of comorbidities, factors and facilities, the source that remains is the variability from the statistical modelling and adjustments. Unfortunately we do not currently have a method of estimating this variability.

Without an estimate of the modelling variability it is not possible to produce a variability estimate for the PCE and, unfortunately, the variability of estimates within a CMG age group is not a good substitute. For example, high variability of these estimated costs may be due to numerous differences in comorbidities and factors, even though the modelling variability might be low. Conversely, if there is little variability of comorbidities, factors and facilities, the observed variability will be low, possibly obscuring a high modelling variability.

**January 2013 Update**

In January 2013, the PCE was updated as follows:

1. Grouping methodology year was updated from CMG+2010 to CMG+2012 grouping methodology.
2. Financial estimates were updated using from CPWC 2009 to CPWC 2010, using CMDB financial data from 2010–2011.
3. Key terms were added to the CMG search engine.
4. Some enhancements were implemented to improve the usability of PCE.
5. Historical estimates for 2009–2010 were added in a downloadable format. Please note that 2009–2010 results were calculated using new CPWC methodology and are not comparable with previous results.

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1. Please see Appendix A for a description of historical updates to the PCE.
Glossary

Age Group
Cases are classified into age group categories by the patient’s age upon admission.

**Neonates:**
- A—Newborn 0 days
- B—Neonates 1 to 7 days
- C—Neonates 8 to 28 days

**Pediatric:**
- F—29 to 364 days
- G—1 to 7 years
- H—8 to 17 years

**Adult:**
- R—18 to 59 years
- S—60 to 79 years
- T—80+ years

**Canadian MIS Database (CMDB)**
CIHI database housing financial and statistical data from submitting health care organizations across Canada, excluding Nunavut and Quebec. A standardized accounting framework (the MIS Standards) is used to report and collect revenues and expenses. In general, expenses related to administrative and support services, ambulatory care services, community and social services, diagnostic and therapeutic services, education, nursing inpatient and resident services, and research are submitted.

**Case**
All the activities related to one inpatient during one inpatient stay.

**Case Mix Group (CMG)**
Distinct patient groupings that are clinically similar and/or homogenous with respect to hospital resources used, created by using the CMG+ grouping methodology and identified by the CMG code and description. By linking patient groups to resources used in their treatment, this grouping methodology provides a tool for analyzing resource utilization and cost.

**Case Mix+ Grouping Methodology (CMG+)**
Assigns patient records to MCCs and CMGs. Both MCCs and CMGs are based on either a diagnosis or condition described as being most responsible for the patient’s stay in hospital, or they are based on an intervention that significantly affects the pattern of care and the resources consumed by a patient. *(Note: CMGs related to termination of pregnancy are not included.)*

The MCCs are defined as follows:

1. Diseases and Disorders of the Nervous System
2. Diseases and Disorders of the Eye
3. Diseases and Disorders of the Ear, Nose, Mouth and Throat
4. Diseases and Disorders of the Respiratory System
5 Diseases and Disorders of the Circulatory System
6 Diseases and Disorders of the Digestive System
7 Diseases and Disorders of the Hepatobiliary System and Pancreas
8 Diseases and Disorders of the Musculoskeletal System and Connective Tissue
9 Diseases and Disorders of the Skin, Subcutaneous Tissue and Breast
10 Diseases and Disorders of the Endocrine System, Nutrition and Metabolism
11 Diseases and Disorders of the Kidney, Urinary Tract and Male Reproductive System
12 Diseases and Disorders of the Female Reproductive System
13 Pregnancy and Childbirth
14 Newborns and Neonates With Conditions Originating in the Perinatal Period
15 Diseases and Disorders of the Blood and Lymphatic System
16 Multisystemic or Unspecified Site Infections
17 Mental Diseases and Disorders
18 Burns
19 Significant Trauma, Injury, Poisoning and Toxic Effects of Drugs
20 Other Reasons for Hospitalization
99 Miscellaneous CMGs and Ungroupable Data

Cost per Weighted Case (CPWC)
An indicator measuring the relative cost efficiency of a hospital’s ability to provide acute inpatient care by determining the organization’s full cost of treating the average acute inpatient from the organization’s total cost. This indicator can be calculated at the organizational, provincial and national levels. For the purpose of this analysis, the CPWC at the provincial, territorial and national levels is used.

Discharge Abstract Database (DAD)
CIHI database containing demographic, administrative and clinical data on hospital discharges. CIHI receives data directly from participating hospitals.

Inpatient
An individual
- Who has been officially accepted by a hospital for the purpose of receiving one or more health services;
- Who has been assigned a bed, bassinet or incubator; and
- Whose person-identifiable data is recorded in the registration or information system of the organization and to whom a unique identifier is assigned to record and track services.

Length of Stay
The number of days spent in a hospital as an inpatient.

MIS Standards
Standards for Management Information Systems in Canadian Health Service Organizations is the standardized accounting framework used to report and collect financial data, such as revenues and expenses, as well as administrative statistical data, such as earned hours.
Resource Intensity Weight (RIW)
A relative cost weight value for the average typical inpatient case. It reflects the resource intensity of each transaction in the DAD and comes with values by age group and factors (factors include age, comorbidity level and select interventions).

An RIW is not a dollar value; it represents the relative resources (total hospital service cost including fixed and variable components), intensity (the amount of service utilized) and weight of each inpatient case compared to the typical average case, which has a value of 1.0000.

Volume
The number of typical inpatient cases. For the purpose of this analysis, the volume does not normally represent all cases, as atypical cases such as deaths, transfers in or out and long stays are excluded. Small volumes (less than 5) are suppressed for privacy reasons.

For More Information
Canadian MIS Database, Hospital Financial Performance Indicators
https://secure.cihi.ca/estore/productFamily.htm?locale=en&pf=PFC2257&lang=en
This report provides information on hospital performance indicators, including the CPWC.

Static Tables
http://www.cihi.ca/CIHI-ext-portal/internet/EN/Quick_Stats/quick+stats/quick_stats_main?xTopic=Spending&pageNumber=1&resultCount=10&filterTypeBy=undefined&filterTopicBy=14&autorefresh=1

DAD data quality documentation

The Cost of Hospital Stays: Why Costs Vary
https://secure.cihi.ca/estore/productSeries.htm?locale=en&pc=PCC400
This report demonstrates how a case mix methodology (CMG+) can be used to determine relative costs in acute care inpatient hospitals for typical patients. An appendix of average costs associated with all CMGs by MCC is provided.

DAD Resource Intensity Weights and Expected Length of Stay (ELOS) 2012 (available at no cost to Core Plan subscribers)
https://secure.cihi.ca/estore/productSeries.htm?locale=en&pc=PCC90

This report explains the expected length of stay (ELOS) calculation and the RIW calculation for typical and atypical acute care inpatient cases. Includes tables containing the base ELOS, trim point and RIW value for each CMG and age group combination, along with a discussion of the activity and cost data sources used for the production of the ELOS and RIW.

CMG+ Directory (available at no cost to Core Plan subscribers)
https://secure.cihi.ca/estore/productSeries.htm?locale=en&pc=PCC358

This product provides more detailed information on MCCs and CMGs. Consult this document to see how the interventions and major diagnoses are classified.
Decision-Support Guide: CMG+ (available at no cost to Core Plan subscribers)
https://secure.cihi.ca/estore/productSeries.htm?locale=en&pc=PCC500

This product was developed to increase clients’ ability to understand and use CMG+ grouping information and to address increasing demands for case mix understanding and direction on how to use case mix measures and products to inform decision support.

Standards for Management Information Systems in Canadian Health Service Organizations (MIS Standards)
https://secure.cihi.ca/estore/productSeries.htm?pc=PCC67

This product provides the framework for Canadian health care facilities to collect and submit financial and statistical data.
Appendix A:

Historical Data and Methodology Year Updates

December 2010 Update

In December 2010, the PCE was updated as follows:

1. Methodology year was updated from CMG+ 2009 to CMG+ 2010 grouping methodology.
3. Length of stay averages were added and were calculated using the 2008–2009 DAD.

The histogram below presents the distribution of the percentage change in estimated average costs at the CMG level following the December 2010 update.

![Histogram of Percentage Change in Estimated Average Cost by CMG in Canada]
June 2010 Update

In June 2010, the PCE estimated average costs were updated as follows:

1. Methodology year was updated from CMG+ 2008 to CMG+ 2009 grouping methodology.

As data sources and methodologies change, the estimates produced may vary dramatically from those of the preceding year. In particular, numerous changes were made to the CMG+ grouping methodology in 2009 to better reflect the coding of patient abstracts submitted to the DAD. Changes in grouping methodology and fluctuation in CMDB and DAD data often result in large variation (both increases and decreases) in the average estimated costs provided by the PCE. These changes are not unexpected, in particular among low-volume CMGs.

The histogram below presents the distribution of the percentage change in estimated average costs at the CMG level following the June 2010 update.

![Distribution of Percent Change in Estimated Average Cost by CMG in Canada](image-url)
November 2009 (initial release)

In November 2009, CIHI released the PCE, and the estimated average costs were generated as follows:

1. Methodology year was CMG+ 2008 grouping methodology.
2. Clinical data year was DAD 2007–2008.
3. Financial estimates were from CPWC 2008 held in CIHI’s CMDB for 2007–2008.

The histogram below presents the distribution of the percentage change in estimated average costs at the CMG level following the November 2009 update.