



Patient Cost Estimator

Methodology Notes and Glossary



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Table of contents

Introduction	4
How does CIHI calculate the estimates?	5
Case Mix Groups	5
Resource Intensity Weight	5
Cost of a Standard Hospital Stay	5
Hospital cost estimates	6
Physician cost estimates	6
Variability in estimated average physician costs versus estimated average hospital costs	8
Length of stay averages	8
Estimated average cost limitations	9
Estimated average cost variability	10
October 2023 update	10
Glossary	11
Age group	11
Canadian MIS Database (CMDB)	11
Case	11
Case Mix Group (CMG)	12
Case Mix Group+ grouping methodology (CMG+)	12
Cost of a Standard Hospital Stay (CSHS)	13
Discharge Abstract Database (DAD)	13
Inpatient	13
Length of stay (LOS)	13
MIS Standards	13
Patient-Level Physician Billing (PLPB) Repository	13
Physician billing during the hospital stay period	14
Resource Intensity Weight (RIW)	14
Shadow billing claims	14
Skewed distribution	14
Volume	14
For more information	15

Introduction

The Patient Cost Estimator (PCE) is an interactive tool developed by the Canadian Institute for Health Information (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 typical inpatient in an acute care facility. 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. The tool includes cost estimates for physician payments in 7 provinces.

Overall, the PCE showcases

- Estimated average hospital costs per Case Mix Group (CMG), by jurisdiction and age group;
- Estimated average physician costs incurred during a hospital stay per CMG and age group for 7 provinces (Newfoundland and Labrador, Nova Scotia, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia);
- 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 approximately 83% of all inpatient cases submitted by acute care hospitals to CIHI in 2021–2022. 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 (5% of CMGs contained less than 50% typical cases in 2021–2022).

Results from 2020–2021 onward should be interpreted in the context of the COVID-19 pandemic. To learn more, see the [Impact of COVID-19 on Canada's health care systems](#). CIHI's CMG+ 2022 grouping methodology does not include a COVID-19–specific CMG; users should refer to CIHI's [COVID-19 Hospitalization and Emergency Department Statistics](#) for COVID-19 cost estimates.

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 (e.g., jurisdictions may employ different provider mixes). As well, the financial data provided to CIHI varies across the jurisdictions (e.g., varying wage rates across the country have a significant impact on the cost estimates).

How does CIHI calculate the estimates?

The PCE methodology relies on financial, physician 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 during an inpatient hospitalization related to a lung transplant. [Read more on the CMG+ methodology.](#)

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 (e.g., 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). [Read more on the RIW methodology.](#)

Cost of a Standard Hospital Stay

Each jurisdiction has an average cost of a standard hospital stay (CSHS) that was calculated using the total costs provided by the hospitals. The CSHS at the jurisdictional level represents the average cost of 1 patient receiving services in a hospital within that specific jurisdiction.

More information on the CSHS methodology and the data used to calculate the CSHS can be found in the In Depth section of the [Your Health System](#) web tool and in the tool's [exported Excel file.](#)

Hospital cost estimates

The CSHS for a selected jurisdiction is calculated by taking the financial data held in CIHI's Canadian MIS Database (CMDB) for 2021–2022 and the weighted cases from the Discharge Abstract Database (DAD) for 2021–2022 grouped using the CMG+ 2022 grouping methodology.

$$\text{CSHS} = \text{total inpatient costs} \div \text{total weighted cases}$$

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

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

Physician cost estimates

Most physicians are paid for their clinical services directly through provincial or territorial medical care plans. The hospital cost estimates in the PCE are based on a series of calculations using CIHI's hospital discharge data, which does not include the information from the medical care plans.

With the availability of data on patient-level physician payments for 7 provinces, we can now generate full hospital costs by patient group, as these physician costs can also be grouped by CMG or MCC, and can be incorporated with the average costs in the PCE. The addition of this data provides a more comprehensive cost measure of hospital care delivery. To remove the extreme outliers from the patient-level physician billing (PLPB) data, a 1% trim was applied at each end to all of the CMGs with a threshold of volume greater than or equal to 30.

Note that interprovincial comparisons may differ due to varying fee schedules and funding sources for clinical laboratory and medical imaging services across Canada. As a result, not all physician remuneration for these services is included in the PLPB data. For instance, if payments to radiologists and pathologists are made through the provincial or territorial medical care plans, they are captured in the PLPB data. Otherwise, if physicians are paid through hospital funding, the payment information is included in the hospital cost estimates. Physician cost estimates by CMG based on small volumes (less than 10) could also be inconsistent and have been removed.

Calculation

Data and linkages

CIHI used 2 databases to calculate the physician cost estimates: the PLPB Repository and the DAD. For trending purposes, we used data from Newfoundland and Labrador, Nova Scotia, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia for 2017–2018 to 2021–2022.

The clinical information from the DAD was grouped using the CMG+ 2022 grouping methodology. The PLPB data was linked to the grouped clinical data from the DAD by encrypted health card number (HCN) and the province issuing the HCN, respectively.

Patient-level physician billing (PLPB)

Physician billing data at the claims level represents provincial government payments to physicians for publicly insured medical services. All of the available fee-for-service and shadow billing claims were considered.

Trimming the extreme outliers from the PLPB data

The “trimming” technique was used to remove the extreme outliers from the PLPB data. Before calculating the mean, a 1% trim from each end was applied to all of the CMGs with a threshold of volume greater than or equal to 30 in order to exclude outliers. For the CMGs

with volumes less than 30 and greater than or equal to 10, we retained all the available typical cases in acute care hospitals and no removal was carried out. Nevertheless, some rounding has occurred up to the nearest whole number because the volume of patients cannot be trimmed as a fraction.

Methodology

The linked physician billing data and clinical data was aggregated to the case level. After trimming the 1% outliers from each tail, these outliers were eliminated from the PLPB data. The trimmed means of the physician costs were then estimated at the provincial level by CMG, or by CMG and age group, for each fiscal year.

The 1% **trimmed mean of the physician cost estimates** incurred within a hospitalization by CMG at the provincial level is calculated as

$$\bar{y}_{1\%n} = \frac{1}{n-2(1\%n)} \sum_{i=1\%n+1}^{n-1\%n} y_{(i)}$$

where n is the number of typical inpatients in acute care hospitals subject to at least one physician claim during the hospital stay for each CMG within the province, and y_i is the i th order statistic when all of the physician costs by each case are arranged in ascending order by CMG:

$$y_{(1)} \leq y_{(2)} \leq \dots \leq y_{(n)}$$

Limitations

The “trimmed means” technique is commonly used in statistical analysis. As there is currently no established benchmark for average physician costs by CMG, we had no precedent to work from. The choice of a 1% trim was based on our investigations of the PLPB data with the consideration of trimming the minimum necessary to remove the influence of the extreme outliers on the means of the physician cost estimates. There was some subjectivity involved in determining what was considered an outlier.

Variability in estimated average physician costs versus estimated average hospital costs

The estimated average physician costs have a less skewed (less asymmetric) distribution than the estimated average hospital costs. Adding physician costs does not alter the asymmetry of the estimated full hospital costs. Overall, the variability of the estimated full hospital costs would not be impacted by including physician costs.

Length of stay averages

There are 3 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:

$$\text{Total LOS} = \text{discharge date} - \text{admission date}$$

If the admission date equals the discharge date (the difference is 0), the calculated LOS is 1.

The total LOS is partitioned into 2 components: the acute LOS and the 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 placement in alternate care during the patient's hospitalization.

The average LOS for a typical hospital inpatient is the average LOS for 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 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's 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 CSHS of the jurisdictions in which they were treated. When one is not interested in

the variability that could be introduced through changes to the mix of comorbidities, factors and jurisdictions, 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.

October 2023 update

In October 2023, the PCE was updated as follows:

1. The grouping methodology year was updated from CMG+ 2020 to CMG+ 2022.
2. Financial estimates were updated from CSHS 2019 to CSHS 2021, using CMDB financial data from 2021–2022.
3. Historical estimates for 2017–2018, 2018–2019, 2019–2020, 2020–2021 and 2021–2022 were added in a downloadable Excel spreadsheet. Please note that historical CSHS values used in previous editions of the PCE are restated for every PCE update. The restated CSHS values may not be identical to the historical values.
4. Estimated average physician costs were added to the tool for Newfoundland and Labrador, Nova Scotia, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia, based on data submitted to the PLPB Repository.

Glossary

Age group

Cases are classified into age group categories by the patient's age upon admission.

Neonates

- A — Newborn
- B — Neonates 0 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. 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 1 inpatient during 1 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.

Case Mix Group+ 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.

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 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 CMG and Ungroupable Data

Cost of a Standard Hospital Stay (CSHS)

An indicator that measures the ratio of a hospital's total acute inpatient care expenses to the number of acute inpatient weighted cases related to the inpatients for which the hospital provided care. This indicator can be calculated at the organizational, provincial and national levels. For the purpose of this analysis, the CSHS values at the provincial, territorial and national levels are used.

Discharge Abstract Database (DAD)

CIHI database containing demographic, administrative and clinical data on hospital discharges. CIHI receives DAD data directly from participating hospitals.

Inpatient

An individual

- Who has been officially accepted by a hospital for the purpose of receiving 1 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 (LOS)

For inpatient abstracts, the calculated difference, in days, between the admission date and the discharge date. If the admission date equals the discharge date (the difference is 0), then the calculated LOS is 1.

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.

Patient-Level Physician Billing (PLPB) Repository

A data holding for PLPB information on provincial government payments to physicians for publicly insured medical services. PLPB data, submitted by the ministry of health, is available for 7 provinces: Newfoundland and Labrador, Nova Scotia, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia.

Physician billing during the hospital stay period

Physician payments incurred during the hospital stay period with a date of service between the admission and discharge dates.

Resource Intensity Weight (RIW)

A relative cost weight value assigned to each patient care episode in the DAD. It reflects the resource intensity of each patient care episode and is adjusted for a number of factors, including age, comorbidity level and selected 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 with the typical average case, which has a value of 1.0000.

Shadow billing claims

Shadow billings are based on a province's fee schedule and used in the methodology to impute the costs for non-fee-for-service modes of remuneration, commonly known as alternative payment programs (APP). [Read more on the APP.](#)

Skewed distribution

A skewed distribution with the tail to the right-hand side is said to be positively skewed. In this distribution, the peak (highest frequency of patients, mode) is on the left-hand side. The mean is located to the right of the median because it is influenced most by the extremely high costs of a very few patients, and is displaced farthest to the right. Therefore, in a positively skewed distribution, the mean of the cost has the largest value, followed by the median and the mode.

Volume

The number of typical inpatient cases from acute care hospitals. 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. In addition, cases with data quality issues have been removed. Note that cost estimates based on small volumes (less than 30) could be highly variable; please interpret with caution.

For more information

For information on hospital performance indicators, including the CSHS, please visit the In Depth section of the [Your Health System](#) web tool.

[DAD data quality documentation](#)

[The Cost of Hospital Stays: Why Costs Vary](#)

This report demonstrates how a case mix methodology (CMG+) can be used to determine relative costs in acute care 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 \(ELOS\) for CMG+ 2020](#) (available at no cost to Core Plan subscribers)

This report explains the expected length of stay (ELOS) calculation and the RIW calculation for typical and atypical acute care inpatient cases. It 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 2020](#) (available at no cost to Core Plan subscribers)

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)

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) 2019

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

[Physicians in Canada](#)

This series of documents provides data on the supply and distribution of physicians, their payments and the services they provide.



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