CMG+

Introduction to CMG+ Aggregation Variables

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Acknowledgements

Introduction

4 new aggregation variables are included in Case Mix Group+ (CMG+) 2022:

- High-Level CMG;
- CMG Provider Service;
- CMG Provider Service Group; and
- CMG Care Level.

This document provides a brief overview of how these new variables were developed. Please see other CMG+ 2022 products for more information about how to use these variables.

Figure 1   New CMG+ aggregation variables
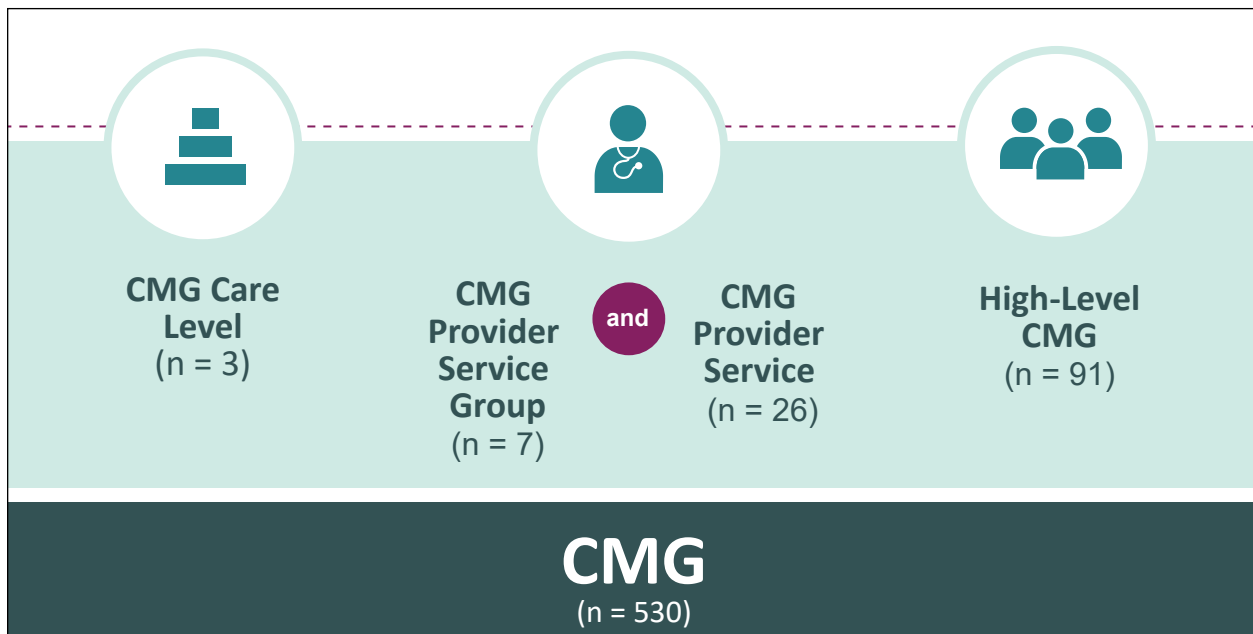
These new variables were developed to support more meaningful analysis at aggregated levels with more robust volumes. This will enable stakeholders to

1. Conduct descriptive and comparative analysis of the current and historic landscape, including

   - Describing inpatient services.

   - Understanding referral/travel patterns.

   - Describing providers across programs.

2. Plan for future states by

   - Informing decision-making around resource planning and sustainability.

   - Informing hospital program planning and regional service delivery.

3. Enhance performance monitoring by

   - Identifying appropriate facility/peer comparators.

   - Supplementing indicators with enhanced context.

Data source

The initial development of these variables was based on 5 fiscal years of acute inpatient data (2013–2014 to 2017–2018) from CIHI's Discharge Abstract Database (DAD), representing all jurisdictions across Canada, except Quebec. The 2018–2019 and 2019–2020 data was used to validate the original results. This methodology has shown year-over-year stability and will be updated every 3 years as part of the DAD update cycle.

High-Level CMG

High-Level CMGs (HL-CMGs) aggregate all 530 CMGs to 1 of 91 HL-CMGs (see Figure 2). These HL-CMGs are based on clinical relevance and provide a greater level of detail compared with major clinical category (MCC). The guiding principle of assigning HL-CMGs was to bring a sufficient volume to cells for meaningful jurisdictional reporting and comparative analysis.

Figure 2   HL-CMGs in relation to MCCs and CMGs

Major clinical category (MCC)
21

High-Level CMG
91

CMG
530 groups
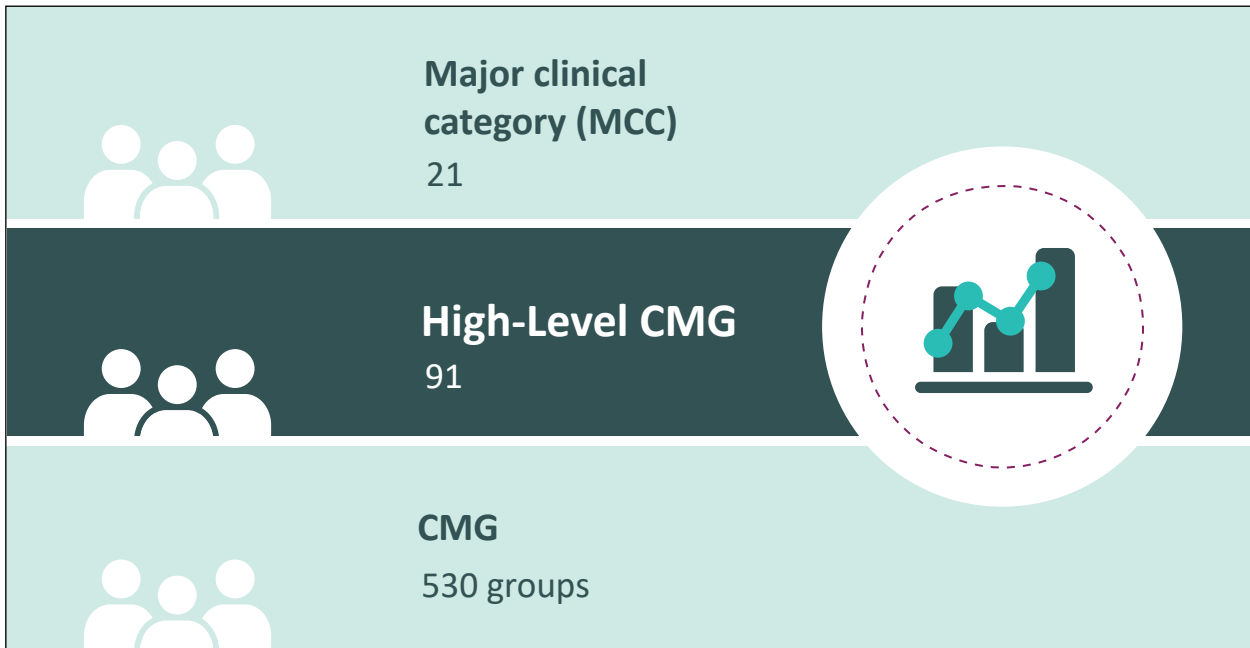
Each HL-CMG is assigned a 3-character alphanumeric code, with the first character representing body system or MCC (A to T). In a few instances, when the HL-CMG contains CMGs from multiple MCCs or when the record is ungroupable, the first character is assigned the value "Z." The remaining 2 digits identify whether the HL-CMG is an intervention (starts at 01) or diagnosis (starts at 51) group.

Exception logic

There are some exceptions to the general rule to include only cases within an MCC and partition together.

Aggregating across MCCs

As mentioned above, in some cases, CMGs from multiple MCCs have been grouped together into an HL-CMG (starting with a Z). For example, most MCCs have at least one CMG for Malignant Neoplasms specific to the MCC. Grouping these cases together as HL-CMG **Z51: Malignant Neoplasm Diagnosis** combines patients treated medically for cancer regardless of site.[i] Cancers of the blood have also been combined in a separate HL-CMG, **Z52: Blood Cancer**.

The CMGs associated with HL-CMG **Z51: Malignant Neoplasm Diagnosis** are as follows:

- 038 Malignant Neoplasm CNS
- 094 Ear/Nose/Throat Malignancy
- 132 Malignant Neoplasm Respiratory System
- 250 Digestive Malignancy
- 284 Hepatobiliary/Pancreatic Malignancy
- 357 Musculoskeletal Malignant Neoplasm
- 403 Malignant Neoplasm of Skin
- 404 Malignant Neoplasm of Breast
- 440 Malignant Neoplasm Thyroid/Parathyroid
- 478 Malignant Neoplasm Urinary System
- 479 Malignant Neoplasm Male Reproductive System
- 520 Malignant Neoplasm of Ovary
- 525 Malignant Neoplasm Female Reproductive System except Ovary
- 630 Malignant Neoplasm Other Site
- 638 Chemo/Radio for Neoplasm

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i. Please note that a small portion of medical oncology patients will not be included as there are insufficient volumes for a specific CMG (e.g., MCC 02 Diseases & Disorders of the Eye).

There are also 2 intervention partition HL-CMGs across body systems:

1. HL-CMG **Z01: Transplant Intervention and Ventricular Assist Implant** includes high-cost organ transplants (e.g., heart, lung, liver, kidney, bone marrow) and ventricular assist implants.
2. HL-CMG **Z02: Unrelated Interventions** includes interventions not related to the MCC of the most responsible diagnosis (CMGs 901 to 918).

Medical and surgical partitions combined

In a few instances, diagnosis and intervention CMGs have been combined. **M52: Pregnancy with Delivery** was combined to include all types of deliveries (vaginal and Caesarean section) in 1 cell. Also, due to low-volume concerns, medical and surgical partitions were combined for the following 3 HL-CMGs: **M01: Ante/Postpartum Diagnosis with Intervention**, **P52: Multi-systemic & Unspecified Site Infection** and **R51: Burns**.

CMG Provider Service and Provider Service Group

The CMG Provider Service variable categorizes each CMG into 1 of 26 CMG Provider Services. This assignment reflects the dominant most responsible provider (MRP) assigned to cases within each CMG. Where it was not possible to identify a dominant provider (i.e., the MRP with the highest proportion of cases represented one-third or less of the cases within the CMG), the CMG was assigned to the Various CMG Provider Service.

CMG Provider Service was further aggregated into 7 CMG Provider Service Groups. 3 of the CMG Provider Service Groups further aggregate CMG Provider Services into 3 groups: Internal Medicine and Subspecialty, Surgery, and Obstetrics and Gynecology. 4 CMG Provider Service Groups — Family Medicine, General Pediatrics, Psychiatry and Various — have a one-to-one match between the CMG Provider Service and CMG Provider Service Group.

- Family Medicine
- General Pediatrics
- Psychiatry

- Various[ii]
- Obstetrics and Gynecology
  - Obstetrics
  - Gynecology[iii]
- Internal Medicine and Subspecialty
  - Cardiology
  - Endocrinology and Metabolism
  - Gastroenterology
  - Hematology/Oncology
  - Internal Medicine
  - Neonatal–Perinatal Medicine
  - Neurology
  - Respirology
- Surgery
  - Cardiac Surgery
  - General Surgery
  - Nephrology
  - Neurosurgery
  - Ophthalmology
  - Oral Surgery
  - Orthopedic Surgery
  - Otolaryngology
  - Plastic Surgery
  - Thoracic Surgery
  - Urology
  - Vascular Surgery

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ii. Various is assigned when the most common most responsible provider is associated with less than a third of the cases in the CMG.

iii. Gynecologists also perform surgery, but the association with obstetrics was considered more clinically relevant.
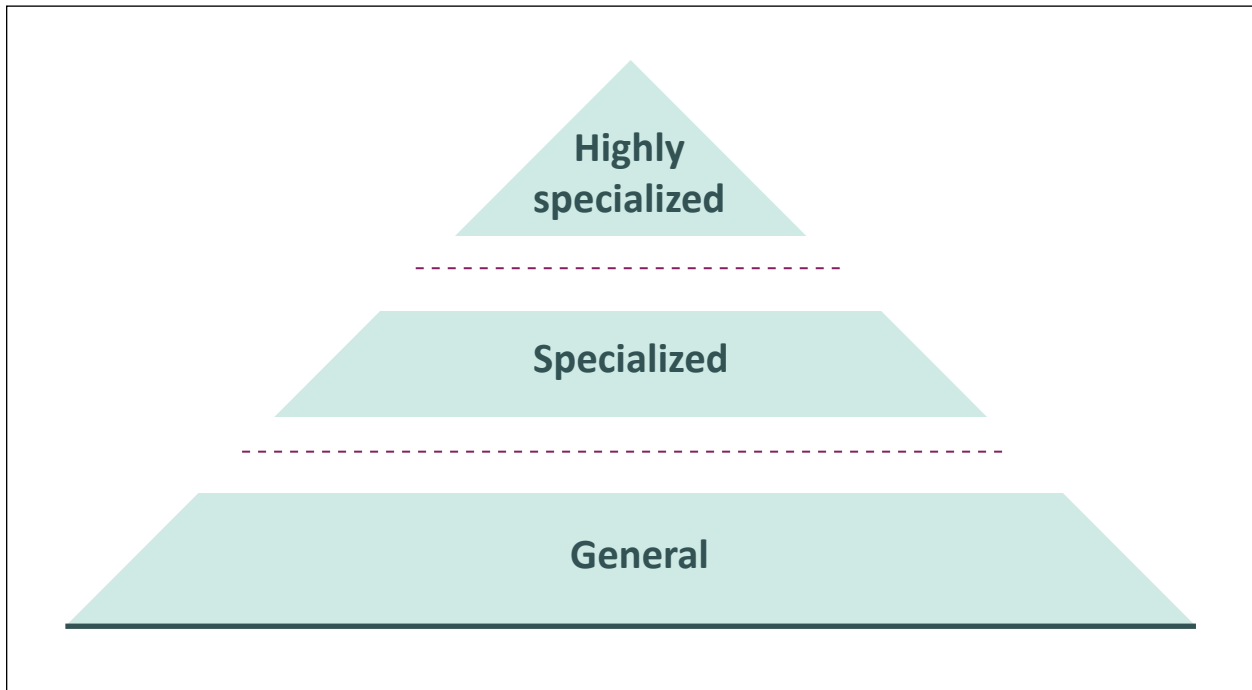
CMG Care Level

CMG Care Level aggregates hospital care into mutually exclusive levels that reflect the degree of specialization. The approach is similar to other CMG Care Level methodologies (e.g., Hay Group approach)[1] and represents the first time CIHI has released this methodology as part of the CMG+ annual product.

As described in Figure 3, CMG Care Level aggregates CMGs into 3 categories:

- Highly specialized: Advanced care requiring complex medical and/or surgical interventions that are focused in a few teaching hospitals per jurisdiction.
- Specialized: Care that's often intervention-based and likely to be provided by a specialist. It's often rationalized to larger, more urban centres in each health region.
- General: Care that's typically available at all hospitals and with a generalist most responsible provider (MRP).

As the portion of specialist MRPs increases, so does the likelihood of the CMG Care Level being assigned to Highly Specialized.

Figure 3   CMG Care Level

A mixed-method iterative approach assigns each CMG to 1 of 3 CMG Care Levels: general, specialized and highly specialized.

The process of assigning each CMG to a CMG Care Level used principal components analysis techniques, as many of the input variables tested are so highly correlated (see the table below). A K-means clustering algorithm was applied iteratively to test each CMG as highly specialized, specialized or general. This unsupervised technique identified 4 variables that, when combined, produced the least-squared Euclidean distance within each CMG Care Level and the greatest separation of the centroids among the 3 groups.

Table   Pearson correlation coefficients between numeric variables that were included in CMG Care Level assignment
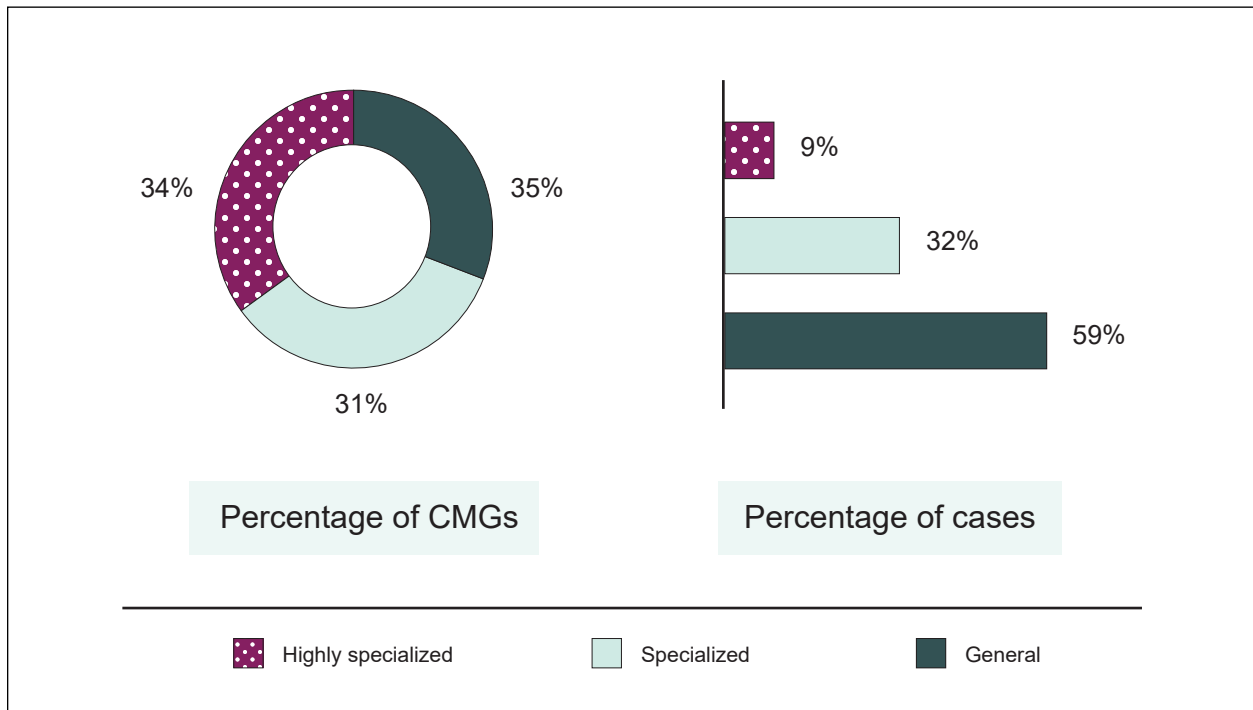
Variable	Percentage specialist	Percentage out-of-region travel	Percentage out-of-province/-territory travel
Percentage specialist	1.00	0.59	0.46
Percentage out-of-region travel	0.59	1.00	0.61
Percentage out-of-province/-territory travel	0.46	0.61	1.00

Many variables were tested for inclusion in the CMG Care Level assigned to each CMG, including Resource Intensity Weight (RIW), number of hospitals, number of regions, length of stay (both total and acute stay, in both the natural and log functions) and the percentage of similar surgeries being performed in the outpatient setting. Length of stay and cost have traditionally been used with earlier versions of care level methodologies. These metrics were tested in preliminary versions of the analysis; however, chronic condition CMGs, such as dementia or chronic obstructive pulmonary disease, were being assigned a more specialized care level than what seemed appropriate.

The details for the 4 variables included in the cluster analyses can further be defined as follows:

1. **Diagnosis versus intervention CMG:** Each MCC has an intervention- and diagnosis-driven partition. The highest-ranking qualifying intervention is used to assign the case to an intervention CMG. If no qualifying interventions are reported, the CMG is assigned based on diagnosis information. Occasionally, surgeons and specialists are identified as the MRP in a diagnosis CMG. This is usually associated with their involvement in non-qualifying interventions such as drains, cancer treatments or investigative technologies.

2. **Percentage specialist as the MRP in CMG:** What percentage of cases in this CMG is considered as having a specialist MRP? For CMG Care Level analytical purposes, all providers except the following were considered specialists:

   - General/family practice physicians
   - General pediatricians
   - Internal medicine physicians
   - Advance practice nurses
   - Gerontologists
   - Midwives
   - Emergency medicine physicians
   - Community medicine physicians

3. **Percentage of out-of-region cases:** Is the patient's postal code outside of the hospital's health region? This variable measures the percentage of patients who do not reside in the same health region as the hospital. Travel for care is highly associated with access to specialists and highly specialized level of care.

4. **Hospital market share:** How concentrated is this CMG within hospitals? A Herfindahl-Hirschman Index[2] approach adjusted for hospitals that provide primarily a specialized service type (e.g., orthopedic, rehabilitation, mental health, convalescence, hernias, children's hospital, obstetrics) or for services that are specialized and rationalized into a small number of facilities.

As illustrated in Figure 4, while there is a relatively even distribution of CMGs within each of the 3 CMG Care Levels, the volume of cases in these 3 levels varies considerably. The largest volume of cases (59%) are general, approximately one-third (32%) are specialized and the remaining 9% are considered highly specialized.

Figure 4   CMG Care Level distribution by CMG number and patient volume

Percentage of CMGs: 35% (General), 34% (Highly specialized), 31% (Specialized)

Percentage of cases: 9% (Highly specialized), 32% (Specialized), 59% (General)

Legend: Highly specialized, Specialized, General

Source
Discharge Abstract Database, 2018–2019, Canadian Institute for Health Information.

Appendix

Text alternative for figure

Text alternative for Figure 1: New CMG+ aggregation variables

This figure shows that the existing 530 CMGs can be aggregated according to the 4 new CMG+ aggregation variables: CMG Care Level (3 levels); CMG Provider Service Group (7 groups); CMG Provider Service (26 services); and High-Level CMG (91 high-level CMGs).

Text alternative for Figure 2: HL-CMGs in relation to MCCs and CMGs

There are 530 CMGs, 91 groups in the new High-Level CMG variable and 21 MCCs. The new High-Level CMG variable provides more specificity than MCC, but with fewer groups than CMG.

References

1. The Hay Group. *The Hay Group Level of Care Methodology: CMG 1999*. 1999.

2. OECD. *Competition Assessment Toolkit: Volume 2 — Guidance*. Version 2. 2011.

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