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CIHI Data Quality Study of the 2005–2006 Discharge Abstract Database

DAD




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CIHI Data Quality Study of the 2005–2006 Discharge Abstract Database

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About CIHI

The Canadian Institute for Health Information (CIHI) collects and analyzes information on health and health care in Canada and makes it publicly available. Canada's federal, provincial and territorial governments created CIHI as a not-for-profit, independent organization dedicated to forging a common approach to Canadian health information. CIHI's goal is to provide timely, accurate and comparable information. CIHI's data and reports inform health policies, support the effective delivery of health services and raise awareness among Canadians of the factors that contribute to good health.

Data and information quality is intrinsic to CIHI's mandate to inform public policy, support health care management and build public awareness about the factors that affect health. CIHI implements a complete data quality program that includes processes and policies to continuously improve data quality both within CIHI and in the broader health sector.

Acknowledgements

The Canadian Institute for Health Information (CIHI) wishes to acknowledge and thank the following individuals and organizations for their contributions to this data quality study on the Discharge Abstract Database:

- The 18 Health Information Management professionals who collected the data;
- The 50 hospitals across Canada that participated in this study and that welcomed the reabstractors into their sites;
- The Canadian Health Information Management Association, which assisted with advertising for reabstractors; and
- The provincial ministries of health and regional health authorities that supported this data quality initiative within their provinces.

Please note that the findings and recommendations outlined in the present document do not necessarily reflect the views of the individuals or organizations mentioned above.

Executive Summary

As part of its comprehensive data quality program, CIHI conducts a variety of data quality analyses and studies on its data holdings, including a systematic program of reabstraction for its Discharge Abstract Database (DAD). This report summarizes the results of a reabstraction study carried out on 2005–2006 data submitted to DAD. Specific objectives for this study included:

- An assessment of the overall quality of coding of clinical and non-clinical data contained in DAD for 2005–2006, with a particular focus on select health conditions (that is, ambulatory care sensitive conditions) and interventions (that is, hip replacements and percutaneous coronary interventions); and
- An assessment of the impact of any observed coding variations on measures of hospital outputs and resource indicators, as measured by CIHI's acute care grouping methodology (that is, CMG/PIx).

The study also focused on identifying the underlying coding issues that might affect the quality of the data/indicators noted above and articulating considerations for improving data quality to address these.

Overall Quality of DAD Data

The study findings support that the DAD data is fit for use with respect to the health conditions and interventions studied, as well as the outputs and resource indicators derived from CIHI's case-mix grouping methodology.

- Hospitalizations for ambulatory care sensitive conditions[i] were well represented in DAD, although some variations in their reliability were noted across jurisdictions. Indicators for hip replacements and percutaneous coronary interventions were minimally affected by coding issues.
- Hospital output measures and related resource indicators did not change substantially, whether they were derived using the original DAD data or data obtained from the chart review.

Coding Issues

While the study found high precision in the clinical data described in DAD, a number of discrepancies were found between the content of the original DAD data and the data documented in patient charts.

- Under- and over-reporting of diagnoses and interventions were found. These issues stemmed from difficulties in locating or accurately interpreting critical information documented in the patient chart, as well as applying some of CIHI's coding directives.
- In general, the coding of diagnoses and interventions was of high quality, but the selection of conditions that have an impact on the patient's overall length of stay or resource utilization was less reliable. Chart documentation frequently did not support the selection and typing of some of these conditions as comorbidities.

i. Ambulatory care sensitive conditions represent patient admissions to a hospital for conditions that should be managed in a primary care setting.

- Coding accuracy was lowest for the patient's most responsible diagnosis, illustrating the multiplicative effect of inconsistencies in diagnosis selection and coding, as well as additional data quality issues stemming from the completeness of reporting diagnostic details to DAD. While this was observed for most jurisdictions, some regions had high coding quality across all these metrics, resulting in reliable reporting of the most responsible diagnosis. The differences in coding practices across jurisdictions are thought to play an important role in these regional differences.

Considerations for Improving Coding Quality

The report indicates that enhancing the information and data quality of DAD is a shared responsibility between the health care professionals at the facilities who treat the patients and the analysts and managers of health information databases. The following ideas are suggested to address the coding issues that were identified:

- *Ensure that chart documentation is sufficient for completing the DAD abstract.* When patient documentation is unclear, incomplete or missing detailed physician clinical notes, the person who is responsible for completing the DAD abstract does not have the information available to accurately capture the conditions that are present and the interventions that were performed.
- *Promote and make accessible CIHI's education and coding directives.* CIHI should ensure that the Canadian Coding Standards, *DAD Abstracting Manual* and ICD-10-CA/CCI electronic books are widely distributed, and facilities should ensure the accessibility and understanding of these directives by persons who complete the DAD abstract.
- *Understand the causes of the variation in the coding quality between jurisdictions.* The high coding quality of diagnoses and interventions observed in Manitoba suggests that there is potential to learn from this province in terms of best practices. This study may offer the data needed to develop target values of coding quality at the regional and national levels.
- *Continue to monitor and query the data being collected.* CIHI, in collaboration with facility staff, could use this as a tool to identify unexpected changes in coding practices in the data reported to DAD.
- *Perform further analysis of the data collected in this study to enhance health indicator statistics and CIHI's grouping methodology.* As the intent of the *Health Indicators* reports and Case Mix Group methodology is to inform policy-makers and researchers, it is critical to ensure the validity of the statistics published and the grouping methodology employed.

For More Information

The enclosed report provides detailed information on the coding quality of DAD. For more information, beyond that presented herein, please write to dataquality@cihi.ca.

1 Introduction

1.1 The Discharge Abstract Database

The Discharge Abstract Database (DAD) is a national database that contains demographic, administrative and clinical data on acute care institution separations (discharges, deaths, sign-outs and transfers) across Canada. DAD was originally developed in 1963 to collect data on institution separations in Ontario. Over time, it has expanded to provide national coverage (with the exception of Quebec).

Information from DAD is used by institutions to support institution-specific utilization management, decisions and administrative research. Governments use the data for funding and system planning and evaluation. Universities and other academic institutions use the data for various research purposes.[1]

In 2005–2006, CIHI received inpatient data from 636 acute care facilities from nine provinces and three territories, as illustrated in Table 1.

Table 1 Volume of Abstracts Submitted to DAD in 2005–2006, by Province/Territory

Province	Number of Acute Care Facilities	Number of Inpatient Abstracts
Newfoundland and Labrador	34	60,329
Prince Edward Island	7	16,783
Nova Scotia	34	96,118
New Brunswick	24	98,915
Quebec*	—	—
Ontario	175	1,138,401
Manitoba	97	137,906
Saskatchewan	69	141,001
Alberta	107	355,560
British Columbia	83	398,860
Yukon	4	5,805
Northwest Territories	1	1,782
Nunavut	1	3,143
Total	**636**	**2,454,603**

Note

* Inpatient data from Quebec is submitted to CIHI's Hospital Morbidity Database.

1.2 Study Overview, Rationale and Objectives

The main goal of this study is to assess the quality of the coding and abstracting of clinical and non-clinical information in DAD for 2005–2006 with an aim to provide reliable results at a provincial level. The study focused on specific health conditions and interventions which are included in CIHI's Health Indicator Framework[2] and which are published in various CIHI reports. The framework uses various indicators, such as health conditions, to standardize measures that enable comparisons of health status and health system performance and characteristics among different jurisdictions in Canada.

Specifically, the objectives of this study are the following:

- Produce national and provincial estimates of overall coding quality.
- Evaluate the quality of coding ambulatory care sensitive conditions, hip replacements and percutaneous coronary interventions at a national level.
- Assess the impact of any observed coding variation on measures of hospital output and resource utilization derived from CIHI's case-mix grouping methodology.
- Identify coding issues that arise as a result of any observed coding variation.

Data collected for this study required Health Information Management professionals (that is, hospital health record coders) to perform a chart review and abstract data that was then compared to DAD in a process called reabstraction. The coders who collected the data in this study are referred to as reabstractors throughout this report. The purpose of reabstraction is to identify systemic problems in coding. Coding problems could result from many areas, such as 1) unclear directives in the *DAD Abstracting Manual*, CIHI's Canadian Coding Standards or the electronic books for the International Classification of Diseases and Health-Related Problems, Tenth Revision, Canada (ICD-10-CA) and the Canadian Classification of Health Interventions (CCI), which make it difficult for the coders to implement these standards and directives consistently; 2) coders' non-compliance to these directives for any number of reasons, which affects the data; 3) hospital policies that unintentionally negatively impact the quality of the data; 4) the quality and completeness of the chart documentation, which affects the coders' ability to interpret the patient's stay with respect to the coding standards; and 5) invariably, unintentional human error introduced during the abstracting and coding process. Reabstraction studies enable CIHI to determine the extent of coding inconsistency and also isolate the areas that are causing inconsistencies. The intent of these studies is not to find fault with either the hospital coder or the reabstractor, but to identify areas where the inconsistencies noted between these coders result in data quality issues. These studies provide CIHI with the information needed to improve its products and to engage in discussion with its stakeholders.

1.3 Privacy, Confidentiality and Security

CIHI policies on privacy, confidentiality and security, with respect to personal privacy and safeguarding the confidentiality of individual records and facilities, were adhered to throughout the course of the study. Information on CIHI policies for privacy and data protection can be found online at www.cihi.ca/privacy.

1.4 Objectives of This Report

This report presents the results of the 2005–2006 DAD data quality study. It focuses on ambulatory care sensitive conditions, hip replacements and percutaneous coronary interventions, which are included in CIHI's Health Indicator Framework.[2]

This report contains eight chapters. This present chapter provides an introduction to the study. Chapter 2 presents the study method. The subsequent four chapters address the study objectives: Chapter 3 presents provincial estimates of overall coding quality; Chapter 4 evaluates the quality of coding ambulatory care sensitive conditions, hip replacements and percutaneous coronary interventions; Chapter 5 assesses the impact of coding variation on measures of hospital output and resource utilization; and Chapter 6 discusses the coding issues identified in this study. The penultimate chapter summarizes the key findings and recommendations and the final chapter provides references to papers used in this research.

2 Study Method

This study was designed to compare data originally captured on the inpatient abstract and reported to DAD to the information documented in the patient chart.

2.1 Study Design

Of all acute care facilities in Canada submitting to DAD, 50 were selected for this study based upon a probability sample that considered their geographic location and volume of abstracts containing an ambulatory care sensitive condition, hip replacement surgery or percutaneous coronary intervention. The following facilities were not considered for random sampling: facilities that reported fewer than 500 abstracts to DAD in 2005–2006 and facilities that submitted fewer than 150 abstracts that contained an ambulatory care sensitive condition, hip replacement surgery or percutaneous coronary intervention. Also, the six facilities from the territories were excluded from this study. These exclusions reduced the scope of this study from 2,454,603 abstracts (all inpatient abstracts) to 2,329,196 abstracts (94.9% of DAD).

Abstracts were selected within each sampled facility based upon the conditions and interventions that were present.

2.2 Training and Data Collection

For the purpose of training reabstractors for data collection, certain guidelines were developed to ensure consistency and thoroughness in the review and interpretation of chart documentation. All guidelines created for this study were developed in consultation with the CIHI Classifications department, which is responsible for developing and maintaining the ICD-10-CA and CCI. Training focused on diagnosis typing and the coding directives for ambulatory care sensitive conditions, hip replacements and percutaneous coronary interventions. Prior to field collection, reabstractors were required to complete a coding test to assess their understanding of the study guidelines.

For data collection, reabstractors performed reviews of the information in the patient's chart regarding his or her inpatient visit.[ii] Their findings were recorded using a CIHI software application. The application stored the reabstracted data, then revealed the data stored in DAD and marked wherever discrepancies existed between the DAD data and the study data. The reabstractor then reconciled data by recording a reason for each discrepancy (Appendix B) or by entering a comment with additional pertinent information.

ii. Data collection took place from November 2006 to January 2007. The response rate for the study was 99% (7,297 of the 7,346 sampled abstracts).

2.3 Data Processing and Analysis

Data collected for the study underwent two stages of processing. In the first stage, edit, validation and logic checks were performed on the data to ensure that the files were in the proper format and to identify missing and/or invalid data and inconsistencies in data transmissions. Where needed, CIHI staff corrected the data manually. In the second stage of processing, study weights and bootstrap weights were applied to the sampled records. This allowed for representative estimation and variance estimation of the study data. Both stages of processing are critical to ensuring accurate information in the study database.

Only weighted estimates for the reabstraction study are presented in this report. Therefore, the 7,297 abstracts that were studied represent the study's population of reference of 2,329,196 abstracts. As estimation is based on a sample taken from the population, many estimates presented include a 95% confidence interval to indicate the amount of sampling error.[iii] Variance estimates were generated using the bootstrap method.

Table 2 compares the characteristics of all abstracts in DAD to weighted estimates generated when using the study data. These figures illustrate that weighted estimates using the study data to describe the patient population are representative of DAD overall.

Table 2 Characteristics of Abstracts Submitted to DAD in 2005–2006

	All Abstracts in DAD*		Weighted Estimates Using Study Sample	
	Male	Female	Male	Female
N	1,060,459	1,393,877	1,058,328	1,270,868
Hospitalized for an Ambulatory Care Sensitive Condition† *N (Percent)*	83,541 (7.9%)	76,182 (5.5%)	87,495 (8.3%)	77,562 (6.1%)
Hospitalized for a Hip Replacement Surgery or a Percutaneous Coronary Intervention† *N (Percent)*	27,984 (2.6%)	20,295 (1.5%)	30,525 (2.9%)	22,044 (1.7%)
Age in Years *Mean (Inter-Quartile Range)*	48 (22–72)	45 (26–70)	46 (18–72)	45 (23–73)
Number of Comorbid Conditions *Mean*	1.0	1.0	0.9	1.0

Notes

N: number in population.

* Note that 267 abstracts are not represented, as the gender reported to DAD was "other."

† These hospitalizations were identified using the 2006 *Health Indicators* methodology but were not restricted based upon the patient's age.

Agreement rates were calculated for various parameters. Data from this study was also analyzed using the analytical model shown in Table 3. Note that this model was also used to analyze interventions, case-mix grouping output variables and other data elements or indicators of interest.

iii. The sample reviewed in this study is only one of many samples, using the same design and size, which could have been selected from the same population. Sampling error is a measure of the variability between all possible samples.

Table 3 Analytical Model

		Status of Health Condition in the Study Data "Criterion Standard"	
		Present	Absent
Status of Health Condition in DAD	Present	A	B
	Absent	C	D

Sensitivity and positive predictive value are two statistics used throughout this report. These statistics describe the quality of a test that determines the presence or absence of some characteristic (here a health condition) by comparing the results of the test to another categorization that is believed to be without error. This "perfect" categorization is often called the "gold standard" or "criterion standard." In this study, the results obtained by the reabstractors are considered the criterion standard.

Sensitivity, $A \div (A + C) \times 100\%$: the percentage of true positives of all patients with a health condition in the study data.

Positive predictive value, $A \div (A + B) \times 100\%$: the percentage of patients with a health condition in DAD who also have the health condition in the study data.

Ideally, the criterion standard indicates whether a health condition is truly present for a patient. In this study, these statistics must be used with caution as the study method used was a chart review of the documentation for the patient. Therefore, this study does not capture charting errors that could occur when patient histories are taken, diagnoses are made and other clinical information is recorded in the chart. It is important to note that it is only for the purpose of calculating these statistics that the *reabstracted data* is considered the criterion standard.

2.3.1 Inter-Rater and Intra-Rater Reliability Analyses

To determine the effectiveness of the additional review of directives provided to the study reabstractors on their ability to code consistently with one another, inter-rater (between reabstractors) and intra-rater (same reabstractor) reliability components were incorporated into the study design to measure the level of agreement in coding between reabstractors. Of the 7,297 abstracts with data collected in the reabstraction study, 1,367 had chart reviews performed by two different reabstractors to permit the inter-rater reliability study, and 472 had chart reviews performed two times by the same coder to permit the intra-rater reliability study.

Coder agreement rates in the intra- and inter-rater reliability studies were compared to reabstraction study agreement rates. This analysis focuses on only those abstracts where chart reviews were included in the intra- or inter-rater studies. Results were not weighted to produce overall national estimates. However, these agreement rates were compared for statistical significance using bootstrap standard errors and confidence intervals. If a 95% confidence interval for a coder agreement rate overlapped with a confidence interval from the corresponding reabstraction study agreement rate, the two rates were deemed not to be significantly different. Otherwise, they were considered to be significantly different.

3 Quality of DAD Data

This chapter focuses on the study's first objective, *to produce national and provincial estimates of overall coding quality*. Coding quality can be defined in terms of completeness and correctness, where completeness represents the proportion of observations "about the world" that are actually recorded and correctness represents the proportion of observations that reflect the "true state of the world."[3] Both measurements are necessary to assess data accuracy. A high level of correctness may be achieved at the expense of failing to record all information. Similarly, a high level of completeness may be obtained at the cost of poor correctness.[4]

The correct and complete capture of clinical data is essential for DAD analysis. Incorrect or incomplete coding limits the ability to use DAD data for regional comparisons and can affect the understanding of patient hospitalizations in terms of case-mix groups or health indicators. It is also problematic when the data is used to study associations between comorbidities, treatment, mortality and other outcomes.

3.1 Completeness of Clinical Data in DAD

This section examines the completeness of DAD data by determining if all associated diagnoses and interventions that were documented in the patient chart were also included on the DAD abstract.

3.1.1 Completeness of Reporting Diagnoses to DAD

Of all the significant diagnoses found during the chart review, 76% were reported on the DAD abstract as a significant diagnosis. This percentage is known as *sensitivity* (Table 4). This sensitivity result indicates potential under-reporting to DAD of 24% of the health conditions experienced in the inpatient setting that can impact the patient's length of stay or resource utilization.

Table 4 Diagnoses Captured During the Chart Review Compared to Data on the DAD Abstract

	DAD Data (in Thousands)		Total in Study Data (in Thousands)	Sensitivity (95% CI)
	Present	Absent		
All Significant Diagnoses in Study Data*	3,436.8	1,104.6†	4,541.4	**75.7** (73.2–78.1)

Notes

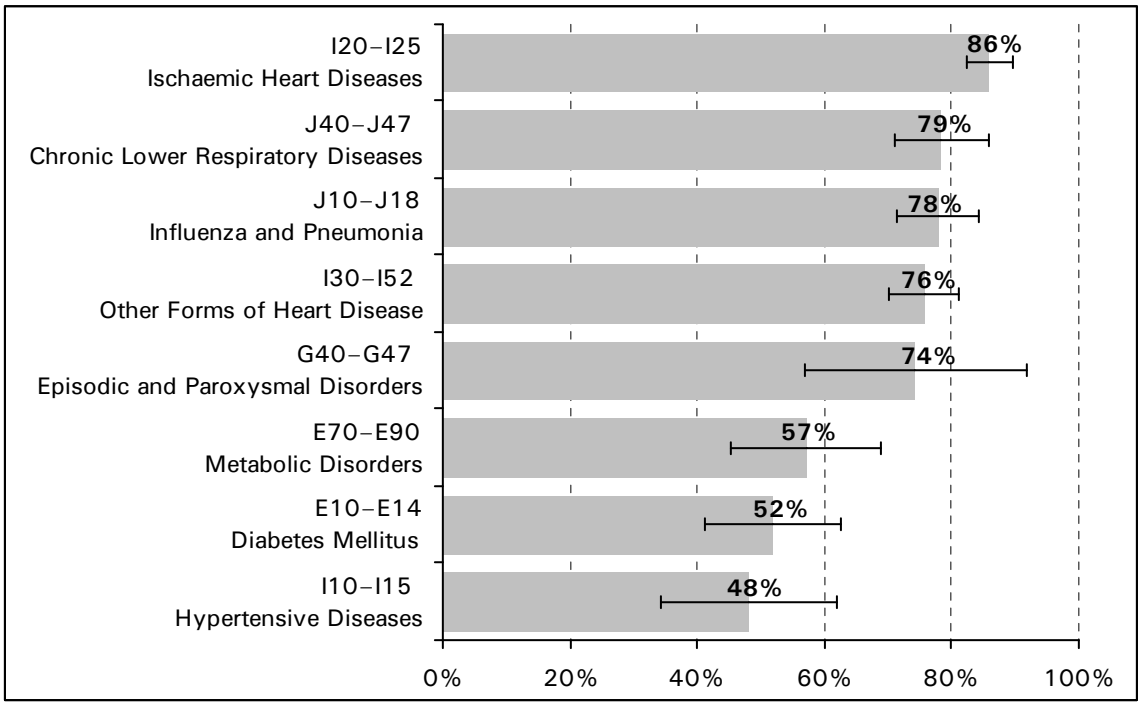
CI: confidence interval.

* Includes only significant diagnoses (types M, 1, 2, W, X or Y).

† These diagnoses were either not present in DAD or were coded as not significantly impacting the patient's length of stay or resource use (that is, diagnosis type 3).

This analysis was repeated for specific diagnoses, which found that hypertensive diseases (I10 to I15), diabetes mellitus (E10 to E14) and metabolic disorders (E70 to E90) were more prone to under-reporting to DAD than other diagnoses. That is, approximately half of the time that these diseases were identified in the chart review as a significant condition, they were not reported to DAD. Note that DAD reporting requirements for diabetes changed in 2006–2007, making it mandatory to capture whenever documented by the physician. Figure 1 illustrates these results.

Figure 1 Frequency That Diagnoses Found During the Chart Review Were Also Present in DAD*



Note

* To be considered for this analysis, the study sample had to contain a minimum of 500 occurrences of the diagnosis code in the reabstracted data. The bars represent the 95% confidence intervals.

3.1.2 Completeness of Reporting Interventions to DAD

Of all the interventions found during the chart review, 84% were reported to DAD (Table 5). This sensitivity result indicates potential under-reporting to DAD of 16% of the interventions performed in the inpatient setting.

Table 5 Interventions Captured During the Chart Review Compared to Data on the DAD Abstract

	DAD Data (in Thousands)		Total in Study Data (in Thousands)	Sensitivity (95% CI)
	Present	Absent		
All Interventions in Study Data*	1,473.1	288.0	1,761.1	**83.6** (77.1–90.2)

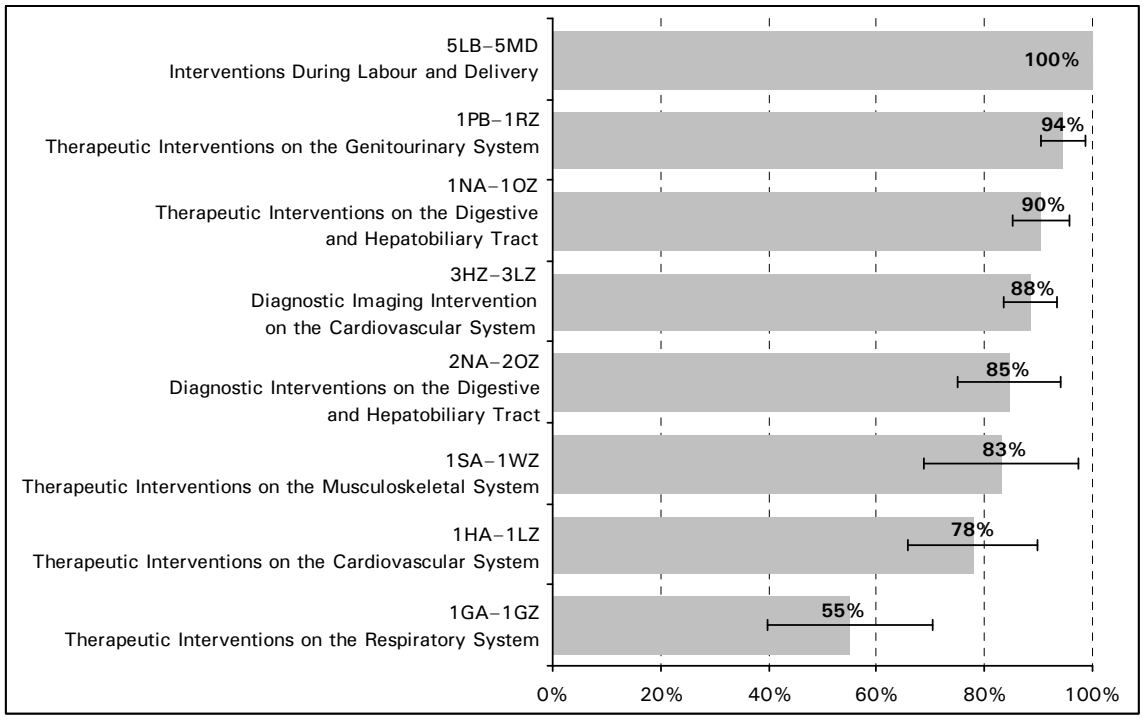
Notes

CI: confidence interval.

* Includes only those interventions that are mandatory to capture according to the 2005 Canadian Coding Standards and/or those that impact CMG/PIx assignment. Note that provincial variations in mandatory coding were not considered (for example, computed tomography [CT] scans are mandatory to capture in Ontario only).[5]

This analysis was repeated for specific interventions, which found that therapeutic interventions on the respiratory system (1.GA to 1.GZ) were prone to under-reporting to DAD. That is, approximately half (45%) of the time when these interventions were identified in the chart review they were not reported to DAD. Figure 2 illustrates these results.

Figure 2 Frequency That Interventions Found During the Chart Review Were Also Present in DAD*



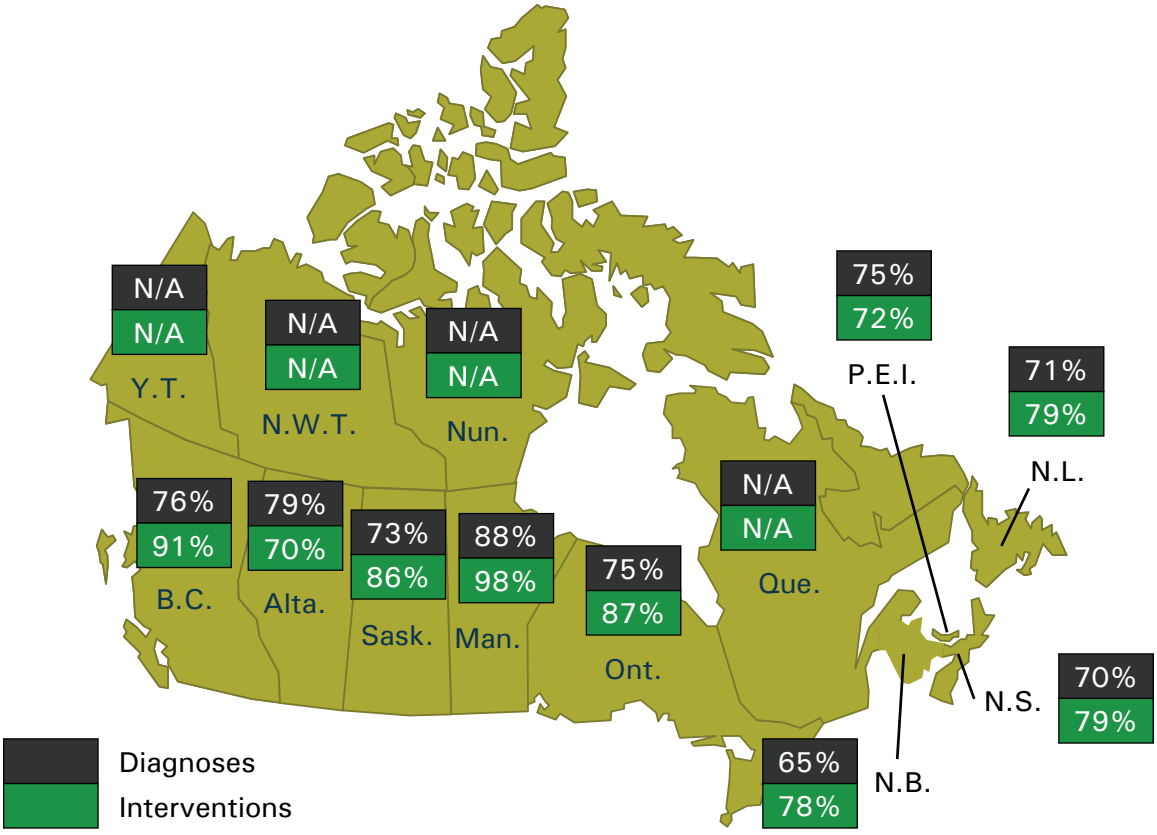
Note

* To be considered for this analysis, the study sample had to contain a minimum of 100 occurrences of the intervention code in the reabstracted data. The bars represent the 95% confidence intervals.

3.1.3 Provincial Variation in the Completeness of Clinical Data in DAD

Provincial differences in the completeness of clinical data in DAD were examined to determine if data from some provinces was reported more completely than from other provinces. When looking at provincial-level results, Manitoba had the highest sensitivity (most complete reporting) for diagnoses, while New Brunswick had the lowest sensitivity (least complete reporting) for diagnoses (Figure 3). Manitoba also had the highest sensitivity for interventions in comparison to the other jurisdictions. Most provinces had fewer issues reporting interventions in comparison to diagnoses.

Figure 3 Frequency That Diagnoses and Interventions* Found During the Chart Review Were Also Present in DAD, by Province



Notes

N/A: not available.

* See the notes under tables 4 and 5 for diagnoses and interventions that are included in this analysis.

3.2 Correctness of Clinical Data Reported to DAD

This section examines the correctness of DAD data by determining how often there is documentation in the patient chart that supports the inclusion of diagnoses and interventions on the DAD abstract.

3.2.1 Correctness of Diagnoses Reported to DAD

For the diagnoses reported to DAD as having a significant impact on the patient's length of stay or resource use, 75% had information located in the chart by the reabstractor that supported its inclusion as a significant condition. This percentage is known as the *positive predictive value* (Table 6). This positive predictive value indicates potential over-reporting of 25% of the significant diagnoses reported to DAD, as information to support their inclusion on the DAD abstract as a significant condition was not found during the chart review.

Table 6 Diagnoses on the DAD Abstract Compared to Data Captured During the Chart Review

	Study Data (in Thousands)		Total in DAD (in Thousands)	Positive Predictive Value (95% CI)
	Present	Absent		
All Significant Diagnoses in DAD*	3,436.8	1,153.5†	4,590.3	**74.9** (72.4–77.4)

Notes

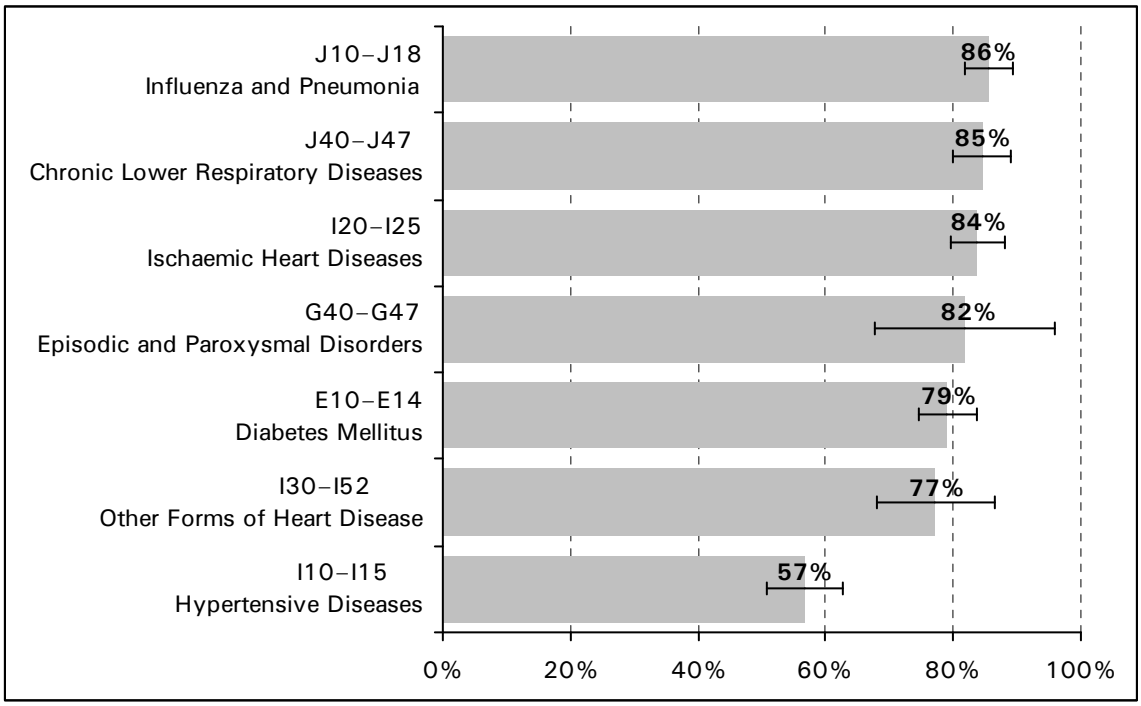
CI: confidence interval.

* See the note under Table 4 for the diagnoses that are included in this analysis.

† These diagnoses were reabstracted as either not present or not significantly impacting the patient's length of stay or resource use (that is, diagnosis type 3).

This analysis was repeated for specific diagnoses, which found that hypertensive diseases (I10 to I15) were more prone to over-reporting to DAD than other diagnoses; 43% of the hypertensive diseases reported to DAD as significant had no supportive chart documentation located during the chart review. Figure 4 illustrates these results.

Figure 4 Frequency That Diagnoses Reported to DAD Were Confirmed During the Chart Review*



Note

* To be considered for this analysis, the study sample had to contain a minimum of 500 occurrences of the diagnosis code in the DAD data. The bars represent the 95% confidence intervals.

3.2.2 Correctness of Interventions Reported to DAD

For interventions reported to DAD, 85% had supporting information located in the chart by the reabstractor (Table 7). This positive predictive value indicates potential over-reporting of 15% of the interventions in DAD, as information to support their inclusion on the DAD abstract was not found during the chart review.

Table 7 Interventions on the DAD Abstract Compared to Data Captured During the Chart Review

	Study Data (in Thousands)		**Total in DAD** (in Thousands)	**Positive Predictive Value** (95% CI)
	Present	**Absent**		
All Interventions in DAD*	1,473.1	264.0	1,737.1	**84.8** (80.9–88.7)

Notes

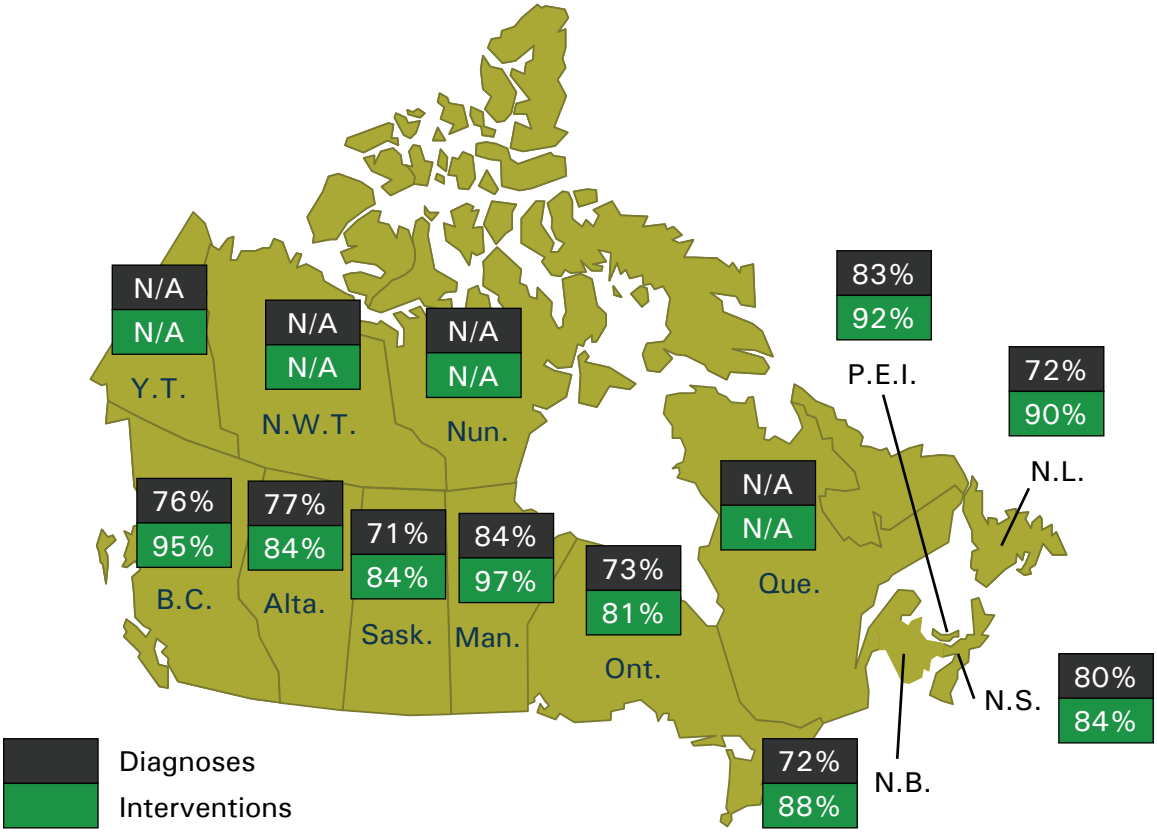
CI: confidence interval.

* See the note under Table 5 for the interventions that are included in this analysis.

3.2.3 Provincial Variation in the Correctness of Clinical Data in DAD

Provincial-level results were examined to determine if there was variation in how often the clinical data submitted to DAD is documented for significance by a physician in the patient chart. High positive predictive values (that is, less over-reporting) for diagnoses were observed in Manitoba and Prince Edward Island; high values for interventions were observed in Manitoba and British Columbia (Figure 5).

Figure 5 Frequency That Diagnoses and Interventions* Reported to DAD Were Confirmed During the Chart Review, by Province



Notes

N/A: not available.

* See the notes under tables 4 and 5 for diagnoses and interventions that are included in this analysis.

3.3 Coding Consistency of Diagnoses and Interventions

This section examines the consistency with which diagnoses and interventions were classified using ICD-10-CA and CCI, respectively. To measure coding consistency, this assessment focuses on only the significant diagnoses and interventions reported to DAD that were confirmed as present after the chart review.

3.3.1 Diagnosis Coding Using ICD-10-CA

Each ICD-10-CA code describes a specific condition and affected body system. These codes are indexed within ICD-10-CA into categories, blocks and chapters.[iv] Using these groupings, codes reported to DAD were compared to the codes captured by the reabstractor. This comparison found exact ICD-10-CA code agreement for 80% of the significant diagnoses and agreement to the code category for 92% of the significant diagnoses (Table 8). That is, DAD reliably describes the various diseases and health-related problems experienced in Canada's acute care setting for broad definitions of diseases, but the precision in the description of the disease is not always accurate to the level of detail available in ICD-10-CA.

Table 8 ICD-10-CA Code Agreement Rate for Significant Diagnoses*

	Agreement Rate (95% CI)
ICD-10-CA Code, in *A.NN.NN* format	**80.3** (78.2–82.5)
ICD-10-CA Category, in *A.NN* format	**91.9** (90.4–93.4)
ICD-10-CA Block, a range of ICD-10-CA categories (for example, *A.NN$_1$ to A.NN$_2$*)	**97.3** (96.6–98.0)
ICD-10-CA Chapter, a grouping of ICD-10-CA blocks	**98.7** (98.2–99.1)

Notes

A: alpha character; N: numeric character; CI: confidence interval.

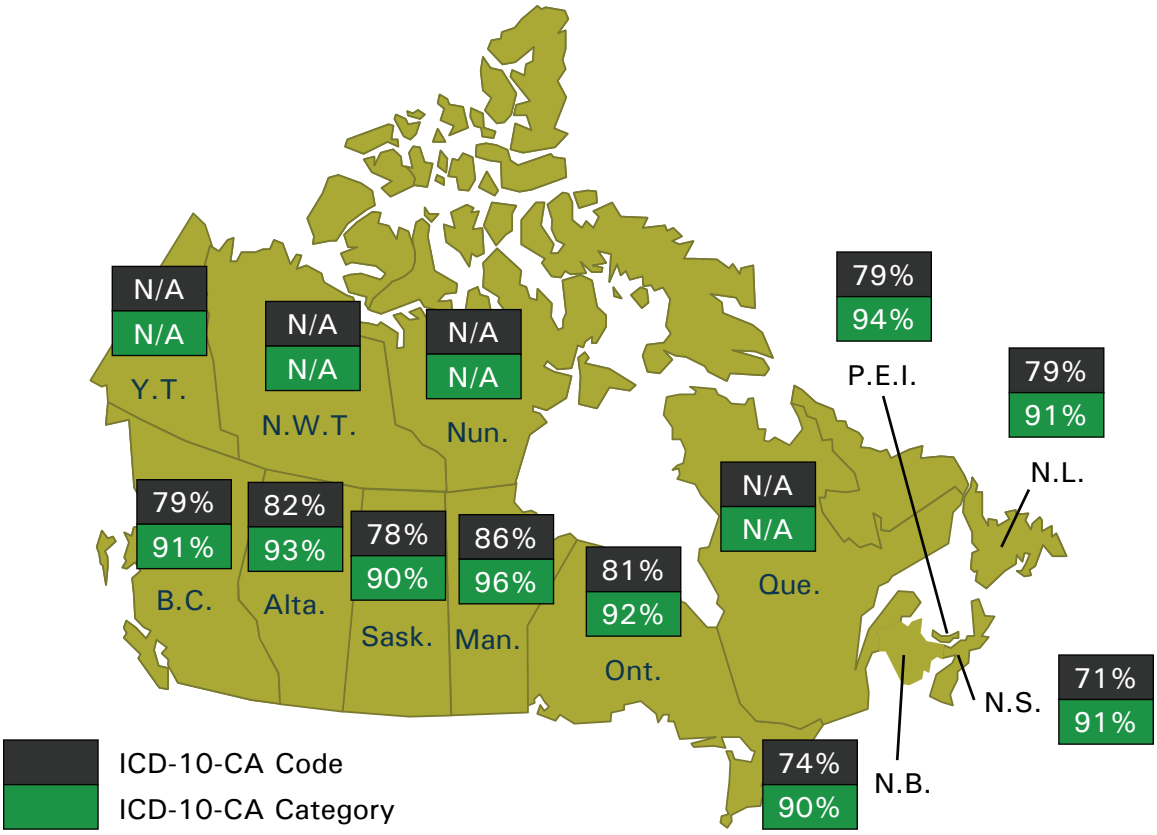
* See the note under Table 4 for the diagnoses that are included in this analysis. Diagnoses included in this analysis include only those coded as significant in DAD and also confirmed as significant by the reabstractor.

3.3.2 Provincial Variation in the Consistency of Diagnosis Coding

The reliability of the ICD-10-CA codes assigned to diagnoses varied between the provinces, as illustrated in Figure 6. Agreement on the exact ICD-10-CA code was observed most frequently in Manitoba (86% of the diagnoses). For provinces with lower agreement rates, differences in code assignment commonly affected the precision of the disease classification. Agreement on the code category was observed for more than 90% of the significant diagnoses in all provinces.

iv. For example, autoimmune thyroiditis (code E06.3) is a type of thyroiditis (category E06), which is a disease of the thyroid gland (block E00 to E07), which is an endocrine, nutritional or metabolic disease (Chapter E00 to E90).

Figure 6 ICD-10-CA Code Agreement Rates for Significant Diagnoses,* by Province



Notes
N/A: not available.
* See the note under Table 4 for the diagnoses that are included in this analysis.

3.3.3 Intervention Coding Using CCI

The interventions provided to treat health problems are captured using the CCI classification system. CCI codes are made up of components that describe the type of health intervention, the anatomy site, the intervention used, the approach/technique, the device/method and the tissue involved.[v] Exact CCI code agreement on all these components was observed for 82% of the interventions, while agreement to the code rubric was observed for 92% of the interventions (Table 9). The CCI rubric describes the intervention performed and on which anatomy site but does not describe the approach, technique, device, method or tissue involved.

v. For example, 1.DK.52.LA represents a middle ear (DK) drainage (52) using an open approach (LA). There are eight sections of CCI; this code belongs to Section 1, Physical and Physiological Therapeutic Interventions. The CCI rubric for this code is 1.DK.52, the CCI group is 1.DK and the CCI block is 1.DA to 1.DZ.

Table 9 CCI Code Agreement Rate for Interventions*

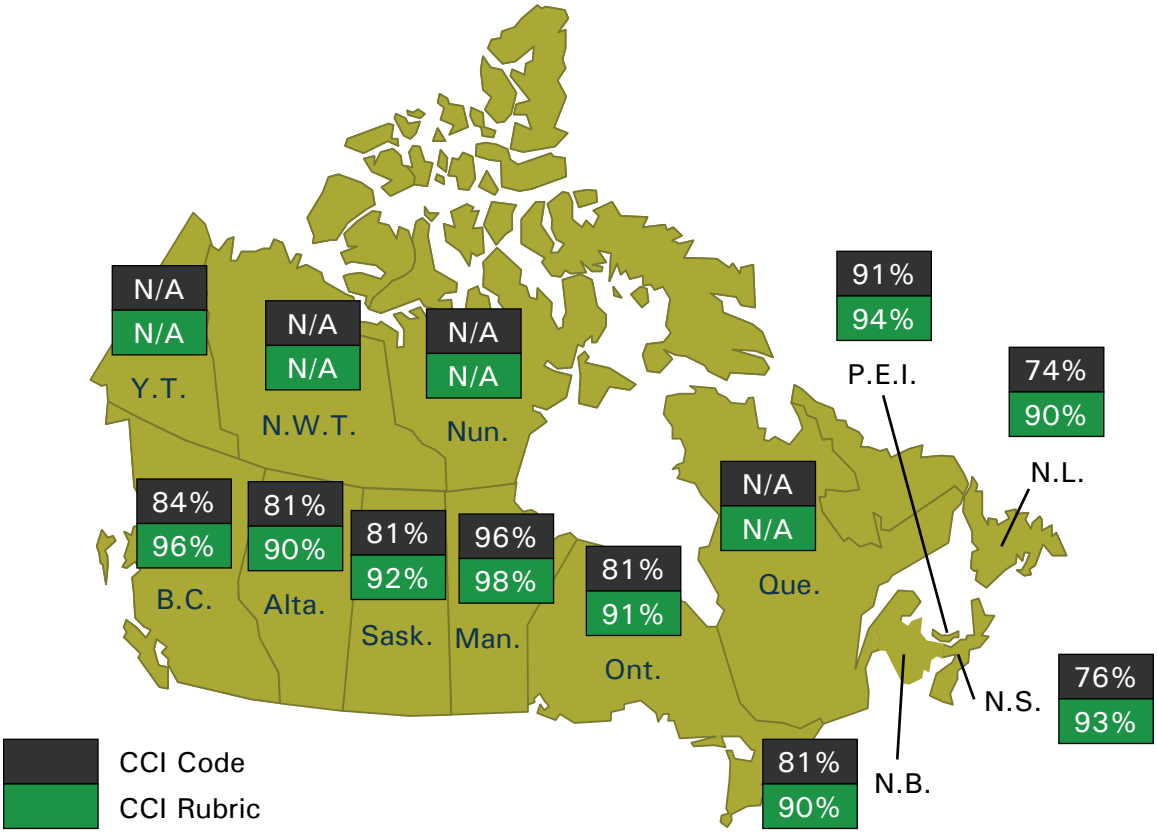
	Agreement Rate (95% CI)
CCI Code, in *N.AA.NN.AA-AA* format	**81.8** (78.0–85.6)
CCI Rubric, in *N.AA.NN* format	**92.1** (89.1–95.0)
CCI Group, in *N.AA* format	**95.6** (93.4–97.9)
CCI Block, a range of CCI groups (for example, *N.AA$_1$ to N.AA$_2$*)	**99.7** (99.3–100.0)

Notes
A: alpha character; N: numeric character; CI: confidence interval.
* See the note under Table 5 for the interventions that are included in this analysis.

3.3.4 Provincial Variation in the Consistency of Intervention Coding

The reliability of CCI codes varied between the provinces (Figure 7). Agreement was highest in Manitoba, where 96% of the interventions matched on the full CCI code. Agreement on the intervention rubric was 90% or higher in all provinces, with Manitoba again being the prominent jurisdiction with agreement on the code rubric observed for 98% of the interventions.

Figure 7 CCI Code Agreement Rates for Interventions,* by Province



Notes
N/A: not available.
* See the note under Table 5 for the interventions that are included in this analysis.

3.4 Consistency in Diagnosis Typing and the Assignment of Significance

A diagnosis type accompanies every ICD-10-CA code on the DAD abstract. It is used to indicate the relationship of a diagnosis to the patient's stay in a hospital as evidenced in the physician's documentation.[6] Diagnosis typing is an important component of the DAD abstract for differentiating conditions which have an impact on the patient's length of stay or resource utilization, otherwise known as *significant diagnoses*. Significant diagnoses include the patient's most responsible diagnosis (type M), pre-admission comorbid conditions (type 1), post-admission comorbid conditions (type 2) and service transfer diagnoses (types W, X or Y).

Table 10 presents the study findings on the reliability of diagnosis typing for those conditions that were reported to DAD as significant. The study found that chart documentation supported the typing for 66% of the significant diagnoses reported to DAD; another 9% of diagnoses changed type following the chart review but the diagnosis remained significant. For the other 25% of diagnoses, reabstractors could not locate documentation to support typing the diagnosis as significant or they could not find any reference to the diagnosis in the chart. The reliability of diagnosis typing varies among the different types; the lowest agreement rates were for pre- and post-admit comorbidities. The low agreement rate for pre-admit comorbidities is of particular interest due to the high volume of these types of conditions reported annually to DAD. The typing of the patient's most responsible diagnosis and service transfer diagnoses had high agreement rates.

Table 10 Agreement Rates on Diagnosis Typing and the Assignment of Significance

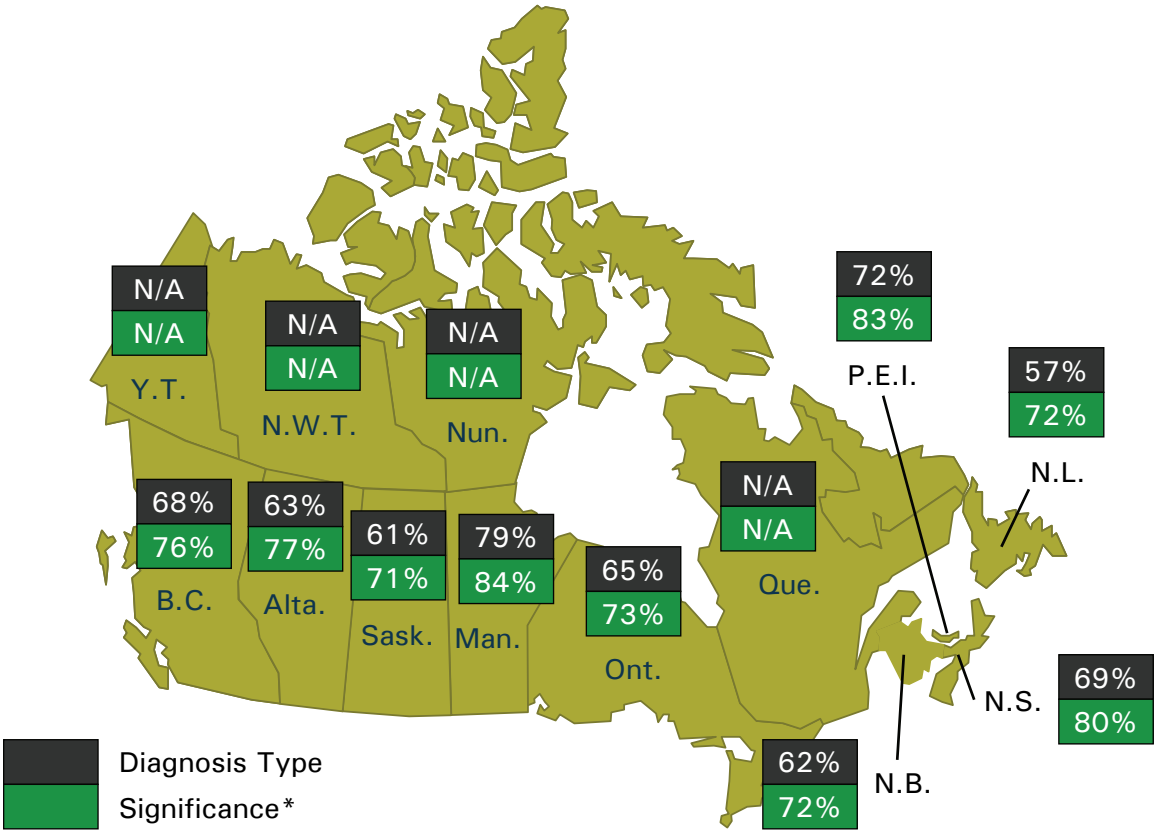
	Volume (in Thousands)	Agreement Rate (95% CI)		Disagreement Rate (95% CI)
		On Diagnosis Type	On Assignment of Significance	Reabstracted as Secondary or Not Reabstracted at All
Most Responsible Diagnosis (M)	2,329.0	**81.5** (78.6–84.4)	**88.6** (86.0–91.1)	**11.4** (8.9–14.0)
Comorbidity (Type 1 or 2)	2,142.7	**47.5** (43.7–51.3)	**59.4** (55.4–63.3)	**40.6** (36.7–44.6)
Pre-Admit Comorbidity (1)	*1,870.5*	***47.5*** *(43.3–51.7)*	***59.3*** *(55.1–63.4)*	***40.7*** *(36.6–44.9)*
Post-Admit Comorbidity (2)	*272.3*	***47.5*** *(39.7–55.3)*	***60.0*** *(52.0–68.1)*	***40.0*** *(31.9–48.0)*
Service Transfer Diagnosis (Type W, X or Y)	118.5	**82.5** (71.5–93.4)	**86.4** (75.7–97.2)	**13.6** (2.8–24.3)
All Diagnoses	**4,590.3**	**65.6** (62.9–68.3)	**74.9** (72.4–77.4)	**25.1** (22.6–27.6)

Note
CI: confidence interval.

3.4.1 Provincial Variation in the Consistency of Diagnosis Typing

Figure 8 presents the provincial-level results on diagnosis typing and the assignment of significance. Manitoba had the highest agreement rate for diagnosis typing out of all the jurisdictions.

Figure 8 Agreement Rates on Diagnosis Type and Significance, by Province



Notes

N/A: not available.

* These percentages also represent the positive predictive value of diagnoses (see Figure 4).

3.5 Reliability of the Patient's Most Responsible Diagnosis

This section examines the reliability of the ICD-10-CA code that represents the patient's most responsible diagnosis. To achieve agreement on the most responsible diagnosis, the reabstractor must confirm the presence of the condition and then agree on the assignment of both the ICD-10-CA code and the diagnosis type that labels this condition as the most responsible for the patient's stay in the hospital.

Agreement on the ICD-10-CA code for the most responsible diagnosis was observed for 64% of all acute care hospitalizations reported to DAD; agreement to the code category was 75% (Table 11). This low agreement rate illustrates the compounding effect of the inconsistencies in the diagnosis coding and typing, as well as additional data quality issues regarding the completeness of reporting diagnoses to DAD.

Table 11 ICD-10-CA Code Agreement Rate for the Most Responsible Diagnosis

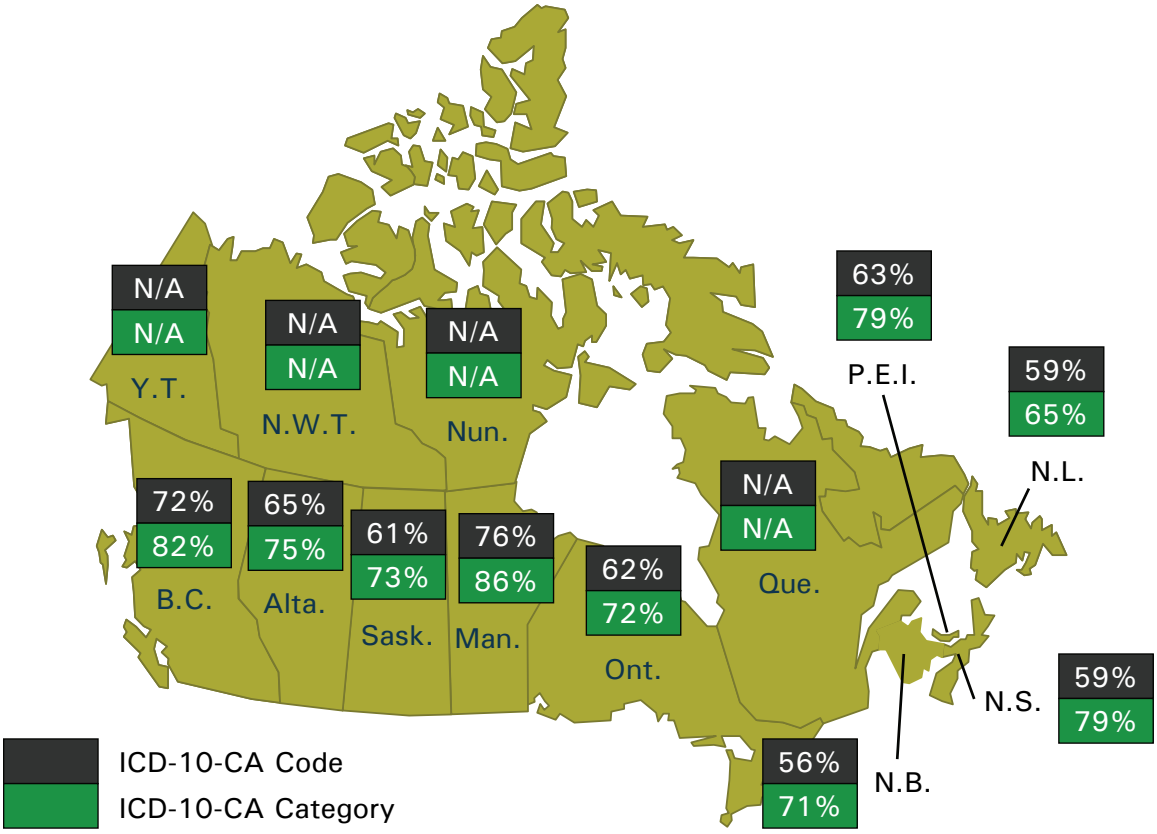
	Agreement Rate (95% CI)
ICD-10-CA Code, in *A.NN.NN* format	**64.1** (60.6–67.6)
ICD-10-CA Category, in *A.NN* format	**75.0** (71.7–78.3)
ICD-10-CA Block, a range of ICD-10-CA categories (for example, *A.NN1 to A.NN2*)	**82.9** (80.2–85.5)
ICD-10-CA Chapter, a grouping of ICD-10-CA blocks	**88.6** (86.4–90.8)

Note
A: alpha character; N: numeric character; CI: confidence interval.

3.5.1 Provincial Variation in the Reliability of the Most Responsible Diagnosis

The reliability of the most responsible diagnosis code varied between the provinces, as illustrated in Figure 9. Agreement rates were low in the Eastern regions and high in Manitoba. Agreement on the classification of most responsible diagnosis to the code category exceeded 70% in most provinces, with Manitoba achieving the highest agreement rate of 86%.

Figure 9 Agreement Rates for the Most Responsible Diagnosis, by Province



Note
N/A: not available.

3.6 Reliability of Non-Clinical Data Reported to DAD

Non-clinical data was reported with high reliability. Values reported to DAD for demographic data elements (for example, health care number, gender and date of birth) were confirmed following the chart review (100% agreement). Admission, discharge and institution data had near perfect agreement, with differences observed following the chart review for less than 1% of the records.

3.7 Summary of Findings for the Quality of DAD Data

Key findings from this chapter:

Diagnoses

- Reabstractors were not able to locate chart documentation to support the inclusion of 25% of the significant diagnoses on the DAD abstract (that is, over-reported). A similar volume of significant diagnoses was missing from the DAD abstract when documented in the patient chart (that is, under-reported).
- For significant diagnoses that were confirmed as present following the chart review, reabstractors generally agreed with ICD-10-CA codes on the DAD abstract (80% agreement) but less often agreed with the diagnosis type (65% agreement).
- Agreement on the most responsible diagnoses was observed for 64% of all acute care hospitalizations.
- Hypertensive diseases (I10 to I15) were commonly flagged as having issues with coding quality with respect to when to include this disease on the abstract as a significant condition.

Interventions

- Reabstractors were not able to locate chart documentation to support 16% of the interventions reported to DAD (that is, over-reported). A similar volume of interventions was missing from the DAD abstract when documented in the patient chart (that is, under-reported).
- For interventions that were confirmed as present following the chart review, reabstractors agreed with the CCI codes on the DAD abstract 82% of the time.

Non-Clinical Data

- All non-clinical data elements studied were reported to DAD with very high quality.

Tables 12 and 13 summarize the results presented in this chapter, including the overall and provincial-level results. Note that some jurisdictions showed significantly different results than all other jurisdictions combined for specific statistics. Cells shaded in light green indicate where provincial results were higher than the national average; cells in dark green show where provincial results were significantly higher ($p < 0.05$). Cells shaded in light yellow indicate where provincial results were lower than the national average; cells in dark yellow show where provincial results were significantly lower ($p < 0.05$). The data from Manitoba was of high quality in all the areas studied.

Table 12 Summary of Findings for Significant Diagnoses*

	Metric	Optimal Value	Can.	N.L.	P.E.I.	N.S.	N.B.	Ont.	Man.	Sask.	Alta.	B.C.
Completeness (Sensitivity) *Diagnoses identified during the chart review that were reported to DAD*	% (95% CI)	100	**76** (73–78)	**71** (63–78)	**75** (68–82)	**70** (63–77)	**65** (59–72)	**75** (71–79)	**88** (84–93)	**73** (68–78)	**79** (72–86)	**76** (71–81)
Correctness (Positive Predictive Value) *Diagnoses in DAD with supportive documentation found in the chart review*	% (95% CI)	100	**75** (72–77)	**72** (65–79)	**83** (79–88)	**80** (74–85)	**72** (67–78)	**73** (69–78)	**84** (79–88)	**71** (64–77)	**77** (71–84)	**76** (70–81)
Net Change in Volume *The difference between the volume of diagnoses identified in the chart review and the volume in DAD*	% (95% CI)	0	**-1** (-4–2)	**2** (-10–14)	**11** (1–21)	**14** (0–29)	**11** (-1–23)	**-3** (-8–3)	**-5** (-10–0)	**-3** (-11–6)	**-2** (-11–7)	**0** (-7–7)
Consistency of ICD-10-CA Coding *Significant diagnoses where the reabstractor agreed on the code assignment*												
ICD-10-CA Code Match	% (95% CI)	100	**80** (78–82)	**79** (69–89)	**79** (71–86)	**71** (63–78)	**74** (68–80)	**81** (78–84)	**86** (83–90)	**78** (73–84)	**82** (74–90)	79 (74–84)
ICD-10-CA Category Match	% (95% CI)	100	**92** (90–93)	**91** (86–96)	**94** (91–98)	**91** (87–95)	**90** (86–94)	**92** (89–94)	**96** (93–99)	**90** (85–95)	**93** (90–96)	**91** (87–94)
Consistency in Diagnosis Typing *Diagnoses where the reabstractor agreed on the diagnosis type*	% (95% CI)	100	**65** (63–68)	**57** (49–65)	**72** (65–80)	**69** (63–76)	**62** (56–68)	**65** (61–70)	**79** (74–84)	**61** (54–67)	**63** (55–71)	**68** (61–74)
Reliability of ICD-10-CA Code of the Most Responsible Diagnosis (MRDx) *Abstracts where the reabstractor agreed on the code assigned to the MRDx*												
ICD-10-CA Code Match	% (95% CI)	100	**64** (61–68)	**59** (47–71)	**63** (53–74)	**59** (49–69)	**56** (48–65)	**62** (56–68)	**76** (68–83)	**61** (53–69)	**65** (53–76)	**72** (65–78)
ICD-10-CA Category Match	% (95% CI)	100	**75** (72–78)	**65** (53–77)	**79** (71–88)	**79** (71–86)	**71** (64–78)	**72** (67–78)	**86** (80–92)	**73** (66–80)	**75** (65–85)	**82** (76–88)

Notes

* See the note under Table 4 for diagnoses that are included in this analysis. Light yellow cells indicate results that are lower than the national average; dark yellow cells indicate where these differences are statistically significant ($p<0.05$). Light green cells indicate results that are higher than the national average; dark green cells indicate where these differences are statistically significant ($p<0.05$). Cells not shaded in the row Net Change in Volume.

Table 13 Summary of Findings for Interventions*

	Metric	Optimal Value	Can.	N.L.	P.E.I.	N.S.	N.B.	Ont.	Man.	Sask.	Alta.	B.C.
Completeness (Sensitivity) *Interventions identified during the chart review that were reported to DAD*	% (95% CI)	100	**84** (77–90)	**79** (63–95)	**72** (57–88)	**79** (70–89)	**78** (69–88)	**87** (84–91)	**98** (96–100)	**86** (79–93)	**70**† (45–94)	**91** (85–97)
Correctness (Positive Predictive Value) *Interventions in DAD with supportive documentation found in the chart review*	% (95% CI)	100	**85** (81–89)	**90** (80–100)	**92** (85–99)	**84** (72–96)	**88** (81–95)	**81** (75–86)	**97** (94–100)	**84** (77–92)	**84** (70–98)	**95** (91–98)
Net Change in Volume *The difference between the volume of interventions identified in the chart review and the volume reported to DAD*	% (95% CI)	0	**2** (-7–10)	**15** (-8–37)	**28** (3–52)	**6** (-14–27)	**12** (-4–28)	**-8** (-15–0)	**-1** (-4–2)	**-2** (-12–8)	**21**† (-5–46)	**4** (-3–12)
Consistency of CCI Coding *Interventions where the reabstractor agreed on the code assignment*												
CCI Code Match	% (95% CI)	100	**82** (78–86)	**74** (55–92)	**91** (82–99)	**76** (65–87)	**81** (71–91)	**81** (74–87)	**96** (92–100)	81 (70–91)	**81** (72–91)	**84** (76–91)
CCI Rubric Match	% (95% CI)	100	**92** (89–95)	**90** (78–100)	**94** (86–100)	**93** (85–100)	**90** (83–98)	**91** (86–96)	**98** (95–100)	**92** (86–99)	**90** (80–99)	96 (92–99)

Notes

* See the note under Table 5 for interventions that are included in this analysis. Light yellow cells indicate results that are lower than the national average; dark yellow cells indicate where these differences are statistically significant ($p<0.05$). Light green cells indicate results that are higher than the national average; dark green cells indicate where these differences are statistically significant ($p<0.05$). Cells not shaded in the row Net Change in Volume.

† The high variance for this estimate arises from a small number of records that differ from the mean and have large study design weights.

4 Quality of Coding for Select Health Conditions and Interventions

This chapter focuses on the study's second objective, *to evaluate the quality of coding ambulatory care sensitive conditions, hip replacements and percutaneous coronary interventions at the national level*. These conditions and interventions are of particular focus in this study as they are used to measure health system performance and community and health system characteristics.

The analysis presented in this chapter utilizes the methodology developed for the *Health Indicators 2006* report for identifying hospitalizations for these conditions and interventions.[vi]

4.1 Ambulatory Care Sensitive Conditions

Ambulatory care sensitive conditions (ACSCs) are "conditions where appropriate ambulatory care may prevent or reduce the need for hospitalization. While not all admissions for these conditions are avoidable, appropriate ambulatory care in the community could prevent the onset of this type of condition, control acute episodic illness or manage a chronic condition."[2] Hospitalization rates of ACSCs are used as a measure of health system performance and were the focus of *Health Indicators 2008*, a report jointly published by CIHI and Statistics Canada.

The methodology for identifying an ACSC hospitalization requires that any one of the following be coded as the most responsible diagnosis:

- Chronic obstructive pulmonary disease
- Heart failure and pulmonary edema
- Angina
- Diabetes
- Hypertension
- Grand mal status and other epileptic convulsions
- Asthma

vi. Appendix A provides full details on the 2006 methodology. See www.cihi.ca/indicators for changes that have since been made to this methodology in subsequent releases of the *Health Indicators* reports.

To assess the quality of identifying an ACSC hospitalization, the completeness and correctness of the clinical data used to identify these hospitalizations were examined. For data completeness, sensitivity was calculated. Of all ACSC hospitalizations identified during the chart review, 87% were similarly identified in DAD. For data correctness, positive predictive value was calculated. Here, of all acute care ACSC hospitalizations in DAD, 86% were confirmed following the chart review. These results for sensitivity and positive predictive value indicate that the method for identifying ACSC hospitalizations provides complete and correct information on this aspect of Canada's overall health system performance. However, there are some areas where the methodology was more prone to misclassifications. For example, the positive predictive value for angina was significantly lower ($p < 0.05$) than chronic obstructive pulmonary disease, diabetes, epilepsy and asthma. That is, there are more issues of over-representation for ACSC hospitalizations for angina than there are for these other conditions.

Table 14 Positive Predictive Value and Sensitivity of ACSC Hospitalizations

	Volume (in Thousands)		Sensitivity† (95% CI)	Positive Predictive Value‡ (95% CI)
	DAD Data	Study Data		
Any ACSC Hospitalization*	**165.1**	**162.9**	**87 (84–90)**	**86 (83–89)**
Chronic Obstructive Pulmonary Disease	48.9	49.7	**86** (81–91)	**87** (80–94)
Heart Failure and Pulmonary Edema	40.3	39.1	**84** (78–90)	**82** (75–88)
Angina	25.9	23.5	**80** (68–91)	**72** (65–80)
Diabetes	20.9	21.2	**86** (78–94)	**87** (80–94)
Hypertension	5.3	5.3	**74** (62–86)	**75** (64–86)
Epilepsy	7.2	7.1	**89** (82–95)	**88** (82–93)
Asthma	16.6	17.0	**87** (79–95)	**90** (85–95)

Notes

CI: confidence interval.

* This analysis was performed on all patient hospitalizations and was not restricted based upon patient's age.

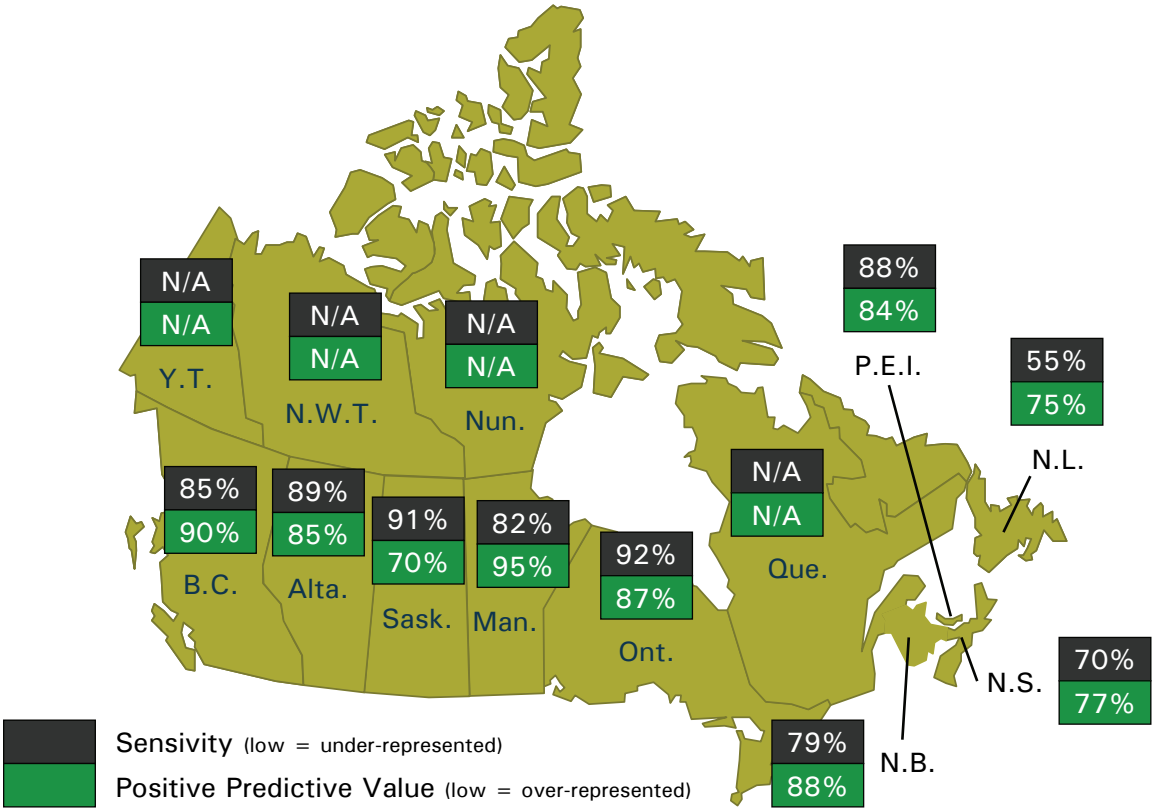
† Low sensitivity values indicate potential under-representation of ACSC hospitalizations in DAD.

‡ Low positive predictive values indicate potential over-representation of ACSC hospitalizations in DAD.

4.1.1 Provincial Variation in the Reliability in Identifying ACSC Hospitalizations

There was some variation in these results at the provincial level, as illustrated in Figure 10. Three provinces had results that differed from the other provinces combined ($p < 0.05$). In Newfoundland and Labrador, one in every two ACSC hospitalizations (55%) identified during the chart review was not similarly identified using DAD data. This sensitivity result is significantly lower than the rate of the other provinces combined. In contrast, Ontario reported ACSC hospitalizations more completely than the other jurisdictions. When assessing correctness in identifying an ACSC hospitalization, Manitoba had better results than the other jurisdictions combined. Almost all ACSC hospitalizations identified in DAD from this province were confirmed as an ACSC following the chart review.

Figure 10 Reliability in Identifying ACSC Hospitalizations Using DAD Data, by Province



4.2 Hip Replacements

Hospitalization rates for hip replacements are used to describe community and health system characteristics. Hip replacement surgery has the potential to result in considerable improvement in functional status and pain relief, as well as other gains in health-related quality of life. Statistics on hip replacements are included in reports produced by CIHI's Canadian Joint Replacement Registry; hip fractures and replacements were also the focus of *Health Indicators 2007*.[7, 8]

To assess the reliability of the clinical data used to identify a hospitalization for hip replacement surgery, sensitivity and positive predictive values were calculated. Table 15 presents this analysis. Overall, DAD contains complete and reliable information on the hip replacements performed in Canada, though the lower sensitivity result suggests possible issues with the completeness of reporting this intervention to DAD. The sample was insufficient to perform meaningful analysis at the provincial level; no statistically significant variation ($p < 0.05$) in these results was observed between the provinces.

Table 15 Coding Quality of Hip Replacements

	Volume (in Thousands)		Sensitivity† (95% CI)	Positive Predictive Value‡ (95% CI)
	DAD Data	Study Data		
Hip Replacement Surgery*	23.6	25.2	**89** (73–100)§	**95** (93–98)

Notes

CI: confidence interval.

* This analysis was performed on all patient hospitalizations and was not restricted based upon patient's age.

† Low sensitivity values indicate potential under-representation in DAD.

‡ Low positive predictive values indicate potential over-representation in DAD.

§ The high variance for this estimate arises from a small number of records that differ from the mean and have large study design weights.

4.3 Percutaneous Coronary Interventions

Hospitalization rates for percutaneous coronary interventions often complement rates of coronary artery bypass grafts, both of which are techniques used to improve blood flow to the heart muscle. In many cases, a percutaneous coronary intervention serves as a non-surgical alternative to coronary artery bypass graft surgery and is undertaken for the purpose of opening obstructed coronary arteries. While percutaneous coronary interventions encompass several techniques, angioplasty is the procedure most frequently provided. Percutaneous coronary interventions are used to describe hospital performance in CIHI's *Hospital Reports* and were introduced to the *Health Indicators* report series in 2006.[9, 10] The methodology for identifying these hospitalizations considers patients in acute care hospitals, same-day surgery facilities or catheterization laboratories.

To assess the reliability of the inpatient data used to identify a percutaneous coronary intervention, sensitivity and positive predictive values were calculated for each of the intervention codes used in the health indicator methodology. Table 16 presents this analysis. Overall, DAD contains complete and reliable information on the percutaneous coronary interventions performed in Canada, though the lower sensitivity result suggests possible issues with the completeness of reporting this intervention to DAD. The sample was insufficient to perform meaningful analysis at the provincial level; no statistically significant variation ($p < 0.05$) in these results was observed between the provinces.

Table 16 Coding Quality of Percutaneous Coronary Interventions (Inpatient Data Only)

	Volume (in Thousands)		Sensitivity† (95% CI)	Positive Predictive Value‡ (95% CI)
	DAD Data	Study Data		
Percutaneous Coronary Intervention*	28.9	31.5	**89** (82–96)§	**97** (95–99)

Notes

CI: confidence interval.

* This analysis was performed on all patient hospitalizations and was not restricted based upon patient's age.

† Low sensitivity values indicate potential under-representation in DAD.

‡ Low positive predictive values indicate potential over-representation in DAD.

§ The high variance for this estimate arises from a small number of records that differ from the mean and have large study design weights.

4.4 Summary of Findings for the Coding Quality of Select Heath Conditions and Interventions

Hospitalizations for ambulatory care sensitive conditions were generally well represented in DAD, although the reliability of this indicator was low in Newfoundland and Labrador. This is related to issues with the coding quality of the most responsible diagnosis for this province, a topic previously discussed in Section 3.5.

The health indicators for hip replacements and percutaneous coronary interventions were minimally affected by coding quality issues.

5 Quality of Case-Mix Grouping Variables

This chapter focuses on the study's third objective, *to assess the impact of any observed coding variation on measures of hospital output and resource utilization*. These measures are derived from CIHI's case-mix grouping methodology.

Case-mix grouping methodologies categorize patients into statistically and clinically homogeneous groups based on various clinical and administrative data. Adjusting for patients of different levels of acuity forms the basis for health care organization comparisons and case mix–adjusted resource utilization (www.cihi.ca/casemix). Case Mix Group resource indicators include expected length of stay (ELOS) and Resource Intensity Weight (RIW).

This analysis focuses on the CMG/PIx 2003 grouping methodology.[vii, 11]

5.1 Reliability of Grouping Hospitalizations Into Major Clinical Categories and Case Mix Groups

There are 25 major clinical categories (MCCs) that identify either a body system or a specific type of clinical problem. The patient's most responsible diagnosis generally determines assignment to a major clinical category. Within each major clinical category there is a surgical and medical partition for Case Mix Group (CMG) assignment. Case Mix Groups categorize patients into one of 478 clusters based on clinical diagnoses, procedures and resource utilization. Surgical Case Mix Groups are determined by the presence of an operative procedure; otherwise, the case is assigned to the medical partition.

Table 17 summarizes the overall reliability of major clinical categories and Case Mix Groups. A total of 91% of the hospitalizations in DAD remained within the same major clinical category when subsequently grouped using the data obtained during the chart review. The same statistic for Case Mix Groups was slightly lower at 79%, with both the medical and surgical partitions for Case Mix Group assignment having similar results.

Table 17 Agreement Rates on Major Clinical Category and Case Mix Group

	Positive Predictive Value (95% CI)
Major Clinical Category	**90.8** (88.7–92.8)
Case Mix Group	**79.4** (76.5–82.4)

Note
CI: confidence interval.

vii. The CMG/PIx 2003 grouping methodology is the predecessor of the new CMG+ grouping methodology.[12] The reliability of the CMG+ grouping variables is assessed in the subsequent DAD reabstraction studies; CMG+ was not yet implemented for the fiscal year of data assessed in this report.

Certain major clinical categories and Case Mix Groups had very high reliability when using DAD data, while others had lower reliability. Tables 18 and 19 illustrate this variation; it is important to note that only those Case Mix Groups with a sufficient sample could be assessed and that this analysis is not exhaustive. Table 18 shows the percent of DAD hospitalizations that were grouped to the same major clinical category or Case Mix Group when using data collected in the chart review. Perfect or near-perfect agreement was observed for five major clinical categories (15, 14, 7, 5 and 6). Two Case Mix Groups (352 and 022) were also very reliable.

Table 18 Major Clinical Categories and Case Mix Groups With High Agreement Rates*

	Volume in DAD (in Thousands)	**Positive Predictive Value** (95% CI)
Major Clinical Categories		
15—Newborns and Other Neonates With Condition Originating in the Perinatal Period	280.3	**100** (100–100)
14—Pregnancy and Childbirth	293.0	**100** (99–100)
7—Diseases and Disorders of the Hepatobiliary System and Pancreas	59.2	**96** (92–100)
5—Diseases and Disorders of the Circulatory System	261.9	**96** (94–98)
6—Diseases and Disorders of the Digestive System	213.3	**95** (92–98)
Case Mix Groups		
352—Hip Replacement	21.1	**99** (99–100)
022—Seizure and Headache	18.4	**96** (93–99)

Notes

CI: confidence interval.

* To be considered for this analysis, the study sample had to contain a minimum of 100 records assigned to the major clinical category or Case Mix Group in the DAD data and a lower limit on the confidence interval for the positive predictive value greater than 90%.

Table 19 presents the same analysis, but lists major clinical categories and Case Mix Groups with low agreement rates. Cases assigned to major clinical category "Other reasons for hospitalization" were grouped to more specific categories when the data from the chart review was used. Case Mix Groups with low agreement rates are also listed.[viii]

Table 19 Major Clinical Categories and Case Mix Groups With Low Agreement Rates*

	Volume in DAD (in Thousands)	Positive Predictive Value (95% CI)
Major Clinical Categories		
23—Other Reasons for Hospitalization	71.2	**60** (40–79)
Case Mix Groups		
188—Percutaneous Transluminal Coronary Angioplasty With Complicating Cardiac Conditions	10.0	**41** (32–50)
235—Angina Pectoris	6.2	**56** (40–73)
140—Chronic Obstructive Pulmonary Disease	20.9	**64** (54–74)

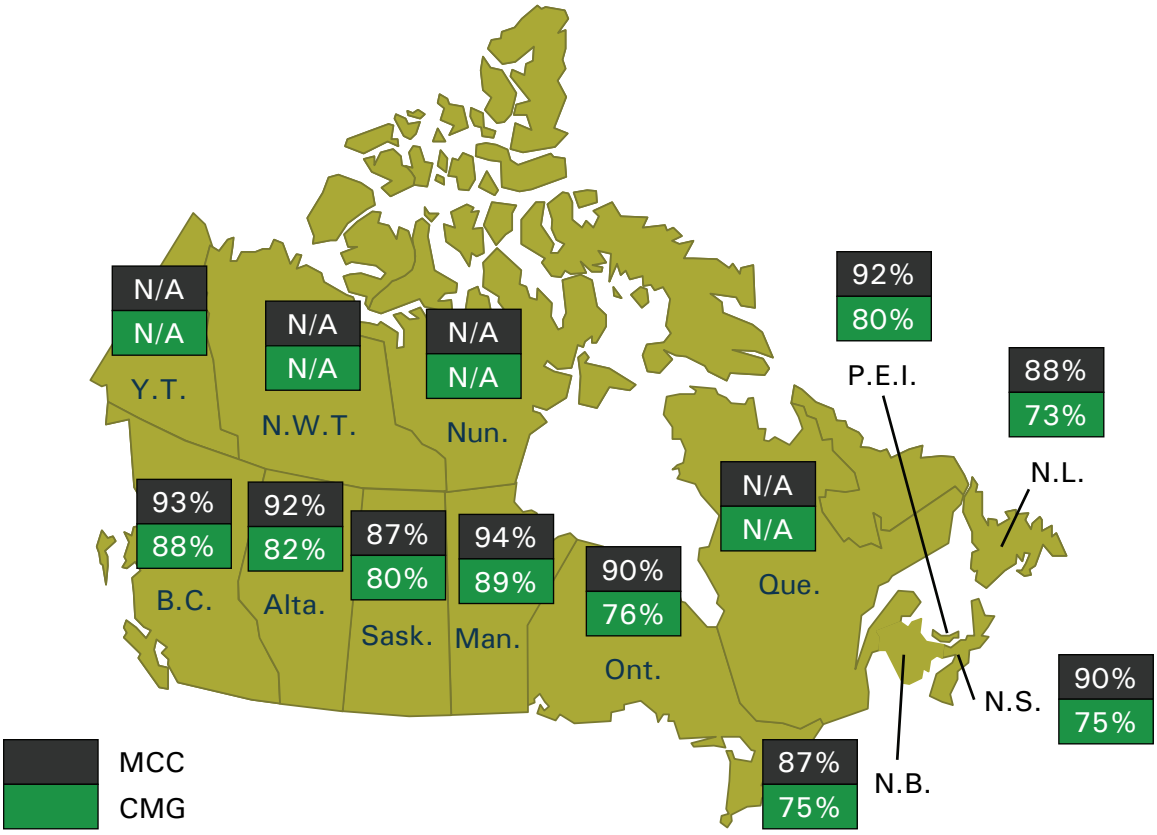
Notes
CI: confidence interval.
* To be considered for this analysis, the study sample had to contain a minimum of 100 records assigned to the major clinical category or Case Mix Group in the DAD data and an upper limit on the confidence interval for the positive predictive value less than 80%.

5.1.1 Provincial Variation in the Reliability of Major Clinical Category and Case Mix Group Assignment

Figure 11 presents the positive predictive values of these case-mix variables for each of the provinces. The reliability of major clinical category was similar among the provinces; none of the differences was statistically significant ($p<0.05$). However, the reliability of Case Mix Group assignment differed between some jurisdictions ($p<0.05$): British Columbia and Manitoba had higher positive predictive values (less over-reporting) than Ontario and New Brunswick; Manitoba's positive predictive value was also higher than Nova Scotia's.

viii. Appendix C presents this analysis for *all* major clinical categories and Case Mix Groups where there was a sufficient sample and is not restricted to those with particularly high or low results.

Figure 11 Reliability of Major Clinical Category and Case Mix Group Assignment, by Province



5.2 Reliability of the Complexity Overlay to Hospitalizations

CIHI's Case Mix Group Complexity Overlay is intended to enhance the prediction of resource utilization in acute care. It identifies diagnoses in DAD, over and above the main diagnoses, for which prolonged length of stay and/or more costly treatment could reasonably be expected. These additional diagnoses are then used to further subdivide a Case Mix Group into four subgroups. These subgroups contain a more homogeneous aggregation of patients with regards to length of stay and resource use than the Case Mix Group as a whole.

The reliability of Complexity Overlay to hospitalizations varied among the complexity levels initially assigned. Ninety percent of the hospitalizations that were grouped to no complexity, or level 1, remained grouped to that complexity when using the data obtained from the chart review. The same was true for 96% of the hospitalizations where complexity was not applied, or level 9. Complexity levels assigned to more complicated hospitalizations, that is, those related to chronic conditions (level 2), serious or important conditions (level 3) or potentially life-threatening conditions (level 4), had lower agreement rates. Table 20 presents the agreement rates for all complexity levels.

Table 20 Reliability of the Complexity Level Assigned to Hospitalizations

	Positive Predictive Value (95% CI)
Overall Agreement Rate on Complexity Level	**87 (85–89)**
Level 1—No Complexity	**90** (88–93)
Level 2—Complexity Related to Chronic Condition(s)	**49** (38–59)
Level 3—Complexity Related to Serious/Important Condition(s)	**39** (20–59)
Level 4—Complexity Related to Potentially Life-Threatening Condition(s)	**60** (45–75)
Level 9—Complexity Not Applied	**96** (93–99)

Note
CI: confidence interval.

Complexity levels 2, 3 and 4 were often grouped to lower complexity levels when using the data obtained during the chart review. For example, 39% of the cases originally assigned to complexity level 2 were assigned to complexity level 1 when regrouped using the data from the chart review. Table 21 provides the full analysis. Note that most hospitalizations were originally assigned to complexity levels 1 or 9 in terms of volume, and these complexity levels had very high agreement rates.

Table 21 Comparison of Complexity Level Assigned When Using DAD Data and Chart Review Data

Complexity Level Using DAD Data	Volume (in Thousands)	Complexity Level Using Data From Chart Review				
		Level 1	Level 2	Level 3	Level 4	Level 9
Level 1	1,291.9	**90%**	5%	3%	0%	1%
Level 2	143.0	39%	**49%**	9%	3%	0%
Level 3	78.3	24%	28%	**39%**	8%	0%
Level 4	59.2	7%	7%	26%	**60%**	1%
Level 9	756.8	3%	1%	0%	0%	**96%**

Changes in complexity assignment were examined for each province; all provinces had similar results to those presented above.

As the purpose of applying a complexity level to a hospitalization is to further subdivide a Case Mix Group into four subgroups, subsequent analysis was performed to assess if this subdivision was more reliable in certain Case Mix Groups than others. It is important to note that most Case Mix Groups had an insufficient sample in this study to allow this analysis, so the following is intended to illustrate the relationship between the Case Mix Group and the reliability of its associated complexity level assignment.

Table 22 lists five Case Mix Groups that have *high* reliability in assigning complexity level. Table 23 lists two Case Mix Groups with *low* reliability in assigning complexity level.[ix]

Table 22 Case Mix Groups With High Agreement on Complexity Overlay*

Case Mix Group	Volume in DAD (in Thousands)	Percent With No Change in Complexity Overlay When Using Chart Review Data (95% CI)
235—Angina Pectoris	6.2	**100** (100–100)
146—Asthma	16.4	**95** (91–99)
233—Hypertension (may not require hospitalization)	5.0	**93** (85–100)
213—Unstable Angina Without Cardiac Catheter Without Specified Cardiac Conditions	16.4	**92** (87–97)
352—Hip Replacement	21.1	**91** (88–95)
142—Chronic Bronchitis	27.1	**86** (80–92)

Notes
CI: confidence interval.
* To be considered for this analysis, the study sample had to contain a minimum of 100 records assigned to the Case Mix Group in the DAD data and a lower limit on the confidence interval for the agreement rate greater than 80%.

Table 23 Case Mix Groups With Low Agreement on Complexity Overlay*

Case Mix Group	Volume in DAD (in Thousands)	Percent With No Change in Complexity Overlay When Using Chart Review Data (95% CI)
188—Percutaneous Transluminal Coronary Angioplasty With Complicating Cardiac Conditions	10.0	**43** (34–52)
222—Heart Failure	45.6	**68** (60–75)
189—Percutaneous Transluminal Coronary Angioplasty Without Complicating Cardiac Conditions	17.6	**69** (61–76)

Notes
CI: confidence interval.
* To be considered for this analysis, the study sample had to contain a minimum of 100 records assigned to the Case Mix Group in the DAD data and an upper limit on the confidence interval for the agreement rate less than 80%.

ix. Appendix C presents this analysis for *all* Case Mix Groups where there was a sufficient sample and is not restricted to those with particularly high or low results.

5.3 Reliability of the Patient's Expected Length of Stay

Expected length of stay is the average "typical" acute length of stay for various types of patients based on data found in DAD. Expected length of stay is adjusted for complexity and age if the adjustments show an improved accuracy of length of stay. There is an expected length of stay associated with each combination of Case Mix Group and complexity assignment.

Expected length of stay values assigned to hospitalizations using DAD data were compared to the values assigned when grouped using data obtained from the chart review. Almost three-quarters (73%) of the cases had no change in the expected length of stay, as illustrated in Table 24. Expected lengths of stay that were less than two days showed the highest reliability; 91% of these hospitalizations had exact agreement on the expected length of stay when using data from the chart review. Hospitalizations with longer expected lengths of stay tended to have lower agreement rates, even when allowing some amount of variation. Only 63% of the hospitalizations with expected lengths of stay of six days or longer remained within 25% of their original expected lengths of stay when using data obtained from the chart review.

Table 24 Reliability of Expected Length of Stay, by Number of Days

Expected Length of Stay	Volume in DAD (in Thousands)	Proportion With No Change in ELOS When Using Chart Review Data (95% CI)	Proportion With Change in ELOS ≤25% When Using Chart Review Data (95% CI)
1.0 to 1.9 Days	513.7	**91** (87–96)	**92** (88–97)
2.0 to 2.9 Days	463.1	**74** (65–83)	**84** (77–92)
3.0 to 3.9 Days	295.2	**82** (76–88)	**88** (83–92)
4.0 to 4.9 Days	242.8	**73** (66–81)	**80** (73–88)
5.0 to 5.9 Days	215.9	**74** (68–80)	**82** (77–88)
6.0 Days or Longer	598.6	**52** (46–59)	**63** (57–70)
Total Acute Care Hospitalizations	**2,329.2**	**73 (70–76)**	**81 (78–83)**

Note
CI: confidence interval; ELOS: expected length of stay.

Agreement rates on expected length of stay were found to vary significantly among the provinces; agreement rates in Manitoba and British Columbia were higher than the rates in New Brunswick, Nova Scotia and Ontario. These findings correspond with the provincial variation in the agreement of Case Mix Group (see Figure 11).

5.4 Reliability of the Patient's Resource Intensity Weight

Resource Intensity Weight is a relative value derived using patient-specific cost data. It is calculated based on the service recipient cost data provided by the Ontario Case Cost Initiative, the Alberta Costing Partnership and the Fraser Health Region in British Columbia. This derived variable is used to provide a measure of the resource use of a patient relative to the average cost of patient hospitalization in the cost data, including that from hospitals that do not collect cost data. There is a Resource Intensity Weight associated with each combination of Case Mix Group, age and complexity assignment.

Resource Intensity Weights assigned to hospitalizations using the original DAD submissions were compared to the values assigned when grouped using data obtained from the chart review. In almost three-quarters (73%) of the cases, the Resource Intensity Weight remained unchanged. Table 25 provides further details. Hospitalizations with smaller Resource Intensity Weights had higher agreement rates than those with larger Resource Intensity Weights. For example, Resource Intensity Weights that were less than 0.5000 were more reliable than those that were greater than 1.0000. This finding is somewhat expected, as charts with higher Resource Intensity Weights represent more complex patients who present with more diagnoses and require more interventions. There is more potential for coding errors to occur for these patients when compared to patients who present with less complicated health conditions.

Although the more complex hospitalizations had lower agreement rates in Resource Intensity Weight, the weights derived using the chart review data were often similar in magnitude. For example, only half (52%) of the hospitalizations with Resource Intensity Weights of 2.5000 or higher had exact agreement on these values, but three-quarters (78%) had values that changed by no more than 25%.

Table 25 Reliability of Resource Intensity Weight, by Magnitude of Weight

Resource Intensity Weight	Volume in DAD (in Thousands)	Proportion With No Change in RIW When Using Chart Review Data (95% CI)	Proportion With Change in RIW ≤25% When Using Chart Review Data (95% CI)
0.0001 to 0.2499	205.9	**90** (80–100)	**92** (82–100)
0.2500 to 0.4999	363.9	**86** (81–90)	**93** (90–96)
0.5000 to 0.7499	582.9	**77** (71–83)	**89** (85–92)
0.7500 to 0.9999	362.4	**76** (67–84)	**84** (77–92)
1.0000 to 1.4999	292.7	**62** (54–69)	**76** (70–82)
1.5000 to 2.4999	312.6	**60** (51–70)	**69** (59–79)
2.5000 and Higher	208.8	**52** (41–64)	**78** (71–85)
Total Acute Care Hospitalizations	**2,329.2**	**73 (70–76)**	**84 (81–86)**

Note
CI: confidence interval; RIW: Resource Intensity Weight.

Agreement rates on Resource Intensity Weight were found to vary significantly among the provinces; agreement rates in Manitoba and British Columbia were higher than the rates in New Brunswick, Nova Scotia and Ontario. These findings correspond with the provincial variation in the agreement of Case Mix Group (see Figure 11).

5.5 Summary of Findings for Case-Mix Grouping Variables

The impact of the observed discrepancies in the coding of diagnoses and interventions affected the output variables from CIHI's grouping methodology in the following ways:

- Discrepancies in the assignment of the patient's most responsible diagnosis affected the grouping of patients to major clinical categories for 9% of the hospitalizations in DAD.
- Discrepancies in the coding of diagnoses and interventions affected the assignment of Case Mix Group for about 20% of the hospitalizations.
- Discrepancies associated with diagnosis typing and the completeness of reporting diagnoses to DAD affected the Complexity Overlay assigned to 13% of the hospitalizations. High agreement rates in Complexity Overlay were observed for level 1 cases (90% agreement) and level 9 cases (96% agreement).
- Three-quarters (73%) of all inpatient hospitalizations had no change in expected length of stay or Resource Intensity Weight. Agreement rates for these derived variables were lower for more complex patients who presented with more diagnoses and required more interventions. There is more potential for coding errors to occur for these patients when compared to patients who present with less complicated health conditions.

6 Discussion of Coding Issues

This chapter focuses on the study's fourth objective, *to identify coding issues that arise as a result of any observed coding variation*. The coding issues listed below are based on observations from the reabstractors following their chart reviews.

The main contributors to the incomplete and over-reporting of diagnoses and interventions to DAD were similar to the main contributors to the coding inconsistencies with ICD-10-CA and CCI.

- *Coders at the hospital were not always complying with directives from the Canadian Coding Standards*, resulting in incomplete collection of significant diagnoses on the DAD abstract, while at other times this non-compliance led to significant diagnoses being included on the DAD abstract when they did not impact the patient's length of stay or resource utilization. Non-compliance to coding directives also resulted in inconsistencies in the ICD-10-CA and CCI codes originally reported to DAD compared to the codes selected by the reabstractors.
- *The inability to locate critical information in the patient chart introduced errors.* Incomplete reporting to DAD was frequently due to coders at the hospital missing key information that was documented in the chart. Reabstractors also suspected that some interventions and diagnoses reported to DAD were likely an accurate reflection of the patient's stay in the hospital, but they were unable to confirm their presence during the chart review.
- *The documentation in the patient chart lacked clarity and could lead to different interpretations* of the significance of a diagnosis on the patient's length of stay or resource utilization or whether certain interventions were performed during the patient's stay at the hospital. Unclear documentation also led to different interpretations of which ICD-10-CA code best described the diagnosis or which CCI code best described the interventions performed.
- *Coders at the hospital were not always following coding instructions that are embedded within the ICD-10-CA and CCI products.* Coders were not using these CIHI tools when they were completing the DAD abstract, or they were not applying the directives as intended by CIHI.

6.1 Inter-Rater Reliability Analysis

To assess the degree of coding consistency that could be reasonably achieved given the present coding environment, the inter-rater reliability results were examined. ICD-10-CA and CCI code assignment showed improved coding consistency between reabstractors. Also, there was improved consistency in the inter-rater reliability study in code selection for the patient's most responsible diagnosis. However, reabstractors remained *inconsistent* in determining which diagnoses to report as significant conditions and which interventions to include on the abstract. This latter finding suggests that the issues noted above for the under- and over-reporting of clinical data to DAD also were a hindrance to reabstractors with respect to reporting diagnoses and interventions.

7 Conclusion

7.1 Summary of Findings

Diagnoses

- Reabstractors were not able to locate chart documentation to support the inclusion of 25% of the significant diagnoses on the DAD abstract (that is, over-reported). A similar volume of significant diagnoses was missing from the DAD abstract when documented in the patient chart (that is, under-reported).
- For significant diagnoses that were confirmed as present following the chart review, reabstractors generally agreed with ICD-10-CA codes on the DAD abstract (80% agreement) but less often agreed with the diagnosis type (65% agreement).
- Agreement on the most responsible diagnoses was observed for 64% of all acute care hospitalizations.
- Hypertensive diseases (I10 to I15) were commonly flagged as having issues with coding quality with respect to when to include this disease on the abstract as a significant condition.

Interventions

- Reabstractors were not able to locate chart documentation to support 16% of the interventions reported to DAD (that is, over-reported). A similar volume of interventions was missing from the DAD abstract when documented in the patient chart (that is, under-reported).
- For interventions that were confirmed as present following the chart review, reabstractors agreed with the CCI codes on the DAD abstract 82% of the time.

Non-Clinical Data

- All non-clinical data elements studied were reported to DAD with very high quality.

Provincial Highlights

- Data from Manitoba was of high quality in all areas studied.

Health Indicators

- Hospitalizations for ambulatory care sensitive conditions were generally well represented in DAD, although the reliability of this indicator was low in Newfoundland and Labrador.
- In general, the health indicators for hip replacements and percutaneous coronary interventions were minimally affected by coding quality issues.

Case Mix Grouping Variables

- Discrepancies in the assignment of the patient's most responsible diagnosis affected the grouping of patients to major clinical categories for 9% of the hospitalizations.
- Discrepancies in the coding of diagnoses and interventions affected the assignment of Case Mix Group for about 20% of the hospitalizations.

- Discrepancies associated with diagnosis typing and the completeness of reporting diagnoses to DAD affected the Complexity Overlay assigned to 13% of the hospitalizations. Lower agreement rates were observed for higher complexity levels.
- Three-quarters (73%) of all inpatient hospitalizations had no change in expected length of stay or Resource Intensity Weight. Agreement rates for these derived variables were lower for more complex patients who presented with more diagnoses and required more interventions.

Coding Issues

- Coders who are capturing data for DAD are not always complying with the Canadian Coding Standards and other directives offered through the ICD-10-CA and CCI products.
- The documentation in the patient chart lacked clarity and/or organization and led to differences in the clinical data recorded on the DAD abstract as well as different selections of ICD-10-CA codes to describe the diagnosis or CCI codes to describe the interventions performed.
- These same coding issues also affected the reabstractors' ability to code consistently with one another.

7.2 Considerations for Improving Coding Quality

Initiatives to enhance the information and data quality of DAD need to be a shared responsibility between physicians who record patient information in the health record, coders who extract patient information and record data on the DAD abstract, researchers who use DAD and those who maintain the DAD database and develop national coding directives.

Considerations below were summarized to address the coding issues that were identified in this data quality assessment of DAD.

- *Ensure that chart documentation is sufficient for completing the DAD abstract.* When patient documentation is unclear, incomplete or missing detailed physician clinical notes, the person who is responsible for completing the DAD abstract does not have the information available to accurately capture the conditions that are present and the interventions that were performed.
- *Promote and make accessible CIHI's education and coding directives.* CIHI should ensure that the Canadian Coding Standards, *DAD Abstracting Manual* and ICD-10-CA/CCI electronic books are widely distributed, and facilities should ensure the accessibility and understanding of these directives by persons who complete the DAD abstract.
- *Understand the causes of the variation in the coding quality between jurisdictions.* The high coding quality of diagnoses and interventions observed in Manitoba suggests that there is potential to learn from this province in terms of best practices. This study may offer the data needed to develop target values of coding quality at the regional and national levels.
- *Continue to monitor and query the data being collected.* CIHI, in collaboration with facility staff, could use this as a tool to identify unexpected changes in coding practices in the data reported to DAD.
- *Perform further analysis of the data collected in this study to enhance health indicator statistics and CIHI's grouping methodology.* As the intent of the *Health Indicators* reports and Case Mix Group methodology is to inform policy-makers and researchers, it is critical to ensure the validity of the statistics published and grouping methodology employed.

8 References

1. Canadian Institute for Health Information, *Executive Summary: Data Quality Documentation: Discharge Abstract Database, 2005–2006* (Ottawa, Ont.: CIHI, 2006).
2. Canadian Institute for Health Information, *Health Indicators 2008* (Ottawa, Ont.: CIHI, 2008).
3. W. Hogan and M. Wagner, "Accuracy of Data in Computer-Based Patient Records," *Journal of American Medical Information Association* 4 (1997): pp. 342–355.
4. K. Jordan, M. Porcheret and P. Croft, "Quality of Morbidity Coding in General Practice Computerized Medical Records: A Systematic Review," *Family Practice* 21, 4 (2004): pp. 396–410.
5. Canadian Institute for Health Information, *DAD Abstracting Manual, 2005–2006 Edition, Revised September 2005, All Provinces Information* (Ottawa, Ont.: CIHI, 2005).
6. Canadian Institute for Health Information, *Canadian Coding Standards for ICD-10-CA and CCI 2005* (Ottawa, Ont.: CIHI, 2005).
7. Canadian Institute for Health Information, *Canadian Joint Replacement Registry (CJRR) 2007 Annual Report—Hip and Knee Replacements in Canada* (Ottawa, Ont.: CIHI, 2008).
8. Canadian Institute for Health Information, *Health Indicators 2007* (Ottawa, Ont.: CIHI, 2007).
9. Canadian Institute for Health Information, *Hospital Report 2007: Acute Care* (Ottawa, Ont.: CIHI, 2007).
10. Canadian Institute for Health Information, *Health Indicators 2006* (Ottawa, Ont.: CIHI, 2006).
11. Canadian Institute for Health Information, *CMG/Plx Directory 2003* (Ottawa, Ont.: CIHI, 2003).
12. Canadian Institute for Health Information, *CMG+ Directory 2007* (Ottawa, Ont.: CIHI, 2007).

Appendix A: Health Indicator Definitions

Ambulatory Care Sensitive Conditions

Any acute care hospitalization where death did not occur before discharge (that is, exclude where discharge disposition = 07) with a most responsible diagnosis code of:

- Grand mal status and other epileptic convulsions: **ICD-10-CA** G40, G41
- Chronic obstructive pulmonary disease (COPD): **ICD-10-CA** J41, J42, J43, J44, J47
- Acute bronchitis, only when a secondary diagnosis* of COPD is also present: **ICD-10-CA** J20
- Pneumonia, only when a secondary diagnosis* of COPD is also present: **ICD-10-CA** J12, J13, J14, J15, J16, J18
- Asthma: **ICD-10-CA** J45
- Congestive heart failure: **ICD-10-CA** I50.0, J81
  Excluding cases with the following surgical procedures†: **CCI** 1.IJ.50, 1.HZ.85, 1.IJ.76, 1.HB.53, 1.HD.53, 1.HZ.53, 1.HB.55, 1.HD.55, 1.HZ.55, 1.HB.54, 1.HD.54
- Hypertension: **ICD-10-CA** I10.0, I10.1, I11
  Excluding cases with the following surgical procedures†: **CCI** 1.IJ.50, 1.HZ.85, 1.IJ.76, 1.HB.53, 1.HD.53, 1.HZ.53, 1.HB.55, 1.HD.55, 1.HZ.55, 1.HB.54, 1.HD.54
- Angina: **ICD-10-CA** I20, I23.82, I24.0, I24.8, I24.9
  Excluding cases with the following surgical procedures†: **CCI** 1.^,2.^,5.^
- Diabetes: **ICD-10-CA** E10.1, E10.6, E10.7, E10.9, E11.0, E11.1, E11.6, E11.7, E11.9, E13.0, E13.1, E13.6, E13.7, E13.9, E14.0, E14.1, E14.6, E14.7, E14.9

* "Secondary diagnosis" refers to a diagnosis other than the most responsible diagnosis.

† Code may be recorded in any position. Procedures coded as cancelled, previous and abandoned after onset are excluded.

Percutaneous Coronary Intervention

Percutaneous coronary interventions performed on patients in acute care hospitals, same-day surgery facilities or catheterization laboratories. One of the following intervention codes must be present: CCI 1.IJ.50^^ or 1.IJ.57.GQ^^.

Hip Replacement Surgery

Unilateral or bilateral hip replacement performed on inpatients in acute care hospitals. One of the following intervention codes must be present: CCI 1.VA.53.LA-PN or 1.VA.53.PN-PN.

Refer to **www.cihi.ca/indicators** for full details on the methodology for these health indicator definitions.

Appendix B: Discrepancy Reasons

Table 26 Reasons Assigned by Reabstractors for Discrepancies With DAD Data

Reason	Description
Standards	Non-compliance with abstracting manual, coding standards, codebook directives (Folio); hospital policy contravenes CIHI standards.
Chart Documentation	Information missed by original coder or the reabstractor; incomplete documentation at original coding and/or reabstraction; reabstractor had difficulty accessing electronic chart documentation.
Download Issue	Admission–discharge–transmission download is inconsistent with information in chart.
Optional/Not Wrong	Difference in chart interpretation between original coder and reabstractor; however, both codes could be correct.

Appendix C: Case-Mix Analysis

Table 27 Agreement Rates for Major Clinical Categories and Case Mix Groups*

	Volume in DAD (in Thousands)	Positive Predictive Value (95% CI)
Major Clinical Categories		
1—Diseases and Disorders of the Nervous System	72.0	**85** (75–96)
3—Diseases and Disorders of the Ear, Nose, Mouth and Throat	61.5	**81** (67–96)
4—Diseases and Disorders of the Respiratory System	168.4	**90** (85–95)
5—Diseases and Disorders of the Circulatory System	261.9	**96** (94–98)
6—Diseases and Disorders of the Digestive System	213.3	**95** (92–98)
7—Diseases and Disorders of the Hepatobiliary System and Pancreas	59.2	**96** (92–100)
8—Diseases and Disorders of the Musculoskeletal System and Connective Tissue	156.3	**80** (65–95)
10—Endocrine, Nutritional and Metabolic Diseases and Disorders	46.2	**81** (67–95)
11—Diseases and Disorders of the Kidney and Urinary Tract	96.1	**93** (89–97)
14—Pregnancy and Childbirth	293.0	**100** (99–100)
15—Newborns and Other Neonates With Condition Originating in the Perinatal Period	280.3	**100** (100–100)
19—Mental Diseases and Disorders	177.3	**88** (76–99)
23—Other Reasons for Hospitalization	71.2	**60** (40–79)
25—Significant Trauma	118.5	**94** (87–100)
Case Mix Groups		
22—Seizure and Headache	18.4	**96** (93–99)
140—Chronic Obstructive Pulmonary Disease	20.9	**64** (54–74)
142—Chronic Bronchitis	27.1	**74** (65–83)
143—Simple Pneumonia and Pleurisy	42.0	**73** (65–80)
146—Asthma	16.4	**90** (85–95)
188—Percutaneous Transluminal Coronary Angioplasty With Complicating Cardiac Conditions	10.0	**41** (32–50)
189—Percutaneous Transluminal Coronary Angioplasty Without Complicating Cardiac Conditions	17.6	**92** (87–97)
213—Unstable Angina Without Cardiac Catheter Without Specified Cardiac Conditions	16.4	**75** (66–84)
222—Heart Failure	45.6	**86** (81–92)
233—Hypertension (May Not Require Hospitalization)	5.0	**75** (64–87)
235—Angina Pectoris	6.2	**56** (40–73)
237—Arrhythmia	26.0	**75** (57–94)
294—Esophagitis, Gastroenteritis and Miscellaneous Digestive Disease	77.9	**89** (81–98)
352—Hip Replacement	21.1	**99** (99–100)
483—Diabetes	20.8	**86** (78–94)

Notes

CI: confidence interval.

* To be included in this analysis, the study sample had to contain a minimum of 100 records assigned to the major clinical category or Case Mix Group in the DAD data.

Table 28 Agreement Rates for Complexity Overlay, by Case Mix Groups*

Case Mix Group	Volume in DAD (in Thousands)	Percent With No Change in Complexity Overlay When Using Chart Review Data (95% CI)
22—Seizure and Headache	18.4	**77** (51–100)
140—Chronic Obstructive Pulmonary Disease	20.9	**80** (72–89)
142—Chronic Bronchitis	27.1	**86** (80–92)
143—Simple Pneumonia and Pleurisy	42.0	**82** (77–88)
146—Asthma	16.4	**95** (91–99)
188—Percutaneous Transluminal Coronary Angioplasty With Complicating Cardiac Conditions	10.0	**43** (34–52)
189—Percutaneous Transluminal Coronary Angioplasty Without Complicating Cardiac Conditions	17.6	**69** (61–76)
213—Unstable Angina Without Cardiac Catheter Without Specified Cardiac Conditions	16.4	**92** (87–97)
222—Heart Failure	45.6	**68** (60–75)
233—Hypertension (May Not Require Hospitalization)	5.0	**93** (85–100)
235—Angina Pectoris	6.2	**100** (100–100)
237—Arrhythmia	26.0	**78** (59–96)
294—Esophagitis, Gastroenteritis and Miscellaneous Digestive Disease	77.9	**80** (60–100)
352—Hip Replacement	21.1	**91** (88–95)
483—Diabetes	20.8	**82** (74–91)

Notes

CI: confidence interval.

* To be included in this analysis, the study sample had to contain a minimum of 100 records assigned to the Case Mix Group in the DAD data.