CIHI Data Quality Study of the 2007–2008 Discharge Abstract Database

Canadian Institute for Health Information

Institut canadien d'information sur la santé

Who We Are

Established in 1994, CIHI is an independent, not-for-profit corporation that provides essential information on Canada's health system and the health of Canadians. Funded by federal, provincial and territorial governments, we are guided by a Board of Directors made up of health leaders across the country.

Our Vision

To help improve Canada's health system and the well-being of Canadians by being a leading source of unbiased, credible and comparable information that will enable health leaders to make better-informed decisions.

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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: 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 within 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 14 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 and territorial ministries of health and regional health authorities that supported this data quality initiative within their provinces and territories.

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, the Canadian Institute for Health Information (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 the data from 2007–2008 that was submitted to DAD. Specific objectives for this study included

- Evaluating the overall quality of coding of clinical and non-clinical data contained in DAD for 2007–2008, with a particular focus on selected health conditions; and
- Assessing the impact of any observed coding variations on measures of hospital outputs and resource indicators, as measured by CIHI's acute care grouping methodology, CMG+.

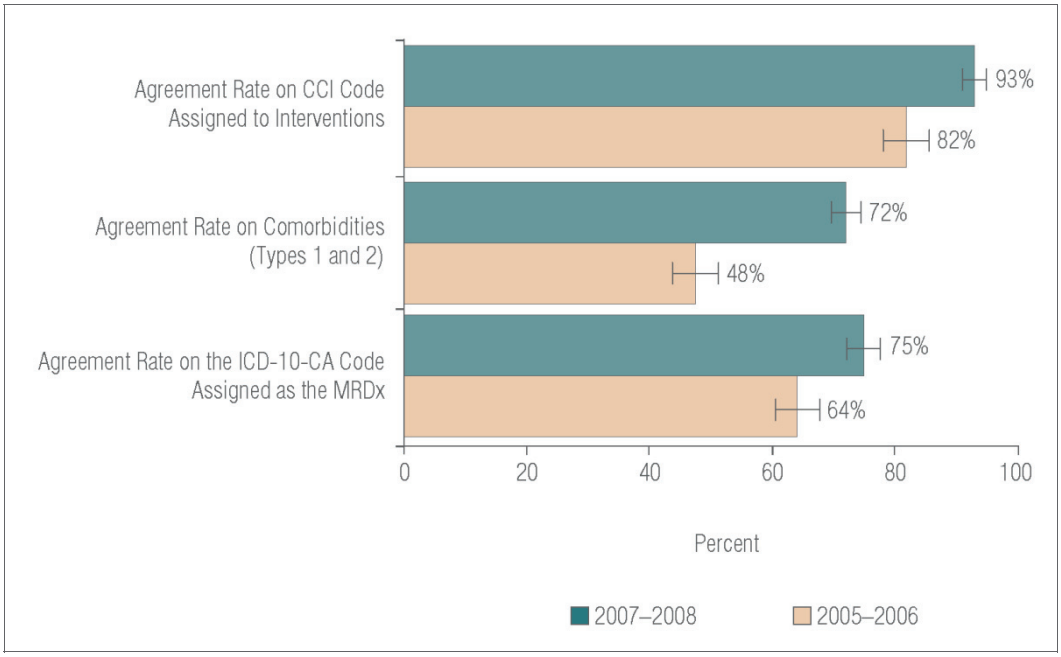
The study also focused on identifying the underlying coding issues that might affect the quality of the data noted and on articulating considerations for improving data quality to address these coding issues.

Overall Quality of DAD Data

The study findings support that the DAD data is fit for use with respect to the health conditions studied and the resource indicators derived from CMG+.

- The completeness and reliability of the diagnoses and interventions reported by hospital coders to DAD significantly improved in 2007–2008, compared to 2005–2006.
- There was minimal regional variation in the coding quality results when looking at the provincial- and territorial-level results across the participating jurisdictions.
- Hospital output measures and related resource indicators did not vary substantially, whether they were derived using the original DAD data or the data obtained from the chart review. However, reabstracted data resulted in slightly higher resource utilization indicators, which corresponds to the observed under-reporting of diagnoses and interventions to DAD.
- The report highlighted several areas of improvement in coding quality, including those highlighted below.

Highlights of Coding Quality Improvements in 2007–2008



Note
MRDx: most responsible diagnosis.

Coding Issues

While the study found high accuracy in the clinical data described in DAD, some discrepancies remained between the DAD data and the documentation in patient charts:

- Many diagnoses recorded in the chart by the physician which met the requirements of significance were not recorded on the hospital abstract as affecting the patient's hospital stay, resulting in incomplete DAD data.
- Coding accuracy for the patient's most responsible diagnosis remains a focus for data quality, though there was improvement since 2005–2006.
- The reasons for coding inconsistencies include difficulties interpreting the physician notes in the patient chart and non-compliance with CIHI's codebook directives and the Canadian Coding Standards. The most prevalent coding difficulty was the ability to identify the health conditions that affected the patient's hospital stay.

Considerations for Improving Coding Quality

The report supports that enhancing the information and data quality of DAD is a shared responsibility among health care professionals at the facilities who treat patients and document their care, coders who extract patient information and record data on the DAD abstract and those who maintain the DAD database and develop national coding directives.

This study indicates that recent efforts to improve clinical reporting to DAD resulted in overall improvements to its information and data quality. Where coding issues remain, the findings from this study will be used to improve CIHI products, such as CMG+. Administrators, physicians and health records staff at the study facilities can review the findings from the study with the information provided in their facility-specific reports to identify areas where improvements are needed to promote high-quality DAD data.

For More Information

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

Chapter 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 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 2007–2008, CIHI received inpatient data from 633 acute care facilities from nine provinces and three territories, as illustrated in Table 1.

Table 1
Volume of Abstracts Submitted to DAD in 2007–2008, by Province/Territory

Province/Territory	Number of Acute Care Facilities	Number of Inpatient Abstracts
Newfoundland and Labrador	33	46,626
Prince Edward Island	7	16,179
Nova Scotia	34	91,898
New Brunswick	23	94,976
Quebec*	—	—
Ontario	174	1,090,040
Manitoba	96	136,667
Saskatchewan	69	137,759
Alberta	109	360,477
British Columbia	82	407,204
Yukon	4	5,796
Northwest Territories	1	1,895
Nunavut	1	3,180
Total	**633**	**2,392,697**

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 was to assess the quality of the coding and abstracting of clinical and non-clinical information in DAD for 2007–2008, with an aim of providing reliable results at the provincial and territorial levels. The study focused on specific health conditions and interventions that are of special interest.

Specifically, the objectives of this study were the following:

- Produce national, provincial and territorial estimates of overall coding quality.
- Evaluate the coding quality of palliative care, strokes, fractures of the hip and femur, acute renal failure in cardiac cases, acute myocardial infarction, obstetrical trauma, birth trauma and pulmonary embolism or deep vein thrombosis 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 the sources of the 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 with DAD in a process called reabstraction. Throughout this report, the coders who collected the data in this study are referred to as reabstractors. The purpose of reabstraction is to identify systemic problems in coding and data collection. Coding problems could result from many areas, such as the following:

- 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, 10th Revision, Canada (ICD-10-CA) and the Canadian Classification of Health Interventions (CCI) that make it difficult for the coders to implement these standards and directives consistently;
- Coders' non-compliance with or need for education on these directives, for any number of reasons, which affects the data;
- Hospital policies that unintentionally affect the quality of the data in a negative way;
- 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
- 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 rather 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 2007–2008 DAD data quality study. It focuses on selected health conditions.

This report contains seven chapters. The 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 national and regional estimates of overall coding quality, Chapter 4 evaluates the coding quality of specific health conditions, 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 final chapter summarizes the key findings and recommendations.

Chapter 2

Study Method

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

2.1 Study Design

There were two main objectives in this reabstraction study. The primary interest was in the general population of inpatients, for which provincial and territorial estimates of the coding quality were desired.[i] The secondary interest was in a number of special patient hospitalizations, defined by diagnoses and interventions, for which national estimates were required. However, since the special hospitalizations were subsets of the general inpatient population, the combined target population for the two levels of interest can simply be described as including all inpatient discharges.

The sample was selected with consideration made to the two interests of this study. Of all acute care facilities in Canada submitting to DAD, 50 were selected based upon a probability sample that considered their geographic location and volume of abstracts containing selected health conditions that were the focus in this study. Two logistical considerations were made when selecting the sample: 1) facilities with fewer than 500 hospital discharges in 2007–2008 were excluded; and 2) hospitalizations with lengths of stay longer than 30 days were excluded. The study design considered hospitalizations with longer lengths of stay to not be comparable to those with shorter lengths of stay.

For the first time, this DAD reabstraction study focused on all jurisdictions reporting to DAD—both provinces and territories. Quebec does not contribute to DAD and New Brunswick chose not to participate in this study, so the target population included all hospital discharges in Canada except those in Quebec and New Brunswick. By excluding hospitalizations with longer lengths of stay from the study design, the scope of the study was reduced from 2,297,721 abstracts (all DAD abstracts in 2007–2008 less New Brunswick) to 2,217,911 abstracts (96.5%).

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 reviewing and interpreting 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 classifications for diagnoses and interventions in Canada (ICD-10-CA and CCI). Training focused on diagnosis typing and the coding directives for the health conditions and interventions that were the focus of this study. Prior to field collection, reabstractors were required to complete a coding test to assess their understanding of the study guidelines.

i. Within this general population, there was a special interest in national estimates by CMG+ comorbidity level; this special interest extended to separate estimates by comorbidity level specifically for the province of Ontario.

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

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 the data transmitted. 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 ensure that accurate information is in the study database.

Only weighted estimates for the reabstraction study are presented in this report. Therefore, the 12,900 abstracts that were studied represent the study's population of reference of 2,217,911 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 (excluding New Brunswick) to weighted estimates generated when using the study data. These figures provide evidence that the weighted estimates using the study data to describe the patient population are representative of the non–long stay cases (30 days or fewer) in the full DAD.

ii. Data collection took place from January to May 2009. Data collected for this study exceeded its target number of 11,520 reabstractions, for a total of 12,900.

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 among all possible samples.

Table 2
Characteristics of Abstracts Submitted to DAD in 2007–2008

	All Acute Care Inpatient Abstracts in DAD*	All Acute Care Inpatient Abstracts in DAD With an LOS ≤30 Days*	Weighted Estimates Using Study Sample
N	2,297,721	2,217,911	2,217,911
Age in Years, *Mean (Inter-Quartile Range)*	46 (24–71)	45 (24–70)	44 (22–68)
Hospitalizations Involving One or More of the Studied Health Conditions,† *N (Percent)*	229,522 (10%)	203,912 (9%)	197,591 (9%)
Total Number of Comorbidities,‡ *N (Mean)*	2,341,373 (1.0)	2,026,446 (0.9)	1,879,932 (0.8)
Total Number of Interventions, *N (Mean)*	2,569,225 (1.1)	2,347,962 (1.1)	2,467,996 (1.1)

Notes
N: number in population; LOS: length of stay.
* Abstracts submitted from New Brunswick are excluded.
† See Appendix A for the methodology for classifying these hospitalizations.
‡ Type 1 and 2 diagnoses only. The lower estimated number of comorbidities using the study sample is due to the exclusion of patient hospitalizations with a length of stay greater than 30 days from the study design.

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 used to analyze various health conditions, interventions, case-mix grouping output variables and other data elements of interest.

Table 3
Analytical Model

		Status of Heath 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."

- Sensitivity: A / (A+C) × 100%—the percentage of true positives of all patients with a health condition in the study data.
- Positive predictive value: A / (A+B) × 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, the results obtained by the reabstractors are considered the criterion standard only for the purpose of calculating these statistics.[iv] It is important to note in this study that these statistics must be used with caution, as the study method used was a chart review of the documentation for the patient. Therefore, the reabstraction data is more of a reference standard than a gold standard, as 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.

iv. Data collected from reabstractors is not perfect. Coding variation between reabstractors is known to exist and was assessed in a previous reabstraction study on DAD 2005–2006 data.[2]

Chapter 3

Quality of DAD Data

This chapter focuses on the study's first objective, "to produce national, provincial and territorial estimates of overall coding quality."

3.1 Completeness of Clinical Data in DAD

This section examines the *completeness*[3] of DAD data by determining if all of the 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[v] found during the chart review, 80% were reported on the DAD abstract as significant diagnoses. This percentage is known as *sensitivity* (Table 4). This sensitivity result indicates potential under-reporting to DAD of 20% of the health conditions that are experienced in the inpatient setting and that can affect the patient's length of stay or resource utilization.

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

	DAD Data (in Thousands)		Total in Study Data (in Thousands)	Sensitivity (95% CI)
	Present	Under-Reported to DAD		
All Significant Diagnoses in Study Data *(Identified in the Chart by the CIHI Reabstractor)**	3,665.6	909.4†	4,575.1	**80.1** (78.4–81.9)

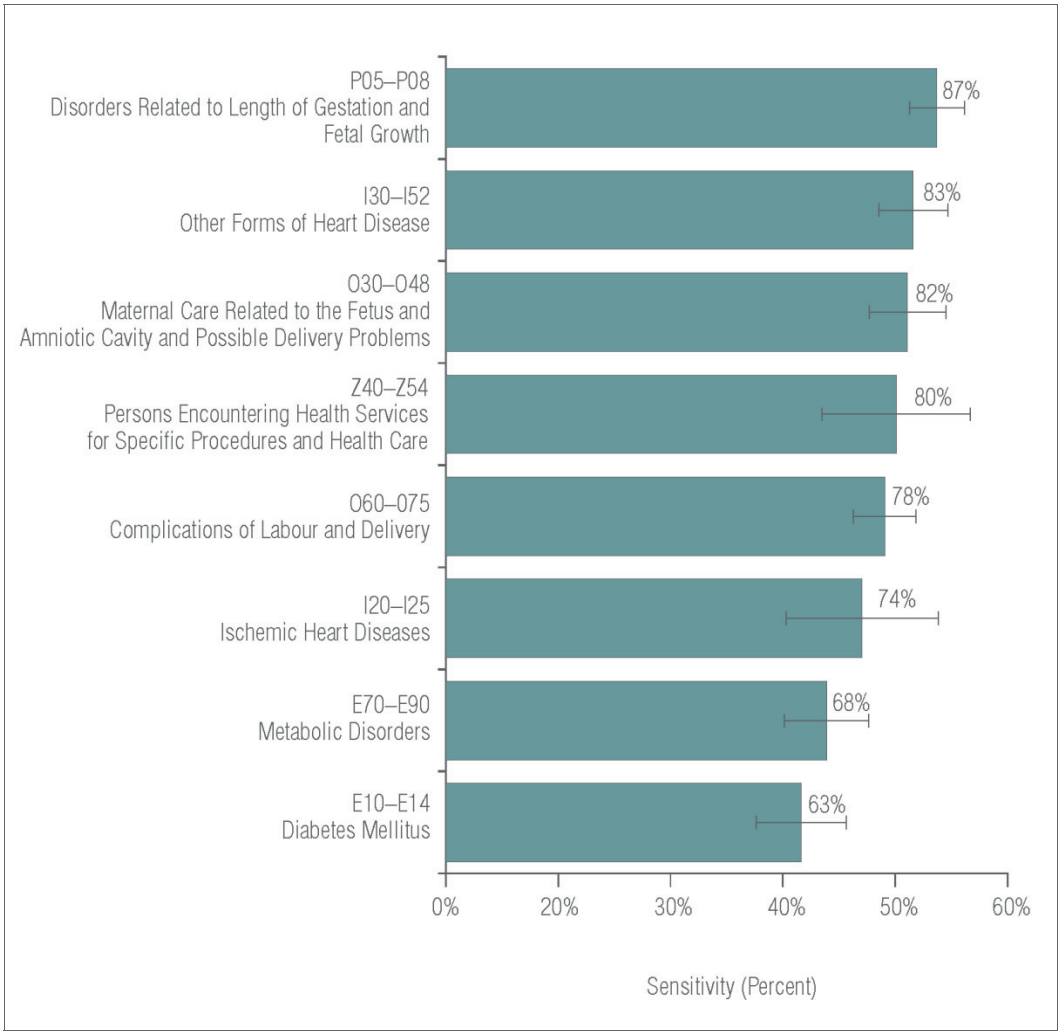
Notes
CI: confidence interval.
* Includes only significant diagnoses (types M, 1, 2, 6, W, X or Y).
† These diagnoses were either not present in DAD or were coded as not significantly impacting the patient's length of stay or resource use (that is, diagnosis type 0 or 3).

v. The full definition of significance is detailed in the special focus discussion "Why Comorbidity Reporting Matters" in Section 3.4.

This analysis was repeated on the specific ICD-10-CA block ranges of diagnoses that had a sufficient sample from the study. This analysis found that metabolic disorders (E70 to E90) and diabetes mellitus (E10 to E14) were more subject to under-reporting to DAD than other diagnoses. Stated more precisely, about one-third of these diseases, which were identified in the chart review as significant conditions, were not reported to DAD as significant. Figure 1 illustrates these results.

Figure 1

Frequency With Which Significant Diagnoses That Were Found During the Chart Review Were Also Present and Coded as Significant in DAD*



Note

* To be considered for this analysis, the study sample had to contain a minimum of 1,000 occurrences of the diagnosis code in the reabstracted data. The bars represent the 95% confidence intervals.

Special Focus: Diabetes Mellitus

The Canadian Coding Standards require that diabetes mellitus be reported to DAD regardless of whether it significantly affects the patient's length of stay or resource utilization; hyperglycemia is also reported if the patient's blood glucose level is 14 mmol/L or higher. These coding requirements make it possible to analyze the completeness of DAD data for identifying hospitalizations of patients with diabetes mellitus without placing any restrictions on whether the condition affected the hospital stay.

The coding quality of these conditions is presented in Table 5. This analysis considers *all* hospitalizations for patients with diabetes mellitus that were identified during the chart review and compares these to the data collected for these hospitalizations in the DAD data. In contrast to the analysis in Table 4, which looked only at conditions reported as significant, the analysis in Table 5 includes those hospitalizations for patients with diabetes mellitus that were typed as both significant and not significant.[vi] The shaded boxes illustrate how frequently diabetes was represented in the same way between DAD and the reabstracted data (including whether it affected the patient's stay and whether hyperglycemia was present). The last two columns show the situations that contributed to the under-reporting of diabetes in DAD.

This analysis found that the cases of under-reporting diabetes as a significant condition were mostly related to the hospital coder underestimating the impact this condition had on the patient's stay. Specifically, when diabetes mellitus affected the patient's stay it was represented in DAD as *not* affecting the patient's stay.

Table 5

Hospitalizations for Patients With Diabetes Mellitus Identified During the Chart Review Compared to Data on the DAD Abstract

		DAD Data			
	Number of Hospitalizations in Study Data (in Thousands)	Affects Stay and Hyper-glycemia Present	Affects Stay and Hyper-glycemia Not Present	Does Not Affect Stay (Under-Reported)	Not Present (Under-Reported)
Hospitalizations of Patients With Diabetes Mellitus* in Study Data					
Affects Patient's Stay (Types M, 1, 2, W, X, Y) and Hyperglycemia Present†	90.2	**80%**	6%	12%	2%
Affects Patient's Stay (Types M, 1, 2, W, X, Y) and Hyperglycemia Not Present	47.8	2%	**65%**	21%	12%
Does Not Affect Patient's Stay (Type 3)	101.5	3%	5%	**80%**	12%

Notes

* Hospitalizations identified with ICD-10-CA codes E10 to E14, as well as additional codes that have diabetes included in the code title, such as O24 *Diabetes mellitus in pregnancy*.

† Hospitalizations where the blood glucose level was 14 mmol/L or higher (indicates hyperglycemia) and that had an additional ICD-10-CA code of either R73.802 or R73.812 included on the DAD abstract.

vi. If any diabetes code was typed as a significant condition on the abstract, diabetes or a complication of diabetes was considered to affect the patient's stay at the hospital.

3.1.2 Completeness of Reporting Interventions to DAD

Of all the interventions found during the chart review, 92% were reported to DAD (Table 6). This sensitivity result indicates potential under-reporting to DAD of 8% of the interventions performed in the inpatient setting.

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

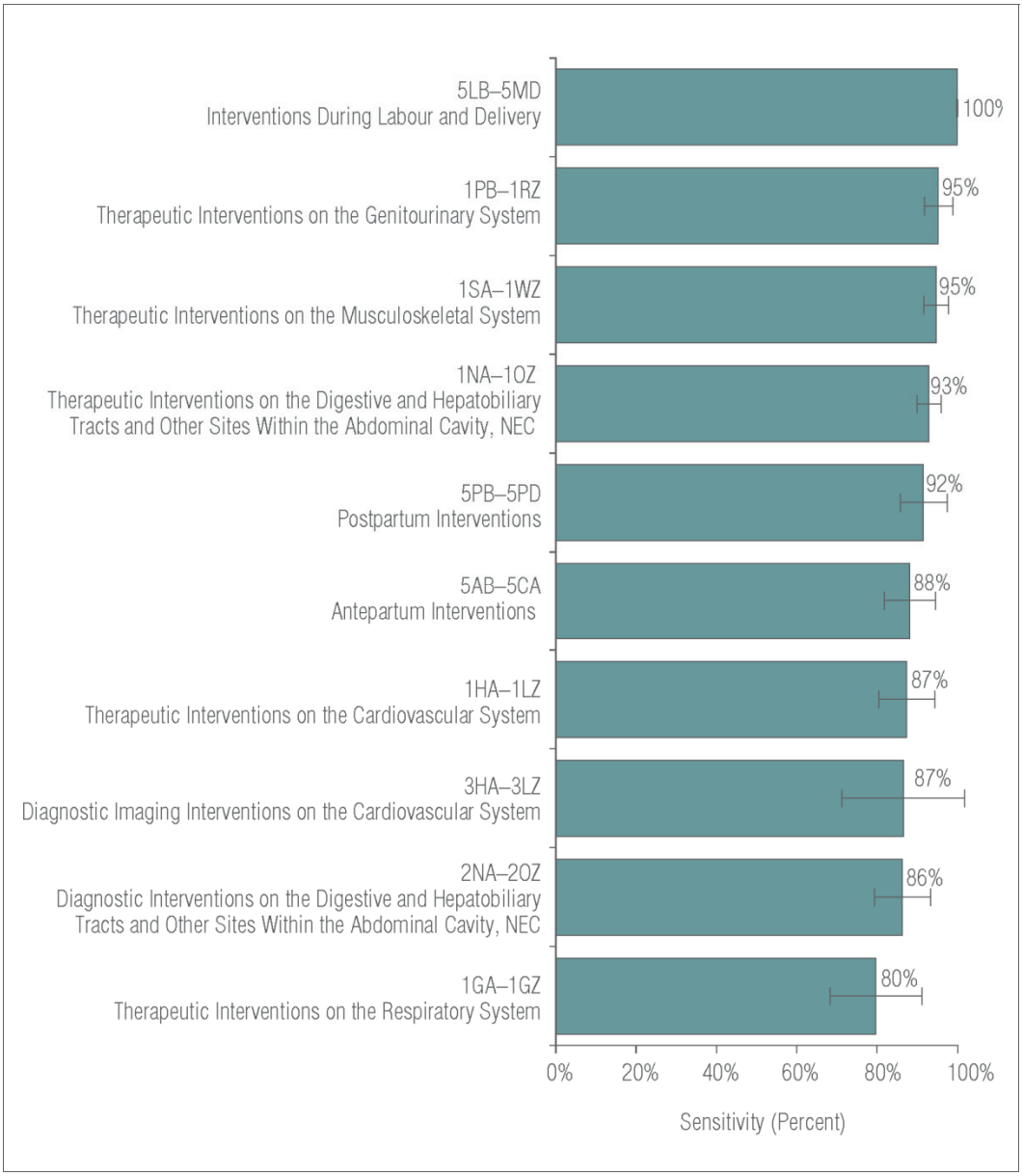
	DAD Data (in Thousands)		Total in Study Data (in Thousands)	Sensitivity (95% CI)
	Present	Under-Reported to DAD		
All Interventions in Study Data*	1,799.4	156.8	1,956.2	**92.0** (90.3–93.7)

Notes
CI: confidence interval.
* Includes only those interventions that are mandatory to capture according to the 2007 Canadian Coding Standards and/or those that impact CMG+ assignment. Note that provincial and territorial variations in mandatory coding were not considered (for example, computed tomography [CT] scans are mandatory to capture in Ontario only).[4]

This analysis was repeated for specific CCI block ranges of interventions where there was a sufficient sample from the study. This analysis found that therapeutic interventions on the respiratory system (1GA to 1GZ) were slightly more prone to under-reporting to DAD. That is, approximately 20% 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 With Which Interventions Found During the Chart Review Were Also Present in DAD*



Notes

NEC: not elsewhere classified.

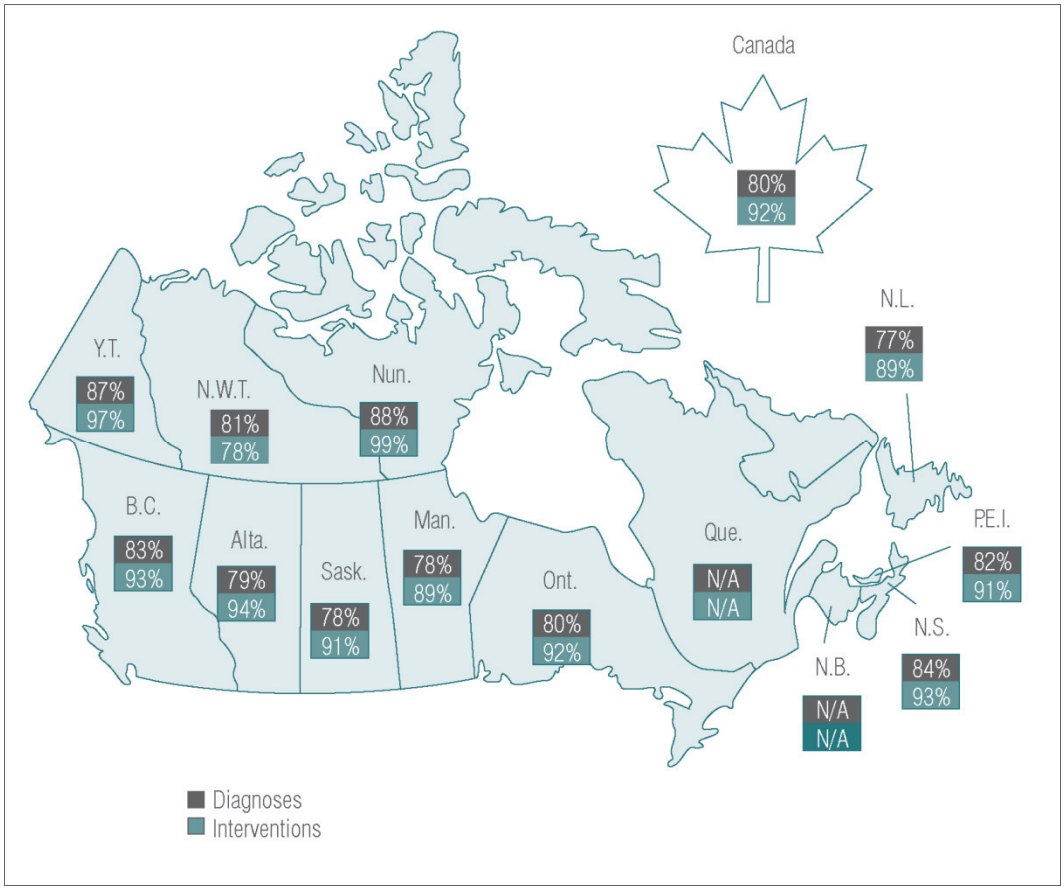
* To be considered for this analysis, the study sample had to contain a minimum of 500 occurrences of the intervention code in the reabstracted data. A lower threshold on the sample size was permitted for interventions to account for the smaller volume of interventions in the study sample. The bars represent the 95% confidence intervals.

3.1.3 Completeness of Reporting Diagnoses and Interventions, by Jurisdiction

Provincial and territorial results for the completeness of reporting clinical data to DAD were examined to determine if data from some regions was reported more completely than data from other regions. This analysis found that there were few regional differences in the completeness of reporting clinical data; the only exception was the degree of under-reporting of interventions in the Northwest Territories. Figure 3 illustrates these results.

Figure 3

Frequency With Which Diagnoses and Interventions* Found During the Chart Review Were Also Present in DAD, by Jurisdiction



Notes

N/A: not available.

* See the notes under tables 4 and 6 for the diagnoses and interventions that are included in this analysis.

3.1.4 Changes in the Completeness of Reporting Diagnoses and Interventions Since 2005–2006

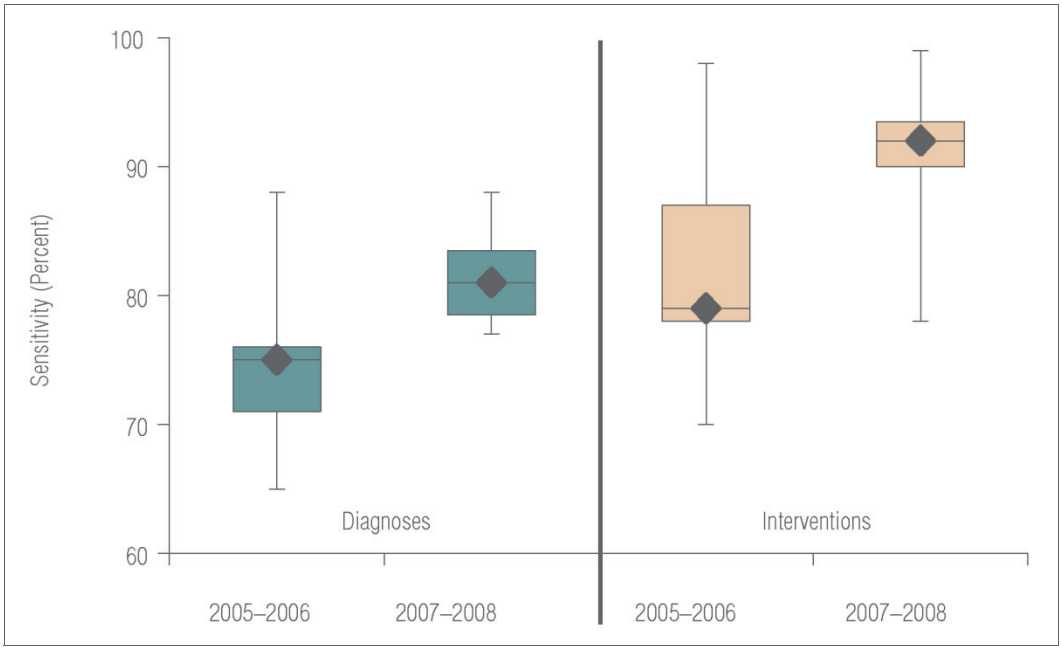
Provincial and territorial results for the completeness of reporting clinical data to DAD in 2007–2008 were compared to similar statistics found with the 2005–2006 data.[vii] Figure 4 uses box-plots to illustrate this comparison. This analysis found that the completeness of reporting diagnoses in 2007–2008 had consistent results across all regions, and that diagnoses tended to be more completely reported than they were in 2005–2006. For example, there were no jurisdictions with particularly low results in 2007–2008, unlike the earlier reporting period. Similar findings were seen for interventions.

How to Interpret a Box-Plot

- The **box** illustrates the range of results observed in half of the provinces and territories, from the 25th to the 75th percentiles.
- The **whiskers** represent the highest and lowest provincial or territorial results.
- The **diamond** represents the province or territory with the results that ranked in the middle.

Figure 4

Jurisdictional Variation in the Frequency With Which Diagnoses and Interventions* Found During the Chart Review Were Also Present in DAD, by Data Year†



Notes

* See the notes under tables 4 and 6 for the diagnoses and interventions that are included in this analysis.

† The 2005–2006 statistics exclude Quebec, the Yukon, the Northwest Territories and Nunavut; the 2007–2008 statistics exclude New Brunswick and Quebec.

vii. For more details on the region-specific results for 2005–2006, refer to *CIHI Data Quality Study of the 2005–2006 Discharge Abstract Database*.[2]

3.2 Correctness of Clinical Data Reported to DAD

This section examines the *correctness*[3] of DAD data by determining how often documentation in the patient chart supports the inclusion of diagnoses and interventions on the DAD abstract.

3.2.1 Correctness of Diagnoses Reported to DAD

Of the diagnoses reported to DAD that had a significant impact on the patient's length of stay or resource use, 88% had chart documentation that supported their inclusion as significant conditions. This percentage is known as the *positive predictive value* (Table 7). This result indicates a potential over-reporting to DAD of 12% of the significant diagnoses. Analysis was performed on specific code blocks for diagnoses, similar to the analysis presented in Section 3.1. However, this yielded no significant findings; therefore, these results are not included in this report.

Table 7

Diagnoses on the DAD Abstract Compared to Diagnoses Captured During the Chart Review

	Study Data (in Thousands)		Total in DAD (in Thousands)	Positive Predictive Value (95% CI)
	Present	Over-Reported to DAD		
All Significant Diagnoses in DAD*	3,665.6	509.4†	4,175.0	**87.8** (86.7–88.9)

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).

Special Focus: Diabetes Mellitus

The correctness of coding diabetes mellitus is presented in Table 8. This analysis considers *all* hospitalizations for patients with diabetes mellitus that were identified in DAD and compares these to the hospitalizations identified by the reabstractor. It was not common for these conditions to be over-reported in DAD; more often, the significance of diabetes was underestimated in DAD or hyperglycemia was not indicated when present in the chart.

Table 8

Hospitalizations for Patients With Diabetes Mellitus Identified in DAD Compared to Data Obtained During the Chart Review

		Study Data			
	Number of Hospitalizations in DAD Data (in Thousands)	Affects Stay and Hyper-glycemia Present	Affects Stay and Hyper-glycemia Not Present	Does Not Affect Stay (Over-Reported)	Not Present (Over-Reported)
Hospitalizations of Patients With Diabetes Mellitus* in DAD					
Affects Patient's Stay (Types M, 1, 2, W, X, Y) and Hyperglycemia Present†	75.9	**95%**	1%	4%	0%
Affects Patient's Stay (Types M, 1, 2, W, X, Y) and Hyperglycemia Not Present	42.8	13%	**73%**	11%	3%
Does Not Affect Patient's Stay (Type 3)	106.2	10%	9%	**77%**	4%

Notes

* Hospitalizations identified with ICD-10-CA codes E10 to E14, as well as additional codes that have diabetes included in the code title, such as O24 *Diabetes mellitus in pregnancy*.

† Hospitalizations where the blood glucose level was 14 mmol/L or higher (indicates hyperglycemia) and that had an additional ICD-10-CA code of either R73.802 or R73.812 included on the DAD abstract.

3.2.2 Correctness of Interventions Reported to DAD

The reabstractors located supporting information in the chart for 94% of interventions reported to DAD (Table 9). This positive predictive value indicates potential over-reporting of 6% of the interventions in DAD, as information to support their inclusion on the DAD abstract was not found during the chart review. Analysis was performed on specific code blocks for interventions, similar to the analysis presented in Section 3.1. However, this yielded no significant findings; therefore, these results are not included in this report.

Table 9
Interventions on the DAD Abstract Compared to Interventions Captured During the Chart Review

	Study Data (in Thousands)		Total in DAD (in Thousands)	Positive Predictive Value (95% CI)
	Present	Over-Reported to DAD		
All Interventions in DAD*	1,799.4	113.1	1,912.5	**94.1** (90.5–97.7)

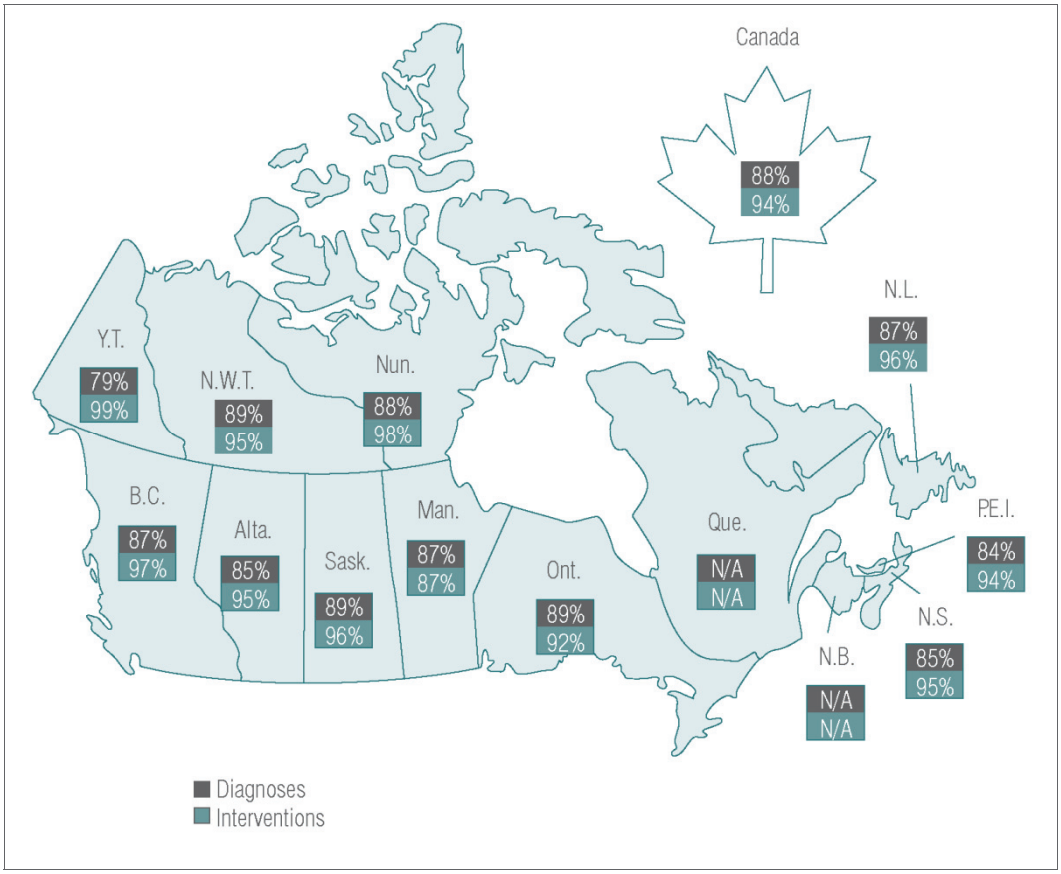
Notes
CI: confidence interval.
* See the note under Table 6 for the interventions that are included in this analysis.

3.2.3 Correctness of Diagnoses and Interventions Reported to DAD, by Jurisdiction

Provincial and territorial results for the correctness of reporting clinical data to DAD were examined to determine if data from some regions was reported more reliably than from other regions. This analysis found that there were few regional differences in the correctness of reporting clinical data; the only region with different findings for the degree of over-reporting was the Yukon for diagnoses. Figure 5 illustrates these results.

Figure 5

Frequency With Which Diagnoses and Interventions* Reported to DAD Were Confirmed During the Chart Review, by Jurisdiction



Notes

N/A: not available.

* See the notes under tables 4 and 6 for diagnoses and interventions that are included in this analysis.

3.2.4 Changes in the Correctness of Diagnoses and Interventions Reported to DAD Since 2005–2006

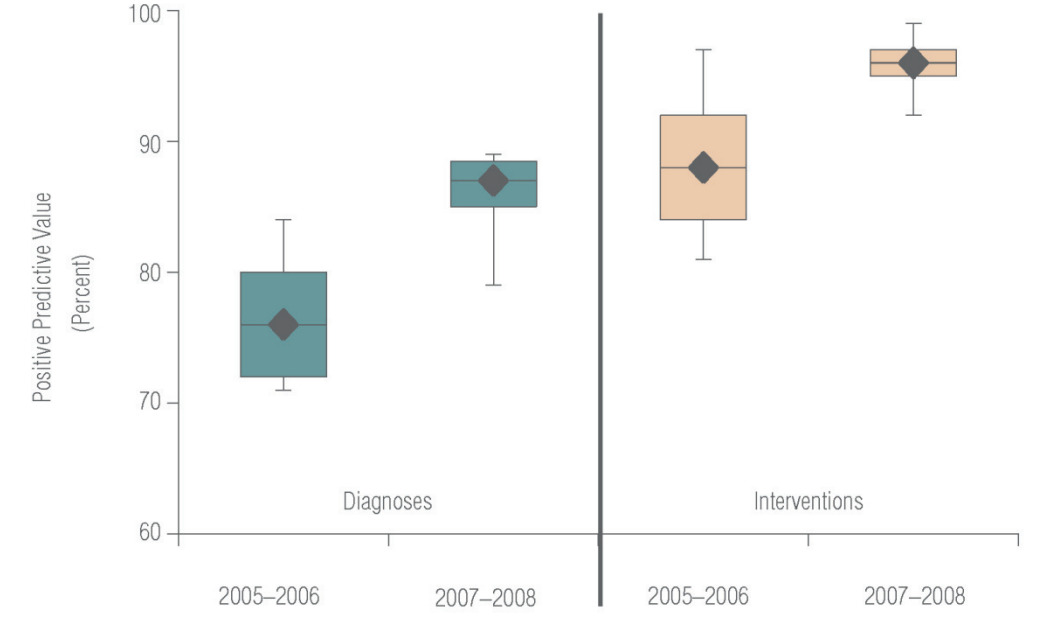
Provincial and territorial results for the correctness of reporting clinical data to DAD in 2007–2008 were compared to similar statistics from 2005–2006.[viii] Figure 6 illustrates this comparison with the use of box-plots. This analysis found that the correctness of reporting diagnoses had consistent results across all regions in 2007–2008, and that diagnoses tended to be more completely reported than they were in 2005–2006. Interventions were also more completely reported in 2007–2008 than they were in 2005–2006.

How to Interpret a Box-Plot

- The **box** illustrates the range of results observed in half of the provinces and territories, from the 25th to the 75th percentiles.
- The **whiskers** represent the highest and lowest provincial or territorial results.
- The **diamond** represents the province or territory with the results that ranked in the middle.

Figure 6

Jurisdictional Variation in the Frequency With Which Diagnoses and Interventions* Reported to DAD Were Confirmed During the Chart Review†



Notes

* See the notes under tables 4 and 6 for the diagnoses and interventions that are included in this analysis.

† The 2005–2006 statistics exclude Quebec, the Yukon, the Northwest Territories and Nunavut; the 2007–2008 statistics exclude New Brunswick and Quebec.

viii. For more details on the region-specific results for 2005–2006, refer to *CIHI Data Quality Study of the 2005–2006 Discharge Abstract Database*.[2]

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

ICD-10-CA codes primarily describe a specific condition and affected body system. These codes are indexed within ICD-10-CA into categories, blocks and chapters.[ix] Using these groupings, codes reported to DAD were compared to codes captured by the reabstractors. This comparison found exact ICD-10-CA code agreement for 87% of the significant diagnoses and agreement to the code category for 95% of the significant diagnoses (Table 10). 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 beyond the code category that is available in ICD-10-CA.

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

	Agreement Rate (95% CI)
ICD-10-CA Code, in *A.NN.NN* Format	**86.8** (85.1–88.4)
ICD-10-CA Category, in *A.NN* Format	**95.3** (94.4–96.1)
ICD-10-CA Block, a Range of ICD-10-CA Categories (for example, $A.NN_1$ to $A.NN_2$)	**97.6** (97.0–98.1)
ICD-10-CA Chapter, a Grouping of ICD-10-CA Blocks	**98.9** (98.6–99.2)

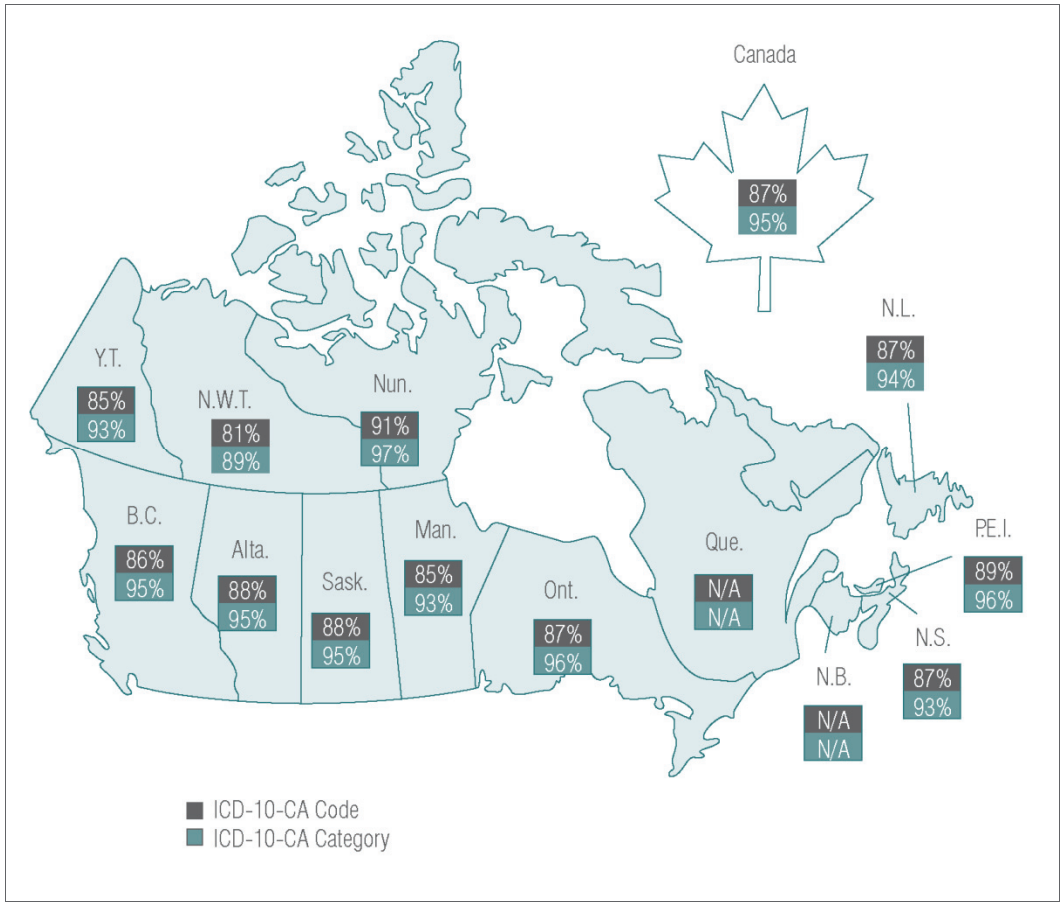
Notes
A: alpha character; N: numeric character; CI: confidence interval.
* See the note under Table 4 for the diagnoses that are included in this analysis. Diagnoses included in this analysis include only those coded as significant in DAD and also confirmed as significant by the reabstractor.

ix. 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).

3.3.2 Consistency of Diagnosis Coding, by Jurisdiction

The reliability of the ICD-10-CA codes assigned to diagnoses was high across all provinces and territories, as illustrated in Figure 7. The lowest agreement rate was observed in the Northwest Territories (81% agreement).

Figure 7
ICD-10-CA Code Agreement Rates for Significant Diagnoses,* by Jurisdiction



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.[x] Exact CCI code agreement on all these components was observed for 93% of the interventions, while agreement to the code rubric was observed for 97% of the interventions (Table 11). The CCI rubric describes the intervention performed and on which anatomy site but does not describe the approach, technique, device, method or tissue involved.

Table 11
CCI Code Agreement Rate for Interventions*

	Agreement Rate (95% CI)
CCI Code, in *N.AA.NN.AA-AA* Format	**92.9** (91.0–94.7)
CCI Rubric, in *N.AA.NN* Format	**96.6** (95.1–98.2)
CCI Group, in *N.AA* Format	**97.8** (96.4–99.3)
CCI Block, a Range of CCI Groups (for example, $N.AA_1$ to $N.AA_2$)	**99.8** (99.7–99.9)

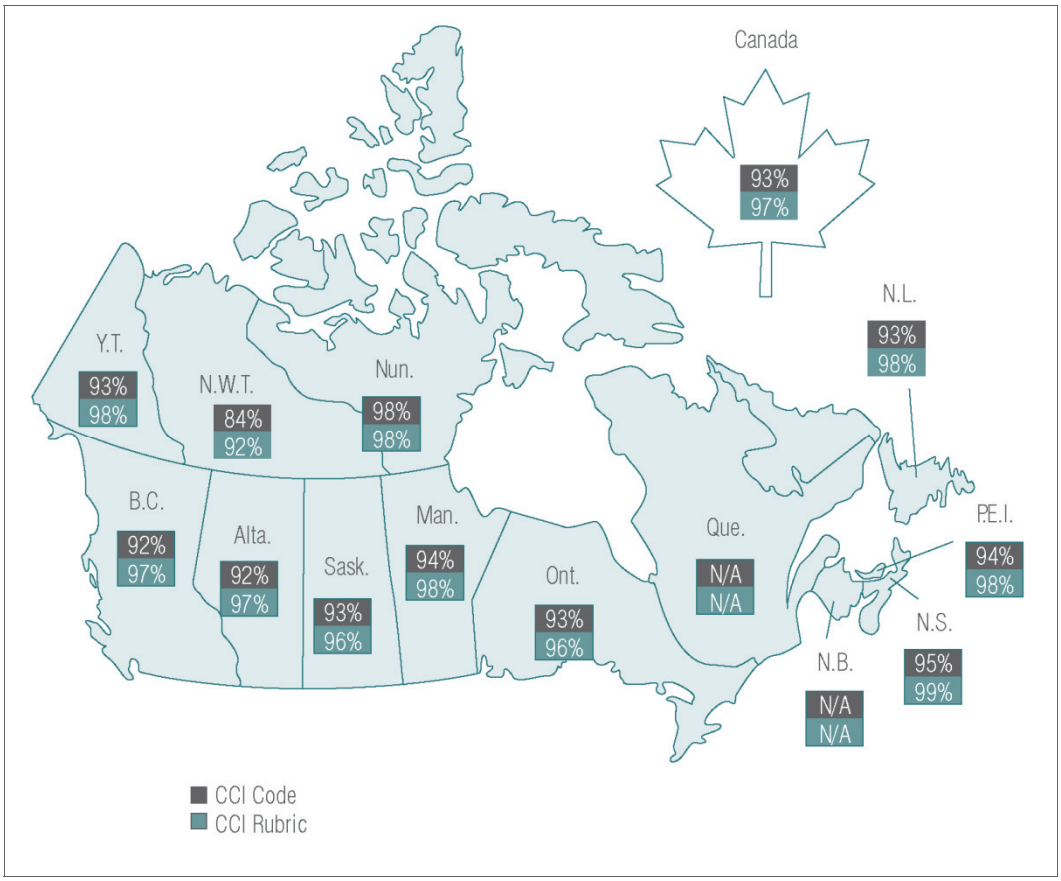
Notes
A: alpha character; N: numeric character; CI: confidence interval.
* See the note under Table 6 for the interventions that are included in this analysis.

x. 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.

3.3.4 Consistency of Intervention Coding, by Jurisdiction

Agreement on CCI codes was high across all regions, with the exception of the Northwest Territories, where 84% of the interventions matched on the full CCI code (Figure 8).

Figure 8
CCI Code Agreement Rates for Interventions,* by Jurisdiction



Notes
N/A: not available.
* See the note under Table 6 for the interventions that are included in this analysis.

3.3.5 Changes in the Consistency of Diagnosis and Intervention Coding Since 2005–2006

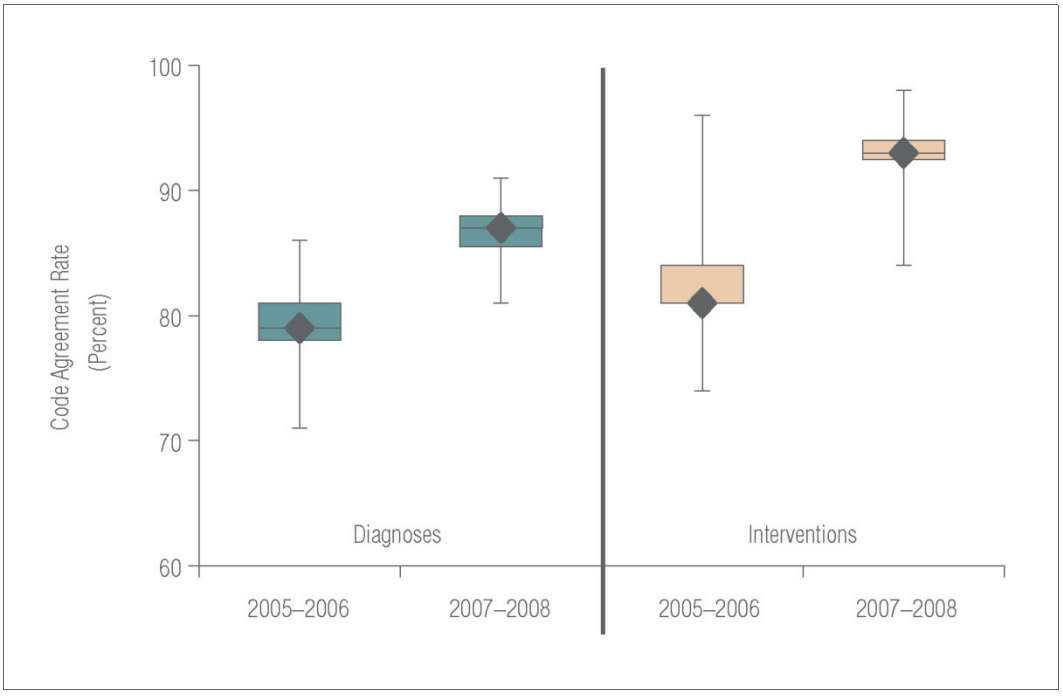
Provincial and territorial results for the consistency of diagnosis and intervention coding in 2007–2008 were compared to similar statistics from 2005–2006.[xi] Figure 9 illustrates this comparison with the use of box-plots. This analysis found that in 2007–2008, there were few regional differences in the consistency of code assignment to diagnoses and interventions. Also, data was more reliability reported in 2007–2008 than it was in 2005–2006.

How to Interpret a Box-Plot

- The **box** illustrates the range of results observed in half of the provinces and territories, from the 25th to the 75th percentiles.
- The **whiskers** represent the highest and lowest provincial or territorial results.
- The **diamond** represents the province or territory with the results that ranked in the middle.

Figure 9

Jurisdictional Variation in ICD-10-CA and CCI Code Agreement Rates for Diagnoses and Interventions,* by Data Year†



Notes

* See the notes under tables 4 and 6 for the diagnoses and interventions that are included in this analysis.

† The 2005–2006 statistics exclude Quebec, the Yukon, the Northwest Territories and Nunavut; the 2007–2008 statistics exclude New Brunswick and Quebec.

xi. For more details on the region-specific results for 2005–2006, refer to *CIHI Data Quality Study of the 2005–2006 Discharge Abstract Database*.[2]

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.[5] Diagnosis typing is an important component of the DAD abstract for differentiating conditions which have an effect 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), proxy most responsible diagnosis (type 6), pre-admission comorbid conditions (type 1), post-admission comorbid conditions (type 2) and service transfer diagnoses (types W, X and Y).

Table 12 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 81% of the significant diagnoses reported to DAD; another 7% of diagnoses changed type following the chart review but remained significant. For the other 12% 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.

Table 12
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 (Type M)	2,217.9	**87.9** (86.4–89.4)	**94.3** (93.3–95.4)	**5.7** (4.7–6.7)
Proxy Most Responsible Diagnosis (Type 6)*	20.5	**82.3** (66.2–98.4)	**82.7** (66.7–98.7)	**17.3** (1.3–33.3)
Comorbidity (Type 1 or 2)†	1,879.9	**72.0** (69.5–74.5)	**80.4** (78.3–82.4)	**19.6** (17.6–21.7)
Pre-Admit Comorbidity (1)	1,650.2	**72.5** (69.7–75.2)	**80.4** (78.1–82.7)	**19.6** (17.3–21.9)
Post-Admit Comorbidity (2)	229.8	**68.5** (64.4–72.5)	**80.2** (77.0–83.3)	**19.8** (16.7–23.0)
Service Transfer Diagnosis (Type W, X or Y)‡	56.7	**72.5** (63.4–81.6)	**81.4** (73.0–89.9)	**18.6** (10.1–27.0)
All Significant Diagnoses	**4,175.0**	**80.5** (78.9–82.1)	**87.8** (86.7–88.9)	**12.2** (11.1–13.3)

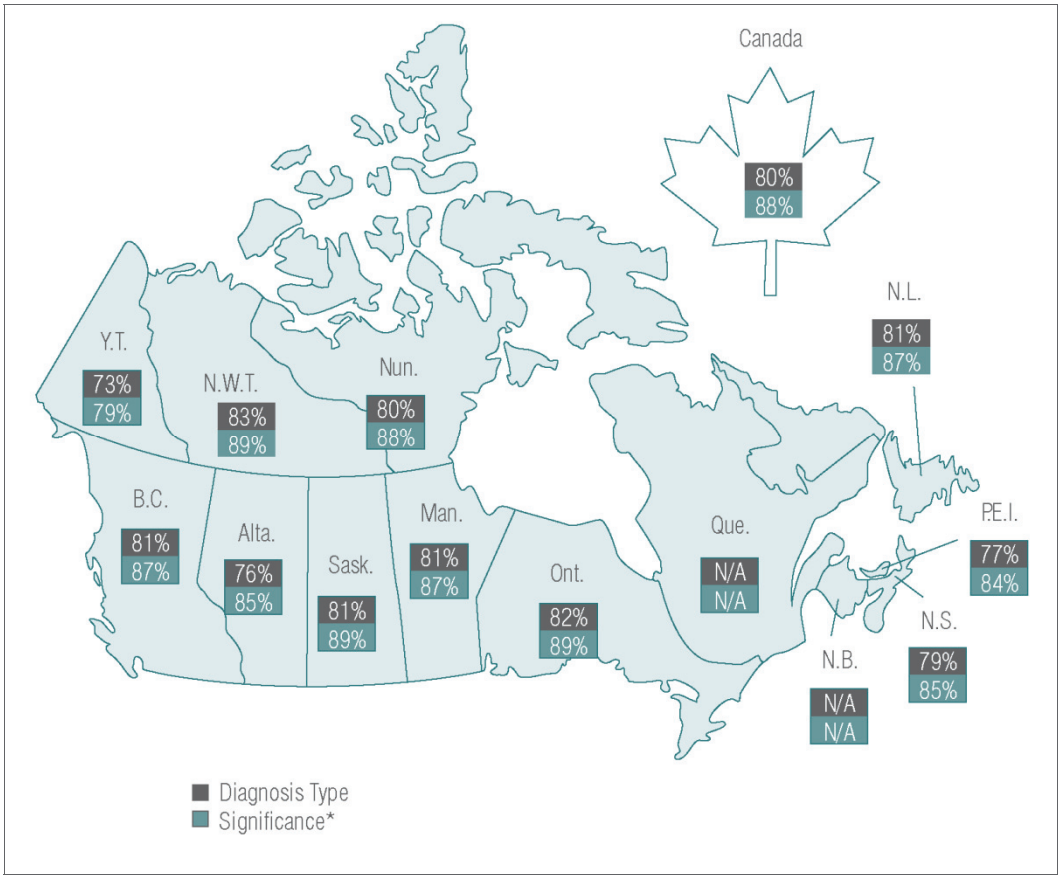
Notes
CI: confidence interval.
* Diagnosis type 6 is assigned to a manifestation that meets the definition of a most responsible diagnosis.
† Comparisons of type 1 and type 2 are *not* considered agreement as there is a definition difference between these two types.
‡ Comparisons of types W, X, and Y are considered agreement on diagnosis type as there is no definition difference between these three types.

3.4.1 Consistency of Diagnosis Typing and the Assignment of Significance, by Jurisdiction

Figure 10 presents the regional results for diagnosis typing and the assignment of significance. All the provinces and territories show similar results, with the exception of the Yukon, where there are slightly lower agreement rates.

Figure 10

Agreement Rates on Diagnosis Type and Assignment of Significance, by Jurisdiction



Notes

N/A: not available.

* These percentages also represent the positive predictive value of significant diagnoses (see Figure 7).

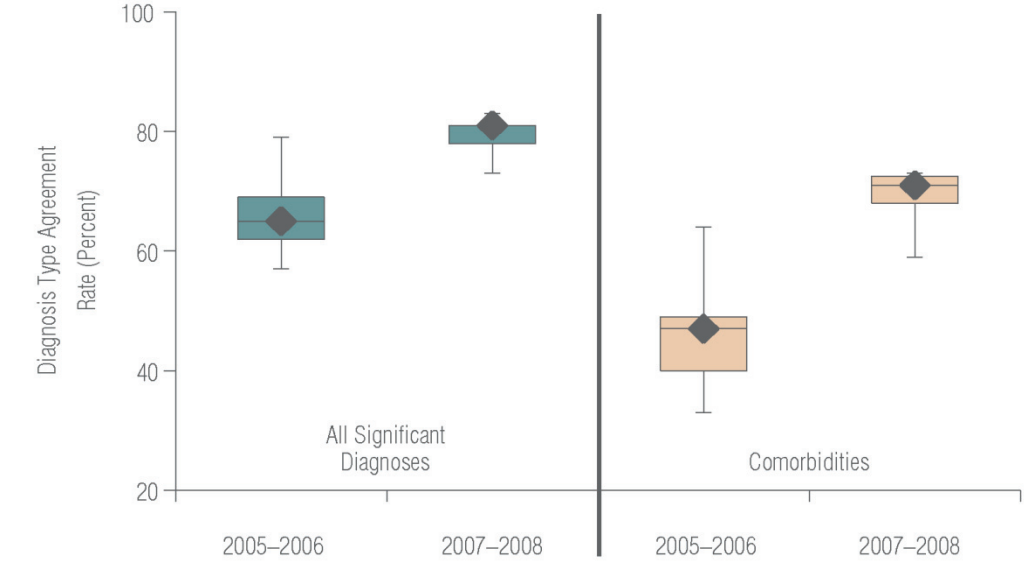
3.4.2 Changes to the Consistency of Diagnosis Typing Since 2005–2006

Provincial and territorial results for the consistency of diagnosis typing in 2007–2008 were examined; these results were compared to similar statistics produced from a previous reabstraction study on the 2005–2006 DAD.[xii] Figure 11 illustrates this comparison. The reliability of diagnosis typing improved since 2005–2006 across the different types; the greatest improvements were noted for pre- and post-admit comorbidities. This analysis also found that in 2007–2008, all regions had similar reliability in diagnosis typing, unlike the results seen in the earlier data year.

How to Interpret a Box-Plot

- The **box** illustrates the range of results observed in half of the provinces and territories, from the 25th to the 75th percentiles.
- The **whiskers** represent the highest and lowest provincial or territorial results.
- The **diamond** represents the province or territory with the results that ranked in the middle.

Figure 11
Jurisdictional Variation in Agreement Rates on Diagnosis Type,* by Data Year†



Notes

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

† The 2005–2006 statistics exclude Quebec, the Yukon, the Northwest Territories and Nunavut; the 2007–2008 statistics exclude New Brunswick and Quebec.

xii. For more details on the region-specific results from this earlier study, refer to *CIHI Data Quality Study of the 2005–2006 Discharge Abstract Database*.[2]

Special Focus: Why Comorbidity Reporting Matters

Comorbidities are health conditions, beyond the most responsible diagnosis, that play a significant role in the care provided and resources used during a patient's hospital stay. The inclusion of comorbidities on the DAD abstract makes for a richer source of health information. Specifically, comorbidities provide a more complete picture of the hospital stay, which increases the understanding of differences in health outcomes or resource use. The value of comorbidity reporting is illustrated with CIHI's case-mix grouping methodology, where comorbid conditions allow for more accurate computation of resource indicators and expected lengths of stay.

Diagnosis typing for comorbidities requires coders to apply the definition of *significance*. The CIHI definition for comorbidity, from the *Canadian Coding Standards for ICD-10-CA and CCI for 2007*, follows:

"A comorbidity is a condition that coexists at the time of admission (type 1) or develops subsequently (type 2) and demonstrates at least one of the following:

- Significantly affects the treatment received
- Requires treatment beyond maintenance of the pre-existing condition
- Increases the length of stay (LOS) by at least 24 hours

To determine significance, there must be documented evidence in the physician documentation (or primary care provider documentation as described above) that the condition required at least one of the following:

- A consultation to assess a previously-undiagnosed condition;
- A consultation to assess a previously-diagnosed condition in which a new or amended course of treatment is recommended and instituted (i.e. excludes a pre-operative anesthetic assessment);
- Therapeutic intervention with a code assignment of 50 or greater from Section 1 of CCI;
- Therapeutic intervention on the Flagged Interventions list in Appendix B (see also the coding standard entitled Selection of Interventions to Code From Section 1 for DAD);
- Diagnostic intervention, inspection or biopsy, with a code assignment from Section 2 of CCI; or
- Extended the length of stay (LOS) by at least 24 hours.

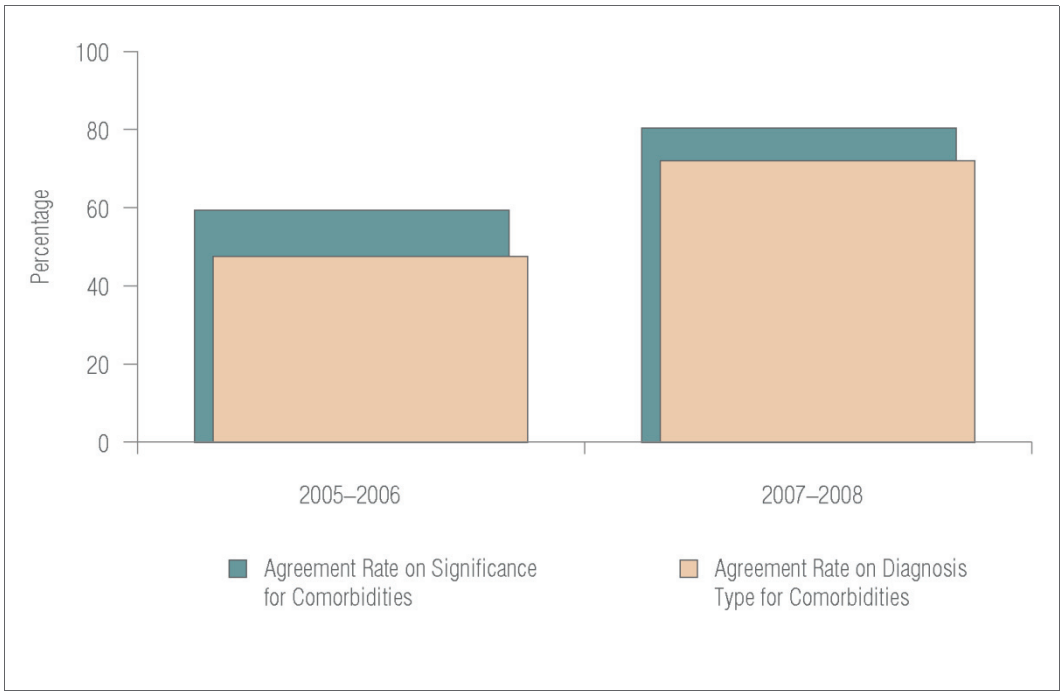
Diagnoses must be supported by physician (or primary care provider) documentation as identified in the criteria listed above to be classified as comorbidities. However, nurses notes, pathology reports, laboratory reports, autopsy reports, medication profiles, radiological investigations, nuclear imaging, and other similar investigations are valuable tools for identifying specificity in assigning the appropriate diagnosis code. Conditions documented in these reports may be captured as a diagnosis type (3) when there is no physician documentation to support capture as a comorbidity."[5]

DAD reabstraction studies historically showed that the most common cause of discrepancies in diagnosis typing was rooted with inconsistencies in applying the definition of significance. Since these findings first surfaced, there were substantial refinements to the definition in the Canadian Coding Standards. Consequently, coders now have clearer instructions on how to apply significance to health conditions documented by physicians.

This past study showed improvements in reporting comorbidities (Figure 12), which supports their value for their many reported purposes. Continued monitoring of the quality of comorbidity reporting will be necessary for researchers and policy-makers to ensure future decisions in health management planning and resource allocation are based on accurate data, particularly as jurisdictions move into different funding models.

Figure 12

Agreement Rates on Diagnosis Type and Significance for Comorbidities in 2005–2006 and 2007–2008*



Note

* The 2005–2006 statistics exclude Quebec, the Yukon, the Northwest Territories and Nunavut; the 2007–2008 statistics exclude New Brunswick and Quebec.

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 reported on the DAD abstract, the reabstractor had to confirm the presence of the condition and then agree on the assignment of both the ICD-10-CA code and the diagnosis type that labelled this condition as 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 75% of all acute care hospitalizations reported to DAD; agreement to the code category was 84% (Table 13).

Table 13
ICD-10-CA Code Agreement Rate for the Most Responsible Diagnosis*

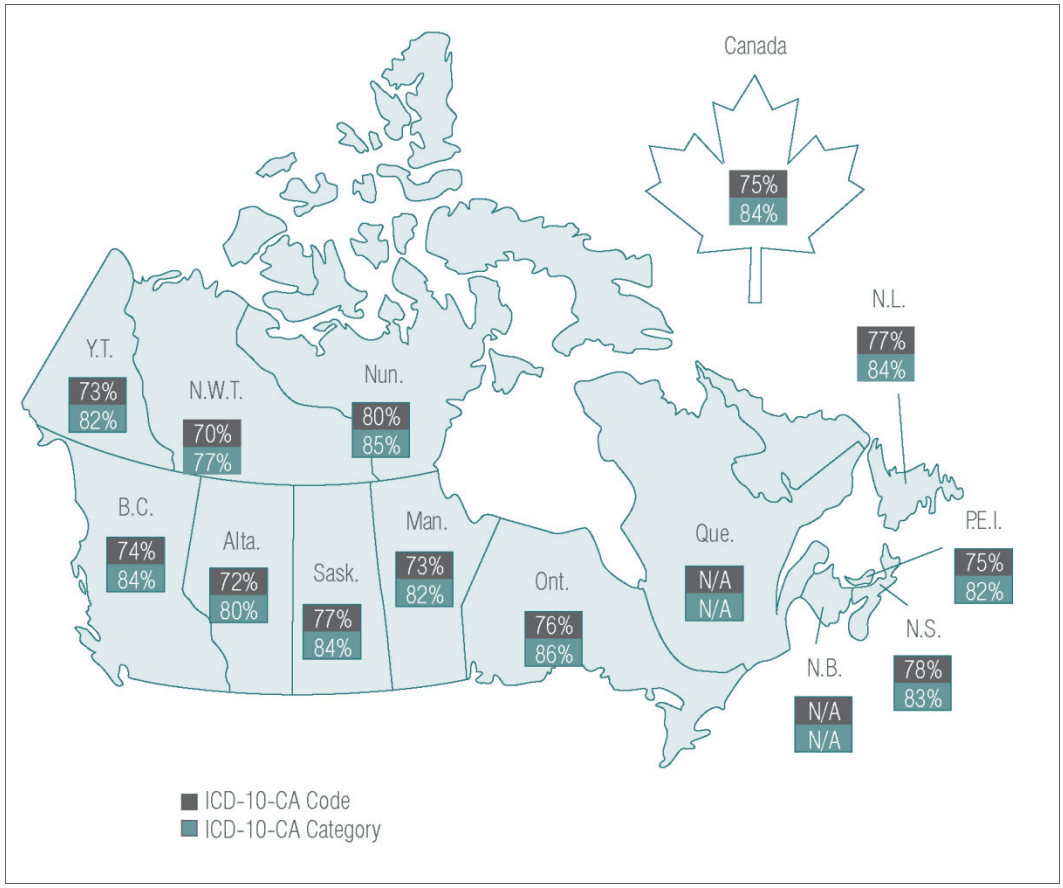
	Agreement Rate (95% CI)
ICD-10-CA Code, in *A.NN.NN* Format	**74.9** (72.3–77.6)
ICD-10-CA Category, in *A.NN* Format	**84.1** (82.2–86.0)
ICD-10-CA Block, a Range of ICD-10-CA Categories (for example, *A.NN*$_1$ to *A.NN*$_2$)	**88.2** (86.7–89.7)
ICD-10-CA Chapter, a Grouping of ICD-10-CA Blocks	**92.7** (91.5–93.8)

Notes
A: alpha character; N: numeric character; CI: confidence interval.
* For patient hospitalizations where a proxy most responsible diagnosis (type 6) was coded, the ICD-10-CA code assigned to the type 6 condition was used in this comparison.

3.5.1 Reliability of the Most Responsible Diagnosis, by Jurisdiction

The reliability of the most responsible diagnosis code was high across all regions, as illustrated in Figure 13. Agreement on the classification of most responsible diagnosis to the code category exceeded 80% in all provinces and two of the three territories.

Figure 13
Agreement Rates for the Most Responsible Diagnosis, by Jurisdiction



Note
N/A: not available.

3.5.2 Changes to the Reliability of the Most Responsible Diagnosis Since 2005–2006

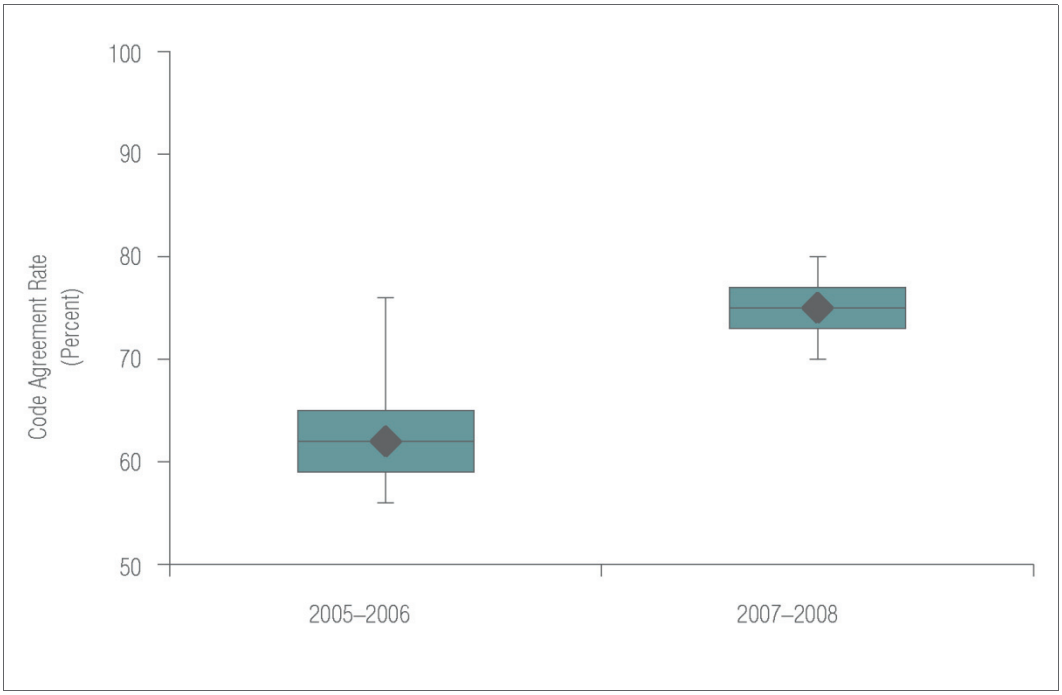
Provincial and territorial results for the reliability of the most responsible diagnosis in 2007–2008 were examined; these results were compared to similar statistics produced for the 2005–2006 DAD.[xiii] Figure 14 illustrates this comparison. This analysis found that in 2007–2008, the patient's most responsible diagnosis was more reliability reported than it was in 2005–2006.

How to Interpret a Box-Plot

- The **box** illustrates the range of results observed in half of the provinces and territories, from the 25th to the 75th percentiles.
- The **whiskers** represent the highest and lowest provincial or territorial results.
- The **diamond** represents the province or territory with the results that ranked in the middle.

Figure 14

Jurisdictional Variation in Agreement on the Most Responsible Diagnosis, by Data Year*



Note

* The 2005–2006 statistics exclude Quebec, the Yukon, the Northwest Territories and Nunavut; the 2007–2008 statistics exclude New Brunswick and Quebec.

xiii. For more details on the region-specific results from this earlier study, refer to *CIHI Data Quality Study of the 2005–2006 Discharge Abstract Database*.[2]

3.6 Reliability of Non-Clinical Data Reported to DAD

Non-clinical data was reported with high reliability.[xiv] Values reported to DAD for demographic data elements (for example, *gender* and *date of birth*) were confirmed following the chart review. Admission and discharge data (for example, *admit category*) and institution numbers for patients who were transferred also had perfect or near-perfect agreement. The exception to the high reliability in coding non-clinical data elements was in recording times for patients admitted via the emergency room.

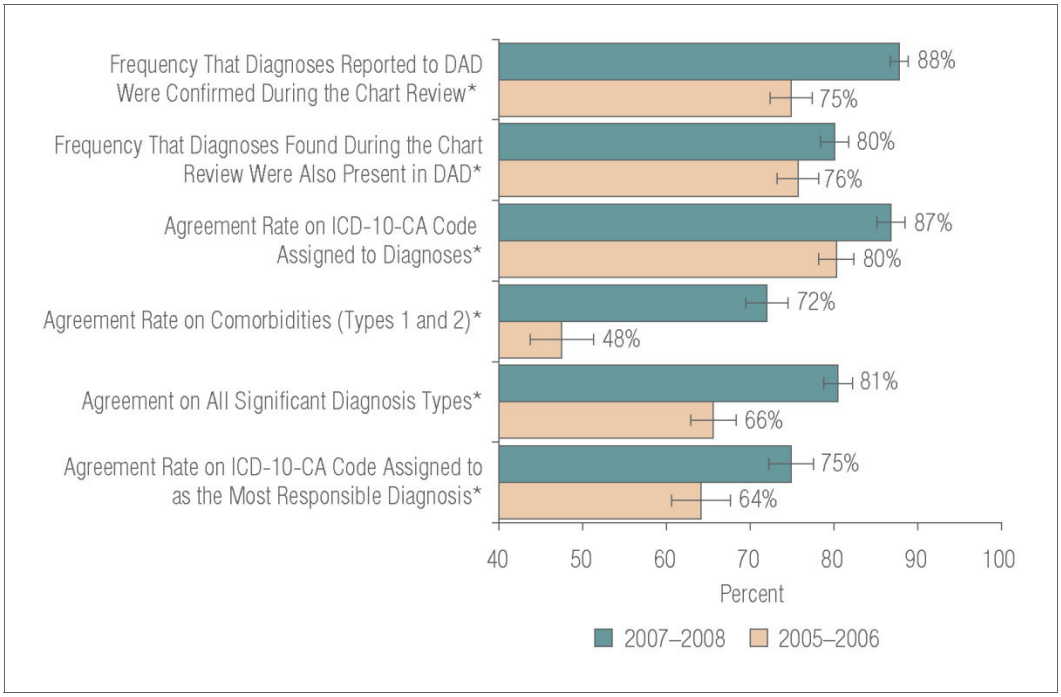
3.7 Summary of Findings for the Quality of DAD Data

This chapter illustrates several areas where the coding quality of diagnoses and interventions to DAD improved for the data submitted in 2007–2008, compared to the data submitted in 2005–2006.

The coding of the patient's most responsible diagnosis and the assignment of diagnosis types had the greatest improvements in coding quality (Figure 15). The improvement in quality seen for diagnosis typing was mostly due to an increase in the agreement of typing comorbidities (types 1 and 2), which is also illustrated. Another notable finding is that more diagnosis codes originally reported to DAD were confirmed by the reabstractors as documented in the patient chart. All improvements seen in 2007–2008 are statistically significant.

xiv. These agreement rates were 100% (*acute length of stay days*, *admit date*, *alternate level of care days*, *birth date*, *birth date is estimated*, *discharge date*, *entry code*, *gender*, *health care number*, *total length of stay*, *weight in grams*); 99% (*discharge disposition*, *institution from*, *institution to*); 98% (*admit category*, *gestational age*); 97% (*admit time*); 96% (*discharge time*); 95% (*date patient left the emergency room*); and 92% (*time patient left the emergency room*).

Figure 15
Coding Quality of Diagnoses to DAD in 2005–2006 and 2007–2008

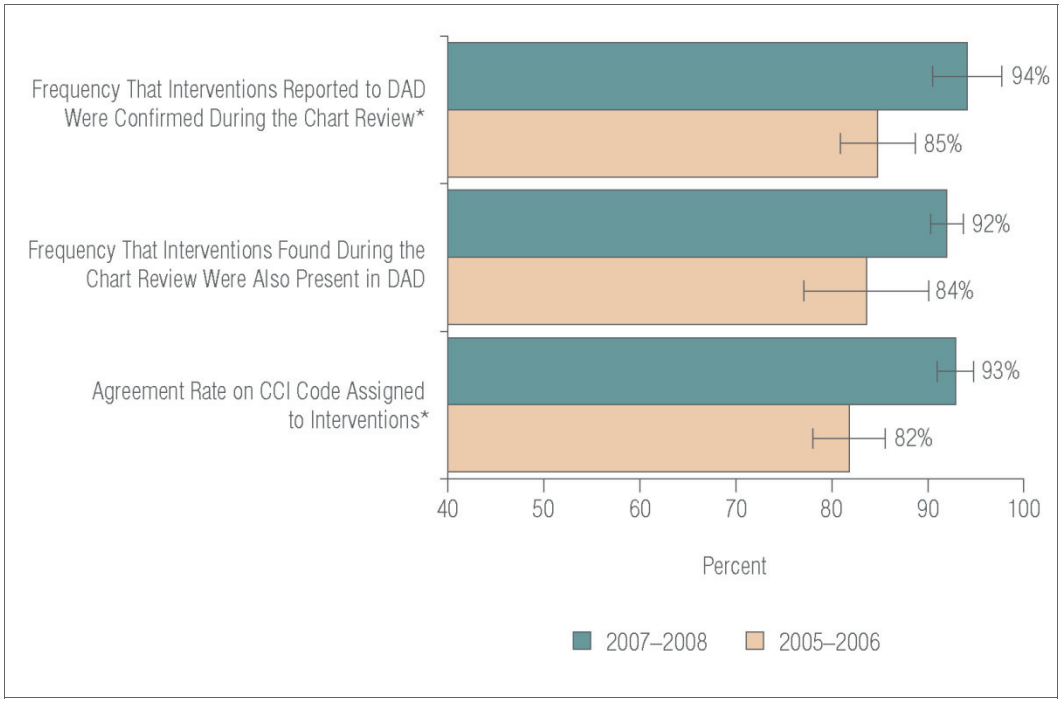


Note

* The difference in the results between 2005–2006 and 2007–2008 was found to be statistically significant ($p<0.05$) when using a two-sided Z-test for comparing two independent proportions. The bars represent 95% confidence intervals.

Improvements in 2007–2008 were also observed for interventions (Figure 16). CCI codes describing interventions were selected more consistently. Also, more interventions that were originally reported to DAD were confirmed by the reabstractors as documented in the patient chart.

Figure 16
Coding Quality of Interventions to DAD in 2005–2006 and 2007–2008



Note

* The difference in the results between 2005–2006 and 2007–2008 was found to be statistically significant ($p<0.05$) when using a two-sided Z-test for comparing two independent proportions. The bars represent 95% confidence intervals.

Tables 14 and 15 summarize the overall and provincial- and territorial-level results for 2007–2008. Note that some jurisdictions showed significantly different results than the national average for specific statistics. Cells shaded in light green indicate where provincial or territorial results were higher than the national average; cells in dark green show where provincial or territorial results were significantly higher ($p<0.05$). Cells shaded in light orange indicate where provincial or territorial results were lower than the national average; cells in dark orange show where provincial or territorial results were significantly lower ($p<0.05$).

Table 14
Summary of Findings for the Coding Quality of Significant Diagnoses in 2007–2008*

	Metric	Optimal Value	Can.	N.L.	P.E.I.	N.S.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nun.
Completeness (Sensitivity) Diagnoses identified during the chart review that were reported to DAD	Percent (95% CI)	100	80 (78–82)	77 (75–80)	82 (79–85)	84 (81–86)	80 (76–83)	78 (76–81)	78 (75–80)	79 (77–82)	83 (81–85)	87 (85–90)	81 (75–86)	88 (85–91)
Correctness (Positive Predictive Value) Diagnoses in DAD with supportive documentation found in the chart review	Percent (95% CI)	100	88 (87–89)	87 (85–89)	84 (82–87)	85 (83–87)	89 (87–91)	87 (85–89)	89 (87–91)	85 (83–87)	87 (86–89)	79 (76–82)	89 (85–94)	88 (85–91)
Consistency of ICD-10-CA Coding Significant diagnoses where the reabstractor agreed on the code assignment														
ICD-10-CA Code Match	Percent (95% CI)	100	87 (85–88)	87 (85–89)	89 (87–92)	87 (85–89)	87 (84–90)	85 (83–87)	88 (86–90)	88 (85–90)	86 (84–88)	85 (82–87)	81 (75–87)	91 (88–94)
ICD-10-CA Category Match	Percent (95% CI)	100	95 (94–96)	94 (93–96)	96 (94–97)	93 (92–95)	96 (94–98)	93 (91–95)	95 (93–96)	95 (94–97)	95 (94–96)	93 (91–95)	89 (85–94)	97 (95–98)
Consistency in Diagnosis Typing Diagnoses where the reabstractors agreed on the diagnosis type	Percent (95% CI)	100	80 (79–82)	81 (78–83)	77 (73–80)	79 (76–82)	82 (79–85)	81 (78–83)	81 (79–84)	76 (73–79)	81 (79–83)	73 (70–76)	83 (76–89)	80 (76–84)
Reliability of ICD-10-CA Code of the Most Responsible Diagnosis (MRDx) Abstracts where the reabstractors agreed on the code assigned to the MRDx														
ICD-10-CA Code Match	Percent (95% CI)	100	75 (72–78)	77 (73–81)	75 (71–80)	78 (74–81)	76 (71–81)	73 (70–77)	77 (73–80)	72 (69–75)	74 (71–77)	73 (69–77)	70 (62–78)	80 (76–84)
ICD-10-CA Category Match	Percent (95% CI)	100	84 (82–86)	84 (81–87)	82 (78–85)	83 (80–86)	86 (82–90)	82 (79–85)	84 (81–87)	80 (77–83)	84 (81–87)	82 (79–86)	77 (70–84)	85 (81–89)

Notes

CI: confidence interval.

* See the note under Table 4 for diagnoses that are included in this analysis. Light orange cells indicate results are lower than the national average; dark orange cells indicate these differences are statistically significant ($p<0.05$). Light green cells indicate results are higher than the national average; dark green cells indicate these differences are statistically significant ($p<0.05$).

Table 15
Summary of Findings for the Coding Quality of Interventions in 2007–2008*

	Metric	Optimal Value	Can.	N.L.	P.E.I.	N.S.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nun.
Completeness (Sensitivity) Interventions identified during the chart review that were reported to DAD	Percent (95% CI)	100	92 (90–94)	89 (86–93)	91 (87–94)	93 (89–96)	92 (88–95)	89 (86–93)	91 (88–93)	94 (92–96)	93 (91–96)	97 (94–99)	78 (68–87)	99 (97–100)
Correctness (Positive Predictive Value) Interventions in DAD with supportive documentation found in the chart review	Percent (95% CI)	100	94 (91–98)	96 (95–98)	94 (91–97)	95 (93–97)	92 (86–99)	97 (95–98)	96 (94–98)	95 (94–97)	97 (95–98)	99 (97–100)	95 (88–100)	98 (97–100)
Consistency of CCI Coding Interventions where the reabstractors agreed on the code assignment														
CCI Code Match	Percent (95% CI)	100	93 (91–95)	93 (91–95)	94 (91–97)	95 (92–97)	93 (90–97)	94 (92–96)	93 (90–95)	92 (89–94)	92 (90–94)	93 (90–96)	84 (71–97)	98 (96–100)
CCI Rubric Match	Percent (95% CI)	100	97 (95–98)	98 (97–99)	98 (97–100)	99 (98–100)	96 (93–99)	98 (96–99)	96 (94–98)	97 (95–99)	97 (96–98)	98 (96–100)	92 (83–100)	98 (96–100)

Notes

CI: confidence interval.

* See the note under Table 6 for interventions that are included in this analysis. Light orange cells indicate results are lower than the national average; dark orange cells indicate these differences are statistically significant ($p<0.05$). Light green cells indicate results are higher than the national average; dark green cells indicate these differences are statistically significant ($p<0.05$).

Chapter 4

Quality of Identifying Hospitalizations for Select Health Conditions

This chapter focuses on the study's second objective, "to evaluate the coding quality of palliative care, strokes, fractures of the hip and femur, acute renal failure in cardiac cases, acute myocardial infarction, obstetrical trauma, birth trauma and pulmonary embolism or deep vein thrombosis at a national level." Appendix A contains details on the methodology used to identify hospitalizations for each of the health conditions examined in this study.

4.1 Palliative Care

Palliative care is "an approach that improves the quality of life of patients and their families facing the problem associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spiritual."[6]

Seventy-six percent of hospitalizations for which palliative care was documented by a physician were similarly reported to DAD (sensitivity). Also, of all hospitalizations where palliative care was recorded on the DAD abstract, 93% had supportive information documented in the patient chart (positive predictive value). These findings are summarized in Table 16.

Table 16
Quality of Coding Palliative Care

	Volume (in Thousands)		Sensitivity* (95% CI)	Positive Predictive Value† (95% CI)
	DAD Data	Study Data		
Hospitalizations for Patients Receiving Palliative Care	38.7	47.2	**76** (72–80)	**93** (91–95)
Palliative Care as the Most Responsible Diagnosis‡	17.8	20.6	**71** (64–79)	**82** (78–87)

Notes
CI: confidence interval.
* Low sensitivity values indicate under-representation of palliative care in DAD.
† Low positive predictive values indicate over-representation of palliative care in DAD.
‡ These statistics consider the presence of palliative care and its being the most responsible diagnosis.

Though this study found that palliative care, when abstracted, is very reliable, it is slightly under-reported to DAD. Just as with all data elements, accurate coding of palliative care is important to many uses of the data, including indicators on health care outcomes, like CIHI's Hospital Standardized Mortality Ratio (HSMR). The HSMR is an indicator aimed at monitoring trends of in-hospital mortality over time.[7]

In 2006–2007, an interim CIHI guideline was released that required the code Z51.5 to be abstracted when a patient with a terminal illness was receiving palliative care.[8] Since then, CIHI released comprehensive coding directives for palliative care, including definitions and examples.[9]

4.2 Stroke

A stroke is the sudden death of brain cells in a localized area due to inadequate blood flow to that part of the brain. A stroke involves either an ischemic or a hemorrhagic event. Ischemic stroke occurs when the flow of blood to the brain is blocked; hemorrhagic stroke occurs when a blood vessel ruptures around or inside the brain.[10]

For 78% of hospitalizations in which a stroke was documented by a physician, stroke was reported to DAD. Also, 90% of the hospitalizations in which stroke was recorded on the DAD abstract had supportive information documented in the patient chart (Table 17). The accuracy dropped slightly when more detail was considered with respect to the type of stroke. This was particularly observed for unspecified stroke. Fifty-nine percent of the hospitalizations that had unspecified stroke coded by the CIHI reabstractors also had unspecified stroke abstracted by the hospital coders.

Table 17
Quality of Coding Stroke

	Volume (in Thousands)		Sensitivity* (95% CI)	Positive Predictive Value† (95% CI)
	DAD Data	Study Data		
Hospitalizations for Patients Who Had Any Stroke	30.5	35.2	**78** (63–93)	**90** (87–93)
Hemorrhagic Stroke‡	7.4	9.8	**63** (27–100)§	**84** (76–92)
Ischemic Stroke‡	14.5	16.3	**78** (68–88)	**88** (83–93)
Unspecified Stroke‡	8.9	9.3	**59** (36–82)	**62** (55–70)

Notes
CI: confidence interval.
* Low sensitivity values indicate under-representation of hospitalizations for stroke in DAD.
† Low positive predictive values indicate over-representation of hospitalizations for stroke in DAD.
‡ These statistics consider the presence of *and* the type of stroke.
§ The high variance for this estimate arises from one record that differed from the mean and that had a large study design weight.

The ability to monitor strokes that occur after a patient's admission to the hospital is of particular interest for various research purposes. For example, the 30-day in-hospital stroke mortality rate published in *Health Indicators* excludes hospitalizations for which a post-admission (type 2) stroke occurred.[11] This study found that post-admission strokes were more likely to be over-reported to DAD than other cases of stroke, as seen by the lower positive predictive value in Table 18.

Table 18
Quality of Coding Post-Admission Stroke

	Volume (in Thousands)		Sensitivity* (95% CI)	Positive Predictive Value† (95% CI)
	DAD Data	Study Data		
Hospitalizations for Which Post-Admission Stroke Occurred‡	2.4	2.6	**73** (63–83)	**79** (73–85)

Notes
CI: confidence interval.
* Low sensitivity values indicate under-representation of post-admission strokes in DAD.
† Low positive predictive values indicate over-representation of post-admission strokes in DAD.
‡ These statistics consider the presence of stroke and its occurrence post-admission (type 2).

4.3 Hip Fracture

A hip fracture is a break in the proximal end of the femur. Hip fractures represent a significant health burden for seniors and for the health system. As well as causing disability or death, a hip fracture may have a major effect on independence and quality of life. The rate of hip fractures in the population is monitored to plan preventive strategies and evaluate their effectiveness, to allocate health resources and to estimate costs.[11] Since they are mostly considered preventable, *in-hospital* hip fractures are of particular interest; therefore, the rate of these fractures is also monitored.[xv]

This study found that hip fractures are well-reported to DAD in terms of completeness (98% sensitivity) and correctness (97% positive predictive value). Table 19 illustrates these findings. Similar results were found for hip fractures that occurred in hospital.

Table 19
Quality of Coding Hip Fractures

	Volume (in Thousands)		Sensitivity* (95% CI)	Positive Predictive Value† (95% CI)
	DAD Data	Study Data		
Hospitalizations for Patients With a Hip Fracture	21.8	21.7	**98** (96–100)	**97** (96–99)
In-Hospital Hip Fracture‡	0.3	0.3	**99** (97–100)	**90** (84–97)

Notes
CI: confidence interval.
* Low sensitivity values indicate under-representation of hip fractures in DAD.
† Low positive predictive values indicate over-representation of hip fractures in DAD.
‡ These statistics consider the presence of a hip fracture and its occurrence while in hospital (type 2).

xv. The Agency for Healthcare Research and Quality attributes variation in these rates to numerous factors, including hospital processes, environmental safety and availability of nursing care.[12]

4.4 Acute Renal Failure

Acute renal failure is a rapid loss of renal function due to damage to the kidneys. Acute renal failure is usually categorized according to pre-renal (causes in the blood supply), intrinsic (damage to the kidney itself) and post-renal causes (obstructive causes in the urinary tract).[13] Acute renal failure can occur as a complication following surgery.

Seventy-eight percent of hospitalizations for which the physician documented acute renal failure had this condition reported to DAD. Also, 91% of hospitalizations for which the DAD abstract showed acute renal failure also had it documented in the patient chart. The completeness and reliability of acute renal failure was lower for patients who received a cardiac intervention[xvi] and who had acute renal failure develop during their hospital stay. For example, of the hospitalizations for which a physician documented a cardiac procedure as well as acute renal failure developing during the hospital stay (type 2), 68% had the post-admission acute renal failure also reported to DAD. Table 20 provides complete details.

Table 20
Quality of Coding Acute Renal Failure

	Volume (in Thousands)		Sensitivity* (95% CI)	Positive Predictive Value† (95% CI)
	DAD Data	Study Data		
Hospitalizations for Patients Experiencing Acute Renal Failure	32.9	38.4	**78** (72–84)	**91** (88–94)
Post-Admission Acute Renal Failure Following a Cardiac Procedure‡	1.1	1.3	**68** (54–82)	**83** (78–88)

Notes
CI: confidence interval.
* Low sensitivity values indicate under-representation of acute renal failure in DAD.
† Low positive predictive values indicate over-representation of acute renal failure in DAD.
‡ These statistics consider the presence of acute renal failure and its occurrence post-admission (type 2).

xvi. The cardiac procedures considered were 3.IP.10^^ *Xray, heart with coronary arteries*, 1.IJ.50^^ *Dilation, coronary arteries*, 1.IJ.57.GQ^^ *Extraction, coronary arteries, percutaneous transluminal approach*, 1.IJ.54.GQ-AZ *Management of internal device, coronary arteries of intravascular stent using percutaneous transluminal approach and ultrasonic device* and 1.IJ.76^^ *Bypass, coronary arteries*.

4.5 Acute Myocardial Infarction

Acute myocardial infarction is the loss of living heart muscle as a result of coronary artery occlusion.[13] Acute myocardial infarction is one of the leading causes of morbidity and death. The occurrence of this disease in the population is monitored to plan preventive strategies and evaluate their effectiveness, to allocate health resources and to estimate costs.[11] CIHI's report *Health Indicators* includes the hospitalization rate for acute myocardial infarction in the population, but the calculation of this rate excludes inpatient stays where the infarct happened post-admission; this exclusion is applied to account for myocardial infarctions that occur as a complication due to surgery.

Eighty-three percent of hospitalizations where acute myocardial infarction was documented in the patient chart had the infarction included on the DAD abstract. Also, 96% of hospitalizations where acute myocardial infarction was recorded on the DAD abstract had supportive information documented in the patient chart. The coding quality was lower when the infarction happened while the patient was in hospital (type 2). These findings are summarized in Table 21.

Table 21
Quality of Coding Acute Myocardial Infarction

	Volume (in Thousands)		Sensitivity* (95% CI)	Positive Predictive Value† (95% CI)
	DAD Data	Study Data		
Hospitalizations for Patients Suffering From an Acute Myocardial Infarction	62.0	71.8	**83** (72–94)	**96** (95–97)
Post-Admission Acute Myocardial Infarction‡	5.7	6.9	**68** (59–78)	**82** (77–87)

Notes
CI: confidence interval.
* Low sensitivity values indicate under-representation of acute myocardial infarction in DAD.
† Low positive predictive values indicate over-representation of acute myocardial infarction in DAD.
‡ These statistics account for the presence of acute myocardial infarction and its occurrence post-admission (type 2).

Myocardial infarctions are divided into two types. An ST-elevation myocardial infarction (STEMI) is the more severe type; the coronary artery is completely blocked off by a blood clot and nearly all the heart muscle being supplied by the affected artery starts to die. A non–ST elevation myocardial infarction (NSTEMI) is the less severe type; it occurs when a coronary artery is partially blocked off by a blood clot.[14] To capture information related to the type of myocardial infarction, the ICD-10-CA code R94.3 *Abnormal results of cardiovascular function studies* was expanded to capture ST elevation, effective April 1, 2007. Starting in that fiscal year, it became mandatory to code R94.3– whenever an acute myocardial infarction occurred or whenever a coronary thrombosis that did not result in myocardial infarction occurred. The coding quality of these cardiovascular function studies is shown in Table 22. In 2007–2008, abnormal results were under-reported to DAD, as illustrated in the last row.

Table 22
Quality of Coding Abnormal Results of Cardiovascular Function Studies*

		Study Data (in Thousands)			Abnormal Result of Cardiovascular Function Studies Over-Reported in DAD (in Thousands)
		ST-Elevation MI	Non–ST Elevation MI	Unspecified ST-Elevation MI	
DAD Data	ST-Elevation Myocardial Infarction	15.8	1.2	0.3	**0.5**
	Non–ST Elevation Myocardial Infarction	0.8	28.7	1.4	**2.2**
	Unspecified ST-Elevation Myocardial Infarction	1.5	2.6	5.7	**0.7**
Abnormal Result of Cardiovascular Function Studies Under-Reported in DAD		**5.4**	**13.3**	**2.3**	

Notes
MI: myocardial infarction.
* This analysis includes all abnormal results, including cases when more than one cardiovascular function study was performed during a single hospitalization.

The ability to identify a hospitalization for a STEMI or NSTEMI is detailed in Table 23. This analysis illustrates that in 2007–2008, there was incomplete reporting of the code R94.3–, which affects the usability of DAD data for classifying the type of myocardial infarction that an inpatient experienced. In 2008–2009, a new edit was applied to DAD data to ensure that these codes are reported.[xvii]

Table 23
Quality of Identifying Hospitalizations for STEMIs and NSTEMIs

	Volume (in Thousands)		Sensitivity* (95% CI)	Positive Predictive Value† (95% CI)
	DAD Data	Study Data		
ST-Elevation Myocardial Infarction	17.9	23.5	**67** (42–93)	**88** (86–91)
Non–ST Elevation Myocardial Infarction	33.1	45.7	**63** (48–78)	**87** (83–91)
Unspecified ST-Elevation Myocardial Infarction	10.4	9.7	**59** (48–70)	**54** (42–67)

Notes
CI: confidence interval.
* Low sensitivity values indicate under-representation of one of these types of myocardial infarctions in DAD.
† Low positive predictive values indicate over-representation of one of these types of myocardial infarctions in DAD.

xvii. This new edit requires that when any diagnosis from category I21.– or code I24.0 is assigned on the abstract as any diagnosis type, there must be an accompanying diagnosis code of R94.30, R94.31 or R94.38 as diagnosis type 3.

4.6 Obstetrical Trauma

Obstetrical trauma is one of the most commonly reported adverse events; it occurs to the mother during the birthing process. Obstetrical trauma includes third- or fourth-degree perineal lacerations; laceration of the cervix, vaginal wall or sulcus; and injury to the bladder or urethra. It can also be identified if a procedure to repair obstetric lacerations of the uterus, cervix, corpus uteri, bladder, urethra, rectum and sphincter after childbirth was performed.[15]

Seventy-eight percent of hospitalizations where the physician documented obstetrical trauma had this information recorded on the DAD abstract. Also, 87% of hospitalizations where obstetrical trauma was recorded on the DAD abstract had supportive information documented in the patient chart. The coding quality of obstetrical trauma was also assessed by delivery types. This found that the coding quality of obstetrical trauma was highest for vaginal deliveries that required the use of instrumentation, as detailed in Table 24.

Table 24
Quality of Coding Obstetrical Trauma

	Volume (in Thousands)		Sensitivity* (95% CI)	Positive Predictive Value† (95% CI)
	DAD Data	Study Data		
Hospitalizations for Patients Suffering From Obstetrical Trauma, All Deliveries	10.7	12.0	**78** (63–93)	**87** (84–90)
Vaginal Delivery Without Instrumentation‡	5.3	6.2	**72** (48–96)	**85** (80–90)
Vaginal Delivery With Instrumentation‡	4.3	4.0	**100** (100–100)	**94** (91–98)
Caesarean Section‡	1.2	1.8	**49** (13–84)‡	**73** (64–83)

Notes
CI: confidence interval.
* Low sensitivity values indicate under-representation of obstetrical trauma in DAD.
† Low positive predictive values indicate over-representation of obstetrical trauma in DAD.
‡ These statistics refer to the coding quality of obstetrical trauma only and *not* the type of birthing process.

4.7 Birth Trauma

Birth trauma refers to when newborns suffer injuries to their scalps or nervous systems, or when they experience a skull fracture during the birthing process.[15]

Fifty-four percent of hospitalizations for which a physician documented birth trauma had this information recorded on the DAD abstract. Also, 63% of hospitalizations for which birth trauma was recorded on the DAD abstract had supportive information documented in the patient chart. This study indicates unreliable and incomplete reporting of birth trauma to DAD, despite the large sampling variances around the point estimates. Table 25 details these results.

Table 25
Quality of Coding Birth Trauma

	Volume (in Thousands)		Sensitivity* (95% CI)	Positive Predictive Value† (95% CI)
	DAD Data	Study Data		
Hospitalizations for Newborns Suffering From Birth Trauma	1.4	1.6	**54** (11–96)‡	**63** (55–71)

Notes
CI: confidence interval.
* Low sensitivity values indicate under-representation of birth trauma in DAD.
† Low positive predictive values indicate over-representation of birth trauma in DAD.
‡ The high variance for this estimate arises from one record that differed from the mean and that had a large study design weight.

4.8 Pulmonary Embolism and Deep Vein Thrombosis

A pulmonary embolism is a blockage of an artery in the lungs. Pulmonary embolisms can be caused by clots from the venous circulation from the right side of the heart, tumours that have invaded the circulatory system or other sources, such as amniotic fluid, air, fat, bone marrow and foreign substances. Most pulmonary embolisms are caused by clots originating in the lower extremities (deep vein thrombosis) and many resolve on their own.[16] Patients with prolonged bed rest or inactivity are at a higher risk of developing this disease during their hospital stay (that is, post-admission).

Ninety percent of hospitalizations where the physician documented a pulmonary embolism or deep vein thrombosis had this information recorded on the DAD abstract. Also, 93% of hospitalizations where either a pulmonary embolism or a deep vein thrombosis was recorded on the DAD abstract had supportive information documented in the patient chart. Lower results were observed for hospitalizations where this condition developed post-admission. Table 26 details these findings.

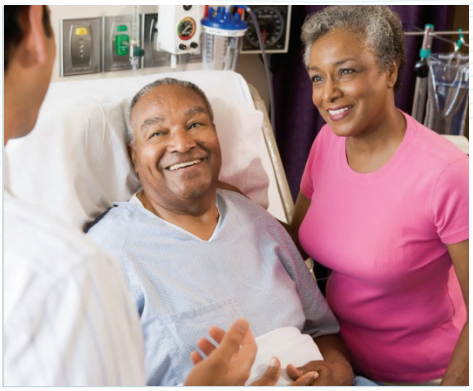
Table 26
Quality of Coding Pulmonary Embolisms and Deep Vein Thrombosis

	Volume (in Thousands)		Sensitivity* (95% CI)	Positive Predictive Value† (95% CI)
	DAD Data	Study Data		
Hospitalizations for Patients Suffering From a Pulmonary Embolism or Deep Vein Thrombosis	14.8	15.3	**90** (86–94)	**93** (91–95)
Post-Admission Pulmonary Embolisms or Deep Vein Thrombosis‡	2.8	3.6	**66** (57–76)	**84** (80–89)

Notes
CI: confidence interval.
* Low sensitivity values indicate under-representation of pulmonary embolisms in DAD.
† Low positive predictive values indicate over-representation of pulmonary embolisms in DAD.
‡ These statistics account for the presence of a pulmonary embolism and its occurrence post-admission (type 2).

4.9 Summary of Findings for the Coding Quality of Select Health Conditions

Hospitalizations for the health conditions studied were generally well represented in DAD, though there was a tendency for these health conditions to be under-reported to DAD. The following specific conditions were found to have lower coding quality: unspecified stroke, STEMI, NSTEMI, post-admission acute myocardial infarction, birth trauma and post-admission pulmonary embolisms or deep vein thrombosis.



Chapter 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 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 and Resource Intensity Weight.

This analysis focuses on the CMG+ 2009 grouping methodology.[17]

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

There are 21 major clinical categories 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 an intervention and diagnosis partition for Case Mix Group assignment. Case Mix Groups categorize patients into 1 of 558 clusters based on clinical diagnoses, procedures and resource utilization. Intervention-driven Case Mix Groups are determined by the presence of a procedure on the intervention partition CCI code list; otherwise, the case is assigned to the diagnosis partition.[18]

Table 27 summarizes the overall reliability of major clinical categories and Case Mix Groups. A total of 96% of the hospitalizations studied 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 90%, with both the diagnosis- and intervention-driven Case Mix Groups having similar results (not shown). The provincial- and territorial-specific results were consistent with these overall findings. The findings from this study were significantly higher than the findings from the 2005–2006 DAD reabstraction study, for which the agreement rate for major clinical category was 91% and for Case Mix Group was 79%. The difference in these results is mainly due to improvements in coding quality, though there are also some differences due to this earlier study being grouped with the CMG/Plx 2003 grouping methodology.

Table 27
Agreement Rates on Major Clinical Category and Case Mix Group

	Agreement Rate (95% CI)
Major Clinical Category	**95.5** (94.7–96.3)
Case Mix Group	**89.5** (88.2–90.8)

Note
CI: confidence interval.

Certain major clinical categories and Case Mix Groups had very high reliability when using DAD data, while others had lower reliability. Tables 27 and 28 illustrate some of 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 28 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 four major clinical categories (14, 13, 12 and 6) and for five Case Mix Groups (536, 545, 726, 727 and 537).

Table 28
Major Clinical Categories and Case Mix Groups With High Agreement Rates*

Grouping Based on DAD Data	Volume in DAD		Agreement Rate (95% CI)
	Total (in Thousands)	Percent of All Cases	
Major Clinical Category			
14—Newborns and Neonates With Conditions Originating in the Perinatal Period	304.4	13.7%	**100** (100–100)
13—Pregnancy and Childbirth	374.1	16.9%	**99.5** (98.9–100)
12—Diseases and Disorders of the Female Reproductive System	121.1	5.5%	**98.2** (96.3–100)
6—Diseases and Disorders of the Digestive System	179.6	8.1%	**96.6** (95.1–98.2)
Case Mix Group			
536—Caesarean Section With Previous Uterine Scar	39.4	1.8%	**99.6** (98.8–100)
545—Vaginal Delivery, No Other Intervention	190.3	8.6%	**99.1** (98.4–99.7)
726—Hip Replacement With Trauma/Complication of Treatment	6.6	0.3%	**98.9** (97.8–100)
727—Fixation/Repair Hip/Femur	12.4	0.6%	**98.4** (97.0–99.8)
537—Primary Caesarean Section	44.6	2.0%	**98.4** (96.9–100)

Notes
CI: confidence interval.
* To be reported, 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 greater than 95%.

Table 29 presents the same analysis, but lists major clinical categories and Case Mix Groups with low agreement rates. Cases assigned to major clinical category 20—*Other Reasons for Hospitalization* were grouped to more specific categories when using the data from the chart review. Case Mix Groups with low agreement rates included 28—*Unspecified Stroke* and 138—*Viral/Unspecified Pneumonia*.[xviii]

Table 29
Major Clinical Categories and Case Mix Groups With Low Agreement Rates*

Grouping Based on DAD Data	Volume in DAD		Agreement Rate (95% CI)
	Total (in Thousands)	Percent of All Cases	
Major Clinical Category			
20—Other Reasons for Hospitalization	74.9	3.4%	**80.5** (71.0–89.9)
Case Mix Group			
28—Unspecified Stroke	7.0	0.3%	**62.1** (53.4–70.9)
138—Viral/Unspecified Pneumonia	23.4	1.1%	**77.0** (65.6–88.3)

Notes
CI: confidence interval.
* To be reported, 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 less than 90%.

xviii. Appendix B 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.

5.2 Reliability of Comorbidity Level Assignment

CIHI's Case Mix Group comorbidity level 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 five 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.[18]

Table 30 presents the agreement rates for all comorbidity levels and illustrates the relationship of the reliability of comorbidity level to the comorbidity level initially assigned. Ninety-four percent of the hospitalizations that were grouped to no significant comorbidity, or level 0, remained grouped to that comorbidity level when using the data obtained from the chart review. Also, cases where comorbidity levels were not applied, or level 8, remained classified this way when using the data from the chart review. Comorbidity levels assigned to more complicated hospitalizations, that is, those related to an increase in the case resources by 25% or more (levels 1 to 4) had lower agreement rates. The provincial- and territorial-specific results were consistent with these overall findings.

Table 30
Reliability of Comorbidity Level Assigned to Hospitalizations

Comorbidity Level Using DAD Data	Agreement Rate (95% CI)
Overall Agreement Rate on Comorbidity Level	**90.4** (89.2–91.6)
Level 0 No Significant Comorbidity	**93.9** (92.4–95.4)
Level 1 Increase the Case Resources by 25%–49%	**71.4** (68.8–74.0)
Level 2 Increase the Case Resources by 50%–74%	**65.9** (62.9–68.8)
Level 3 Increase the Case Resources by 75%–124%	**63.0** (60.1–65.8)
Level 4 Increase the Case Resources by at Least 125%	**76.1** (73.4–78.8)
Level 8 Comorbidity Not Applied	**94.3** (91.2–97.5)

Cases assigned to comorbidity levels 1 to 4 were often grouped to lower comorbidity levels when using the data obtained during the chart review. For example, 17% of the cases originally assigned to comorbidity level 1 were assigned to comorbidity level 0 when regrouped using the data from the chart review. Table 31 provides the full analysis. Note that most hospitalizations were originally assigned to comorbidity level 0 in terms of volume, and this comorbidity level has a very high agreement rate, with 5% of these hospitalizations being assigned to higher comorbidity levels with the reabstraction study data. In volumes, all increases in comorbidity levels (shaded in yellow) represent a total of 124,000 hospitalizations, whereas the decreases (shaded in green) represent 64,000 hospitalizations. These findings on comorbidity level are related to the completeness and correctness of the diagnoses reported to DAD, as discussed in Chapter 4 and further detailed in the special focus analysis in Section 5.2.1.

Table 31
Comorbidity Level Assigned When Using DAD Data and Chart Review Data

Comorbidity Level Using DAD Data	Volume (in Thousands)	Comorbidity Level Using Data From Chart Review					
		Level 0	Level 1	Level 2	Level 3	Level 4	Level 8
Level 0	1,654.8	**94%**	3%	1%	1%	0%	1%
Level 1	170.3	17%	**71%**	5%	6%	1%	0%
Level 2	77.9	16%	6%	**66%**	9%	3%	0%
Level 3	49.4	8%	9%	9%	**63%**	11%	0%
Level 4	20.1	2%	3%	4%	15%	**76%**	0%
Level 8	245.4	6%	0%	0%	0%	0%	**94%**

As the purpose of applying a comorbidity level to a hospitalization is to subdivide a Case Mix Group into five 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 32 lists six Case Mix Groups that have high reliability in assigning comorbidity level. Note that most of the obstetrical Case Mix Groups were assigned to level 8. Table 33 lists eight Case Mix Groups with low reliability in assigning comorbidity level.[xix]

Table 32
Case Mix Groups With High Agreement on Comorbidity Level*

Case Mix Group Using DAD Data	Volume in DAD (in Thousands)	Percent With No Change in Comorbidity Level When Using Chart Review Data (95% CI)
536—Caesarean Section With Previous Uterine Scar	39.4	**99** (97–100)
576—Normal Newborn, Singleton Vaginal Delivery	168.0	**96** (94–99)
543—Forceps/Vacuum Delivery, No Other Intervention	26.6	**96** (93–99)
321—Unilateral Knee Replacement	43.3	**95** (93–98)
193—Myocardial Infarction/Shock/Arrest With Cardiac Catheter	8.6	**95** (92–98)
202—Arrhythmia Without Cardiac Catheter	39.3	**95** (91–99)

Notes
CI: confidence interval.
* To be reported, 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 90%.

xix. Appendix B 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.

Table 33
Case Mix Groups With Low Agreement on Comorbidity Level*

Case Mix Group Using DAD Data	Volume in DAD (in Thousands)	Percent With No Change in Comorbidity Level When Using Chart Review Data (95% CI)
654—Other/Unspecified Septicemia	11.0	**45** (17–73)
601—Newborn/Neonate 2,500+ Grams, Other Minor Problem	20.9	**67** (45–88)
196—Hypertensive Disease Except Benign Hypertension	19.2	**74** (64–84)
138—Viral/Unspecified Pneumonia	23.4	**77** (66–87)
194—Myocardial Infarction/Shock/Arrest Without Cardiac Catheter	27.4	**79** (75–84)
200—Pulmonary Embolism	5.1	**83** (76–89)
26—Ischemic Event of Central Nervous System	12.0	**83** (77–88)
810—Palliative Care	17.6	**85** (80–89)

Notes
CI: confidence interval.
* To be reported, 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 90%.

Special Focus: Comorbidity Reporting and the Reliability of Comorbidity Levels Assigned to Hospitalizations

This special focus analysis looks at the relationship between the coding of comorbidities and the reliability of the comorbidity level assigned to a hospitalization. Comorbidity levels are derived by summing the comorbidity factors associated with certain comorbidities reported on the DAD abstract. Comorbidity factors apply to select ICD-10-CA codes included on the comorbidity factor code list.[17] In this analysis, the comorbidities analyzed are not limited to the comorbidity factor code list. All diagnoses that are captured with an associated type of 1, 2, W, X or Y are considered.

Table 34 presents this analysis. For hospitalizations where there was agreement on the number of comorbidities, there was very high agreement in comorbidity level. However, where there were differences in the number of comorbidities reported, the agreement rates for comorbidity level dropped substantially. This illustrates the relationship between the completeness of reporting comorbidities and the reliability of comorbidity levels. For example, when there were more comorbidities in DAD than in the study data, there was generally either no change or a decrease in comorbidity level. There are exceptions. For example, of hospitalizations with two or more comorbidities on the DAD abstract in comparison to the number of comorbidities reabstracted, 4% still had an increase in comorbidity level upon reabstraction. This occurred when the comorbidity factors assigned to the diagnoses in the reabstracted data summed to a greater amount than the comorbidity factors assigned to the diagnoses in DAD.

Table 34

Reliability of Comorbidity Level in Relation to the Number of Comorbidities Reported to DAD*

Difference in the Number of Comorbidities Between DAD Data and Study Data		Volume (in Thousands)	Change in Comorbidity Level When Using Chart Review Data (95% CI)		
			Decrease	No Change†	Increase
More DAD Comorbidities‡	2+	31.4	24%	71%	4%
	1	138.2	14%	85%	2%
	Agreement	1,530.6	1%	97%	1%
More Study Comorbidities‡	1	290.5	2%	83%	15%
	2+	127.4	2%	64%	34%

Notes

* To isolate the changes that relate to comorbidity reporting, only those hospitalizations that remained grouped to the same major clinical category in the reabstraction study were analyzed.

† Comorbidity level 8 is considered equivalent to level 0 for this analysis.

‡ For this analysis, comorbidities include diagnosis types 1, 2, W, X and Y. All comorbidities were included in these counts, regardless of whether they were on the comorbidity factor code list.

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 comorbidity level, age, flagged intervention and intervention event if they are shown to be statistically significant. There is an expected length of stay associated with each inpatient in DAD.[18]

Expected length of stay values assigned to hospitalizations using DAD data were compared to the values assigned when regrouped using data obtained from the chart review. Eighty-two percent of the cases had no change in expected length of stay, as illustrated in Table 35. Expected lengths of stay that were less than two days showed the highest reliability; 90% 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. This is illustrated below in the right-most column with decreasing rates of agreement as the expected lengths of stay increase.

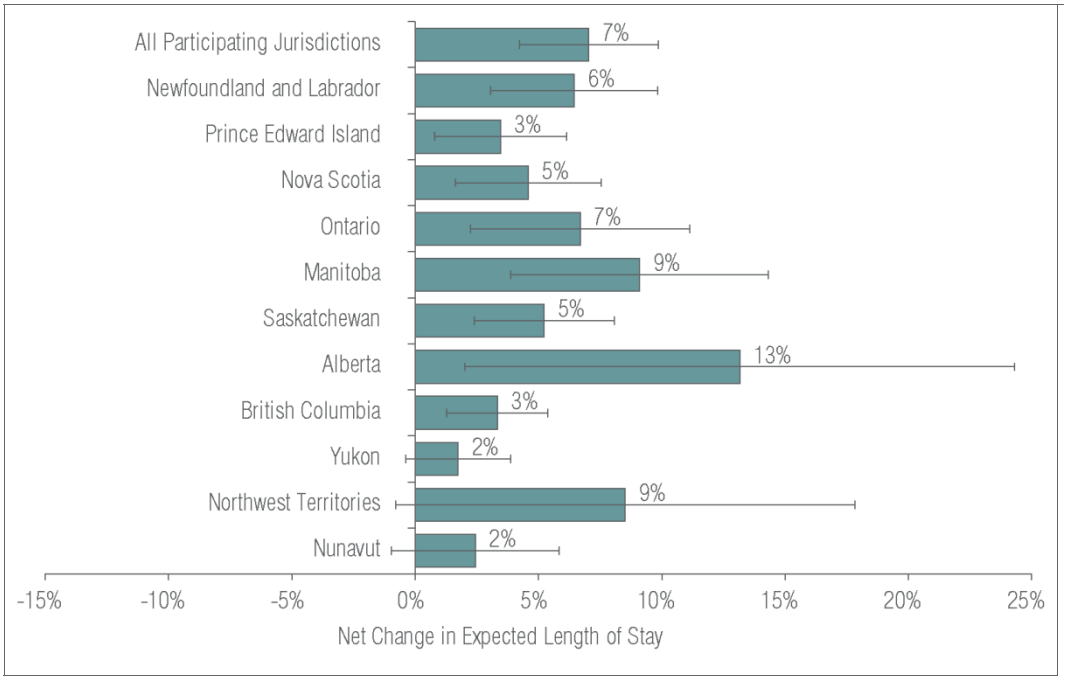
Table 35
Reliability of Expected Length of Stay, by Number of Days

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)
1.0–1.9 Days	622.0	**90** (87–94)	**92** (89–95)
2.0–2.9 Days	518.2	**86** (82–90)	**92** (89–95)
3.0–3.9 Days	242.9	**82** (77–86)	**88** (84–91)
4.0–4.9 Days	256.4	**83** (78–89)	**90** (86–93)
5.0–5.9 Days	158.9	**73** (63–83)	**80** (71–88)
6.0 Days or Longer	418.9	**66** (63–70)	**78** (75–81)
Total Acute Care Hospitalizations	**2,217.9**	**82 (80–84)**	**88 (86–89)**

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

Overall, the differences in the expected length of stay resulted in a net increase in value of 7.0% (95% confidence interval 4.2% to 9.9%) upon reabstraction. That is, there was a tendency for the reabstracted data to have slightly longer expected lengths of stay than those originally derived using the DAD data. Further analysis of the net change in expected length of stay was conducted by province and territory to determine if the reliability of this derived variable differed among the different regions. This analysis found a net *increase* in expected length of stay that was statistically significant ($p<0.05$) in each of the provinces, whereas the net changes seen in the territories were not significantly different from 0%. Figure 17 illustrates these results.

Figure 17
Percent Net Change in Expected Length of Stay, by Jurisdiction



Note
The bars represent 95% confidence intervals. The high variance for the Alberta estimate arises from one record that differed from the mean and that had a large study design weight.

5.4 Reliability of the Patient's Resource Intensity Weight

The 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 assigned to each inpatient in DAD and provides a measure of the resource use of the patient relative to the cost of an average, typical inpatient. There is a Resource Intensity Weight associated with each combination of Case Mix Group, age, comorbidity level, flagged intervention, intervention event and out-of-hospital factors.[18]

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. For 81% of the cases, the Resource Intensity Weight remained unchanged. Table 36 provides further details. Hospitalizations with large Resource Intensity Weights (2.5000 or more) had the lowest agreement rates. 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 for Resource Intensity Weight, the weights derived using the chart review data were often similar in magnitude. For example, half (49%) of the hospitalizations with Resource Intensity Weights of 2.5000 or higher had exact agreement on these values, but 76% of these hospitalizations had values that changed by no more than 25%.

Table 36
Reliability of Resource Intensity Weight, by Magnitude of Weight

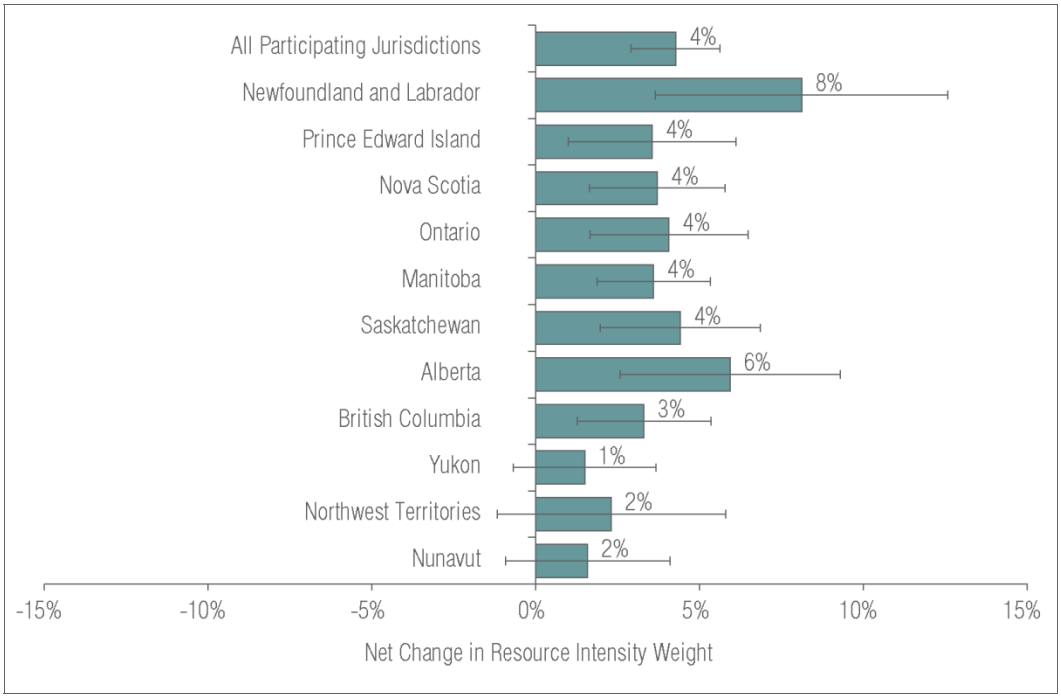
Resource Intensity Weight	Volume in DAD (in Thousands)	Proportion With No Change in RIW When Using Chart Review Data (95% CI)	Proportion With Change in RIW ≤25% When Using Chart Review Data (95% CI)
0.0001–0.4999	769.4	**86** (83–90)	**91** (89–94)
0.5000–0.7499	471.9	**85** (81–89)	**92** (89–94)
0.7500–0.9999	367.9	**86** (82–90)	**91** (88–94)
1.0000–1.4999	239.3	**73** (67–79)	**83** (77–88)
1.5000–2.4999	265.2	**74** (68–81)	**87** (82–92)
2.5000 and Higher	103.6	**49** (41–56)	**76** (67–85)
Total Acute Care Hospitalizations	**2,217.9**	**81 (79–83)**	**89 (88–91)**

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

Overall, the differences in Resource Intensity Weight resulted in a net increase in value of 4.3% (95% confidence interval 2.9% to 5.6%) upon reabstraction. That is, there was a tendency for the reabstracted data to have slightly higher weights than those originally derived using the DAD data. Further analysis of the net change in Resource Intensity Weight was conducted by province and territory to determine if the reliability of this derived variable differed among the different regions. This analysis found a net *increase* in Resource Intensity Weight that was statistically significant ($p<0.05$) in each of the provinces, whereas the net changes seen in the territories were not significantly different from 0%. Figure 18 illustrates these results.

Figure 18

Percent Net Change in Resource Intensity Weight, by Jurisdiction



Note
The bars represent 95% confidence intervals.

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 and the coding of diagnoses and interventions marginally affected the grouping of hospitalizations into major clinical categories (96% agreement) and Case Mix Groups (90% agreement).
- Discrepancies associated with diagnosis typing and the completeness of reporting diagnoses to DAD affected the comorbidity level assigned to 10% of the hospitalizations.
- Due to under-reporting of diagnoses and interventions, reabstracted data tended to group to longer expected lengths of stay and larger Resource Intensity Weights.

Table 37 summarizes the results presented in this chapter and provides additional findings for each of the participating jurisdictions.

Table 37

Summary of Findings for the Reliability of Case-Mix Derived Variables in 2007–2008*

	Metric	Optimal Value	Can.	N.L.	P.E.I.	N.S.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nun.
Major Clinical Category Agreement Rate	Percent (95% CI)	100	**96** (95–96)	**93** (91–96)	**94** (92–96)	**94** (93–96)	**96** (94–97)	**96** (94–97)	**95** (93–96)	**96** (94–97)	**95** (93–96)	**94** (92–96)	**96** (93–100)	**98** (97–100)
Case Mix Group Agreement Rate	Percent (95% CI)	100	**90** (88–91)	**88** (86–91)	**88** (85–91)	**87** (84–89)	**91** (89–94)	**88** (85–91)	**89** (87–92)	**87** (84–90)	**89** (87–91)	**87** (84–90)	**84** (78–91)	**91** (88–94)
Comorbidity Level Agreement Rate	Percent (95% CI)	100	**90** (89–92)	**91** (89–94)	**93** (91–95)	**90** (87–92)	**91** (88–93)	**90** (88–92)	**91** (88–93)	**88** (86–91)	**92** (90–93)	**92** (90–95)	**94** (90–97)	**91** (88–94)
Expected Length of Stay Agreement Rate	Percent (95% CI)	100	**82** (80–84)	**81** (78–84)	**84** (81–88)	**80** (77–83)	**82** (79–86)	**82** (79–85)	**81** (78–84)	**80** (76–83)	**82** (80–85)	**82** (79–85)	**77** (70–84)	**87** (84–91)
Percent Net Change	Percent (95% CI)	0	**7** (4–10)	**6** (3–10)	**3** (1–6)	**5** (2–8)	**7** (2–11)	**9** (4–14)	**5** (2–8)	**13** (2–24)	**3** (1–5)	**2** (0–4)	**9** (-1–18)	**2** (-1–6)
Resource Intensity Weight Agreement Rate	Percent (95% CI)	100	**81** (79–83)	**78** (74–81)	**83** (80–87)	**80** (77–83)	**82** (78–86)	**82** (78–85)	**80** (77–83)	**79** (76–82)	**82** (80–85)	**81** (78–85)	**76** (69–84)	**85** (81–88)
Percent Net Change	Percent (95% CI)	0	**4** (3–6)	**8** (4–13)	**4** (1–6)	**4** (2–6)	**4** (2–6)	**4** (2–5)	**4** (2–7)	**6** (3–9)	**3** (1–5)	**1** (-1–4)	**2** (-1–6)	**2** (-1–4)

Notes

CI: confidence interval.

* Light orange cells indicate results are farther from the optimal value than the national average; dark orange cells indicate the difference between the jurisdictional results and national average is statistically significant ($p<0.05$). Light green cells indicate results are closer to the optimal value than the national average; dark green cells indicate the difference between the jurisdictional results and national average is statistically significant ($p<0.05$).

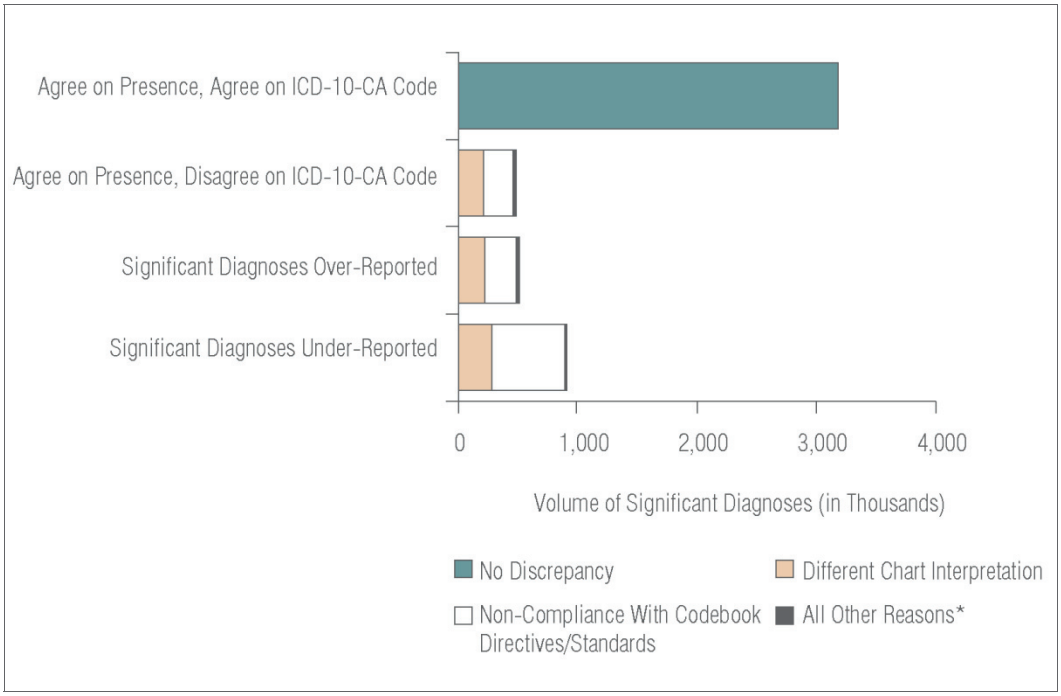
Chapter 6

Discussion of Coding Issues

This chapter focuses on the study's fourth objective, "to identify the sources of the coding issues that arise as a result of any observed coding variation."

Figure 19 summarizes the coding issues identified for significant diagnoses. Most significant diagnoses had no coding issues with respect to assigning significance or with selecting the ICD-10-CA code. However, when there was disagreement on ICD-10-CA code or on the significant diagnoses to include on the DAD abstract, discrepancies stemmed from either differing chart interpretation or from non-compliance with coding rules included in the codebook directives or the Canadian Coding Standards.

Figure 19
Analysis of Coding Issues for Significant Diagnoses

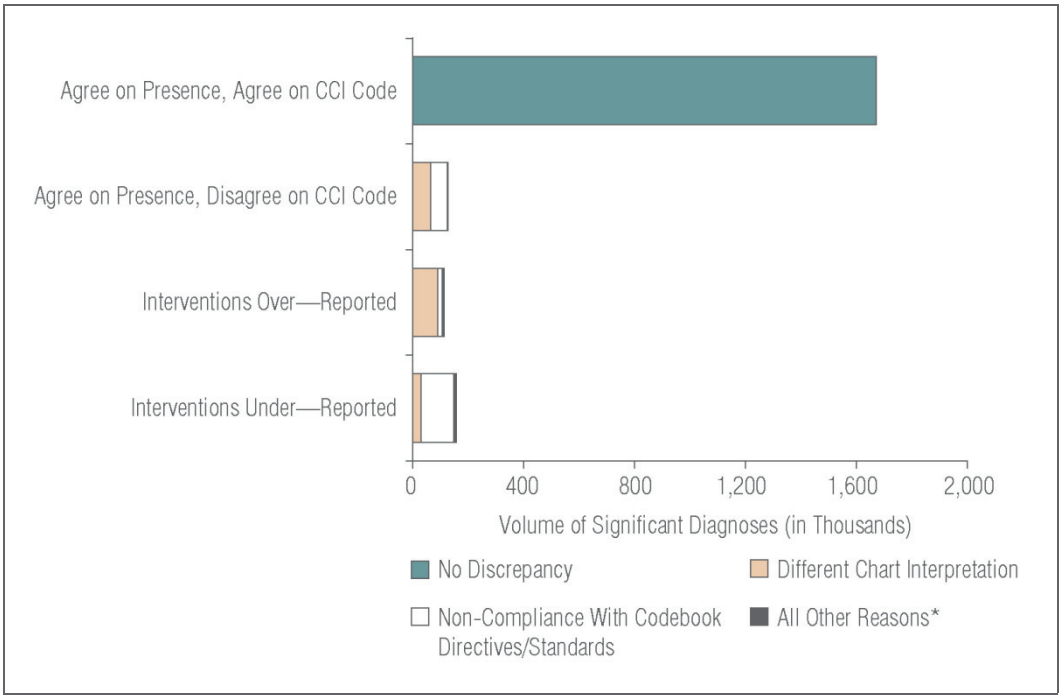


Note

* All Other Reasons includes acceptable coding difference, difference due to asterisk code selected, conflicting chart documentation and incomplete chart documentation.

Figure 20 summarizes the coding issues identified for interventions. Nearly all interventions had no coding issues. However, when there was disagreement on CCI code or on the interventions to include on the DAD abstract, discrepancies were caused either by differing chart interpretation or non-compliance with coding rules included in the codebook directives or the Canadian Coding Standards.

Figure 20
Analysis of Coding Issues for Interventions



Note

* All Other Reasons includes acceptable coding difference, conflicting chart documentation, incomplete chart documentation and non-compliance with the Canadian Coding Standards.

Chapter 7

Conclusion

7.1 Summary of Findings

Trends

- There were several areas where the coding quality of diagnoses and interventions in DAD improved for the data submitted in 2007–2008, compared to the data submitted in 2005–2006.
- The coding of the patient's most responsible diagnosis and the assignment of comorbidities demonstrated the greatest improvements in coding quality.
- More diagnosis and intervention data originally reported to DAD was confirmed by the reabstractor as documented in the patient chart.

Diagnoses

- Reabstractors were not able to locate chart documentation to support the inclusion of 12% of the significant diagnoses on the DAD abstract (that is, over-reported). It was more common for significant diagnoses to be missing from the DAD abstract when documented in the patient chart (20% 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 (87% agreement) and the diagnosis types (81% agreement).
- Agreement on the most responsible diagnosis was observed for 75% of all acute care hospitalizations.

Interventions

- Reabstractors were not able to locate chart documentation to support 6% 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 93% of the time. This, again, is a result that significantly improved since 2005–2006.

Non-Clinical Data

- Non-clinical data continues to be well-reported to DAD.

Jurisdictional Highlights

- Many of the coding quality metrics assessed in this report showed statistically significant and substantial improvement since 2005–2006. Results at the provincial and territorial levels that were considered high in the earlier reporting period are now considered typical.
- The variation in coding quality once seen across jurisdictions is less emphasized. There is more uniformity in the coding quality of DAD data across Canada.

Health Conditions

- The health conditions studied were generally well represented in DAD, though there was a tendency for these health conditions to be under-reported.
- Conditions with overall low data quality include unspecified stroke, unspecified ST-elevation myocardial infarction and birth trauma.
- Conditions with coding issues specific to under-reporting include post-admission acute myocardial infarction, STEMI, NSTEMI and post-admission pulmonary embolism or deep vein thrombosis.

Case Mix Grouping Variables

- Overall, reabstracted data indicated slightly larger resource utilization when assessed with the CMG+ grouping methodology. This outcome corresponds to the under-reporting of diagnoses and interventions to DAD.
- Discrepancies associated with diagnosis typing and the completeness of reporting diagnoses to DAD affected the comorbidity level assigned to 10% of the hospitalizations.
- Discrepancies in the assignment of the patient's most responsible diagnosis affected the grouping of patients to major clinical categories for 4% of the hospitalizations; these as well as any additional differences in the coding of diagnoses and interventions affected the assignment of Case Mix Group for about 10% of the hospitalizations.

Coding Issues

- Coders who capture 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, which 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.

7.2 Considerations for Improving Coding Quality

This report supports that enhancing the information and data quality of DAD is a shared responsibility among health care professionals at the facilities who treat patients and document their care, coders who extract patient information and record data on the DAD abstract and those who maintain the DAD database and develop national coding directives.

This study indicates that recent efforts to improve clinical reporting to DAD resulted in overall improvements to its information and data quality. Where coding issues remain, the findings from this study will be used to improve CIHI products, such as the CMG+ grouping methodology. Administrators, physicians and health records staff at the study facilities can review the findings from the study with the information provided in their facility-specific report to identify areas where improvements are needed to promote high-quality DAD data.

Appendix A: Methodology for Identifying Hospitalizations for Specific Health Conditions

Palliative care: any hospitalization with a diagnosis code of Z51.5 that is assigned a significant diagnosis type[xx]

Stroke: any hospitalization with a diagnosis code between I60 and I64 that is assigned a significant diagnosis type

Hip fracture: any hospitalization with a hip fracture code (S72.000, S72.001, S72.010, S72.011, S72.080, S72.081, S72.090, S72.091, S72.100, S72.101, S72.190, S72.191, S72.200 or S72.201) that is assigned a significant diagnosis type

Acute renal failure: any hospitalization with a diagnosis code of N17.0, N17.1, N17.2, N17.8, N17.9 or N99.0 that is assigned a significant diagnosis type

- Cardiac cases: if one of the following interventions was performed during the same hospitalization: 3.IP.10^^, 1.IJ.50^^, 1.IJ.57.GQ^^, 1.IJ.54.GQ-AZ or 1.IJ.76^^

Acute myocardial infarction: any hospitalization with a diagnosis code between I21 and I22 that is assigned a significant diagnosis type

Abnormal results of cardiovascular function studies: any hospitalization with a diagnosis code of R94.3– of any diagnosis type

- ST-elevated myocardial infarction: if the diagnosis code R94.30 is present
- Non–ST elevated myocardial infarction: if the diagnosis code R94.31 is present
- Unspecified ST-elevation myocardial infarction: if the diagnosis code R94.38 is present

Obstetrical trauma: any hospitalization for a mother during the birthing process (5.MD.50^^, 5.MD.51^^, 5.MD.52^^, 5.MD.53^^, 5.MD.54^^, 5.MD.55^^, 5.MD.56^^ or 5.MD.60^^) who experienced a birth trauma (diagnosis code of O70.2–, O70.3–, O71.3–, O71.4– or O71.5– or an intervention code of 5.PC.80.JH, 5.PC.80.JJ, 5.PC.80.JK, 5.PC.80.JL, 5.PC.80.JM, 5.PC.80.JQ or 5.PC.80.JR)

- Vaginal without instrumentation: if one of the following interventions was performed during the same hospitalization: 5.MD.50^^, 5.MD.51^^, 5.MD.52^^, 5.MD.56.AA, 5.MD.56.NL, 5.MD.56.NP, 5.MD.56.NU, 5.MD.56.GH, 5.MD.56.PA, 5.MD.56.PD, 5.MD.56.PG, 5.MD.56.NM, 5.MD.56.NQ, 5.MD.56.NV, 5.MD.56.PB, 5.MD.56.PE or 5.MD.56.PH

xx. Significant diagnosis types include types M, 1, 2, 6, W, X and Y.

- **Vaginal with instrumentation:** if one of the following interventions was performed during the same hospitalization: 5.MD.53^^, 5.MD.54^^, 5.MD.55^^, 5.MD.56.NN, 5.MD.56.PC, 5.MD.56.NR, 5.MD.56.PF, 5.MD.56.NW or 5.MD.56.PJ
- **Caesarean section:** if the following intervention was performed during the same hospitalization: 5.MD.60^^

Birth trauma: any hospitalization with a diagnosis code of P10–, P11.0, P11.1, P11.2, P11.4, P11.5, P11.9, P12.2, P13.0–, P13.1, P13.2, P13.3–, P13.8, P13.9, P14.2, P14.8, P14.9 or P15–

Pulmonary embolism or deep vein thrombosis: any hospitalization with 1) a diagnosis code of I80.1, I80.2, I80.3, I26.0 or I26.9 assigned a significant diagnosis type; or 2) a diagnosis code of T81.7, T82.8, T83.8, T84.8 or T85.8 assigned a significant diagnosis type, with I80.1, I80.2, I80.3, I26.0 or I26.9 as a diagnosis type 3 or 0; all hospitalizations assigned to major clinical category 13—*Pregnancy and Childbirth* are excluded

Appendix B: Detailed Analysis

Table 38
Agreement Rates for Major Clinical Categories*

Major Clinical Category Based on DAD Data	Volume in DAD (in Thousands)	Agreement Rate (95% CI)
1—Diseases and Disorders of the Nervous System	84.0	**92** (88–96)
3—Diseases and Disorders of the Ear, Nose, Mouth and Throat	45.9	**96** (92–99)
4—Diseases and Disorders of the Respiratory System	120.2	**95** (94–97)
5—Diseases and Disorders of the Circulatory System	210.8	**93** (88–98)
6—Diseases and Disorders of the Digestive System	179.6	**97** (95–98)
7—Diseases and Disorders of the Hepatobiliary System and Pancreas	62.8	**97** (94–100)
8—Diseases and Disorders of the Musculoskeletal System and Connective Tissue	144.1	**96** (93–99)
9—Diseases and Disorders of the Skin, Subcutaneous Tissue and Breast	60.1	**94** (88–99)
10—Diseases and Disorders of the Endocrine System, Nutrition and Metabolism	50.0	**87** (75–98)
11—Diseases and Disorders of the Kidney, Urinary Tract and Male Reproductive System	109.2	**97** (94–99)
12—Diseases and Disorders of the Female Reproductive System	121.1	**98** (96–100)
13—Pregnancy and Childbirth	374.1	**99** (99–100)
14—Newborns and Neonates With Conditions Originating in the Perinatal Period	304.4	**100** (100–100)
15—Diseases and Disorders of the Blood and Lymphatic System	59.5	**95** (92–98)
16—Multisystemic or Unspecified Site Infections	20.7	**84** (75–93)
17—Mental Diseases and Disorders	62.3	**93** (86–100)
19—Significant Trauma, Injury, Poisoning and Toxic Effects of Drugs	128.2	**90** (84–96)
20—Other Reasons for Hospitalization	74.9	**80** (71–90)

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 in the DAD data.

Table 39
Agreement Rates for Case Mix Groups*

Case Mix Group Based on DAD Data	Volume in DAD (in Thousands)	Agreement Rate (95% CI)
25—Hemorrhagic Event of Central Nervous System	5.0	**91** (85–97)
26—Ischemic Event of Central Nervous System	12.0	**83** (77–90)
28—Unspecified Stroke	7.0	**62** (53–71)
138—Viral/Unspecified Pneumonia	23.4	**77** (66–88)
139—Chronic Obstructive Pulmonary Disease	48.4	**95** (91–99)
175—PCI Without Myocardial Infarction/Shock/Arrest/Heart Failure	12.1	**97** (95–100)
193—Myocardial Infarction/Shock/Arrest With Cardiac Catheter	8.6	**96** (94–98)
194—Myocardial Infarction/Shock/Arrest Without Cardiac Catheter	27.4	**89** (86–92)
196—Heart Failure Without Cardiac Catheter	19.2	**84** (76–93)
200—Pulmonary Embolism	5.1	**89** (83–94)
202—Arrhythmia Without Cardiac Catheter	39.3	**77** (55–99)
321—Unilateral Knee Replacement	43.3	**95** (85–100)
437—Diabetes	26.9	**94** (88–100)
536—Caesarean Section With Previous Uterine Scar	39.4	**100** (99–100)
537—Primary Caesarean Section	44.6	**98** (97–100)
542—Forceps/Vacuum Delivery With Non-Major Intervention	3.9	**75** (46–100)
543—Forceps/Vacuum Delivery, No Other Intervention	26.6	**74** (40–100)
544—Vaginal Delivery With Non-Major Intervention	3.9	**91** (87–95)
545—Vaginal Delivery, No Other Intervention	190.3	**99** (98–100)
557—Antepartum Disorder Treated Medically	32.1	**96** (92–100)
576—Normal Newborn, Singleton Vaginal Delivery	168.0	**96** (94–98)
577—Normal Newborn, Multiple/Caesarean Delivery	53.4	**87** (75–100)
593—Newborn/Neonate 2,500+ Grams, Short Gestation/Low Birthweight	7.3	**67** (31–100)
601—Newborn/Neonate 2,500+ Grams, Other Minor Problem	20.9	**70** (48–91)
654—Other/Unspecified Septicemia	11.0	**78** (62–94)
726—Hip Replacement With Trauma/Complication of Treatment	6.6	**99** (98–100)
727—Fixation/Repair Hip/Femur	12.4	**98** (97–100)
806—Convalescence	16.8	**65** (38–93)
810—Palliative Care	17.6	**83** (78–87)

Notes
CI: confidence interval; PCI: percutaneous coronary intervention.
* 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.

Table 40
Agreement Rates for Comorbidity Level, by Case Mix Group*

Case Mix Group Based on DAD Data	Volume in DAD (in Thousands)	Percent With No Change in Comorbidity Level (95% CI)
25—Hemorrhagic Event of Central Nervous System	5.0	**91** (85–97)
26—Ischemic Event of Central Nervous System	12.0	**83** (77–88)
28—Unspecified Stroke	7.0	**89** (84–93)
138—Viral/Unspecified Pneumonia	23.4	**77** (66–87)
139—Chronic Obstructive Pulmonary Disease	48.4	**87** (79–96)
175—PCI Without Myocardial Infarction/Shock/Arrest/Heart Failure	12.1	**93** (90–96)
193—Myocardial Infarction/Shock/Arrest With Cardiac Catheter	8.6	**95** (92–98)
194—Myocardial Infarction/Shock/Arrest Without Cardiac Catheter	27.4	**79** (75–84)
196—Heart Failure Without Cardiac Catheter	19.2	**74** (64–84)
200—Pulmonary Embolism	5.1	**83** (76–89)
202—Arrhythmia Without Cardiac Catheter	39.3	**95** (91–99)
321—Unilateral Knee Replacement	43.3	**95** (93–98)
437—Diabetes	26.9	**87** (75–99)
536—Caesarean Section With Previous Uterine Scar	39.4	**99** (97–100)
537—Primary Caesarean Section	44.6	**84** (72–97)
542—Forceps/Vacuum Delivery With Non-Major Intervention	3.9	**93** (89–97)
543—Forceps/Vacuum Delivery, No Other Intervention	26.6	**96** (93–99)
544—Vaginal Delivery With Non-Major Intervention	3.9	**93** (86–99)
545—Vaginal Delivery, No Other Intervention	190.3	**94** (90–99)
557—Antepartum Disorder Treated Medically	32.1	**86** (80–91)
576—Normal Newborn, Singleton Vaginal Delivery	168.0	**96** (94–99)
577—Normal Newborn, Multiple/Caesarean Delivery	53.4	**87** (75–100)
593—Newborn/Neonate 2,500+ Grams, Short Gestation/Low Birthweight	7.3	**64** (29–100)
601—Newborn/Neonate 2,500+ Grams, Other Minor Problem	20.9	**67** (45–88)
654—Other/Unspecified Septicemia	11.0	**45** (17–73)
726—Hip Replacement With Trauma/Complication of Treatment	6.6	**88** (84–93)
727—Fixation/Repair Hip/Femur	12.4	**89** (85–92)
806—Convalescence	16.8	**93** (87–99)
810—Palliative Care	17.6	**85** (80–89)

Notes
CI: confidence interval; PCI: percutaneous coronary intervention.
* 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.

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Canadian Institute for Health Information
495 Richmond Road, Suite 600
Ottawa, Ontario K2A 4H6

Phone: 613-241-7860
Fax: 613-241-8120
www.cihi.ca
copyright@cihi.ca

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Talk to Us

CIHI Ottawa
495 Richmond Road, Suite 600
Ottawa, Ontario K2A 4H6
Phone: 613-241-7860

CIHI Toronto
4110 Yonge Street, Suite 300
Toronto, Ontario M2P 2B7
Phone: 416-481-2002

CIHI Victoria
880 Douglas Street, Suite 600
Victoria, British Columbia V8W 2B7
Phone: 250-220-4100

CIHI Edmonton
10235 101 Street Northwest, Suite 1414
Edmonton, Alberta T5J 3G1
Phone: 780-409-5438

CIHI Montréal
1010 Sherbrooke Street West, Suite 300
Montréal, Quebec H3A 2R7
Phone: 514-842-2226

CIHI St. John's
140 Water Street, Suite 701
St. John's, Newfoundland and Labrador A1C 6H6
Phone: 709-576-7006

www.cihi.ca
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