



# Data Quality Study of the 2015–2016 Discharge Abstract Database

A Focus on Hospital Harm



Canadian Institute  
for Health Information

Institut canadien  
d'information sur la santé

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- The provincial and territorial ministries of health and regional health authorities that supported this data quality initiative within their jurisdictions.

Please note that the findings and recommendations outlined in the present document are CIHI's and do not necessarily reflect the views of the organizations mentioned above.

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## Executive summary

From October to December 2015, the Canadian Institute for Health Information (CIHI) conducted a reabstraction study on 2015–2016 Discharge Abstract Database (DAD) data. A total of 2,152 charts were sampled from 19 hospitals across Canada. The study was conducted on open-year data, which provided time for hospitals to make any changes to the original DAD data before the year-end closure of the database. This report summarizes the results of this study.

The study provides an assessment of coding quality for all sampled charts, with a primary focus on data used to measure patient safety. Specifically, the study addressed a subset of clinical groups used in the Hospital Harm measure, including 2 existing indicators (Obstetric Trauma and [in-hospital] Sepsis), as well as Obstetric Hemorrhage and Infections Due to *Clostridium difficile*, MRSA or VRE.<sup>i</sup> The study also evaluated the quality of data for 2 other health system performance indicators (Low-Risk Caesarean Section and Time Waiting for Inpatient Bed), which were included in response to stakeholder and internal feedback that the coding should be assessed.

## Overall coding quality

Agreement between the original hospital coders and the reabstractors was measured to provide estimates of diagnosis and intervention coding quality. General coding quality results were compared with results from the last reabstraction study conducted in 2009–2010. Although the designs of the 2 studies were different, overall, the quality of abstract coding in the most recent study appeared to be as good as or better than what was seen in the 2009–2010 study. In particular, the results showed

- Overall, more consistent reporting of significant diagnoses and interventions, including higher agreement on the presence of conditions and the codes used to describe them;
- More consistent identification of the most responsible diagnosis (MRDx) and more precise agreement on the code used to describe it; and
- More consistent identification of comorbidities, particularly for pre-admit (type (1)) comorbidities.

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i. Methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci.

The DAD continues to be a reliable source of data on inpatient hospital care in Canada. Reabstractors observed many practices that had a good impact on quality. For example, several hospitals had collaboration between their health records department (responsible for the coding) and physicians (responsible for the clinical documentation), which generally has a positive effect on data quality and coding consistency, particularly if it is a formalized, regular process. The reabstractors also noted the increasing use of standard templates to help with consistent data capture.

There are some areas that could benefit from additional quality improvement efforts:

- While comorbidity coding has improved, some inconsistency remains about the assignment of type (1) (pre-admit) and type (2) (post-admit) comorbidities. The uncertainty lies with whether a comorbidity significantly contributed to a patient's hospital stay and with whether conditions were actually present at hospital admission or occurred later. There were also challenges in diagnosis typing for obstetric cases, particularly for postpartum conditions.
- The use of diagnosis clusters remains inconsistent. This can result in not correctly classifying conditions as post-intervention complications and may also affect case-mix resource indicators.
- There was some capturing of optional type (3) diagnosis codes and optional interventions, which can contribute to additional coder burden. When optional codes are captured to meet facility or jurisdictional data needs, it is important that this data be collected consistently by all coders; otherwise, the data captured is incomplete and may not be fit for use.
- The availability and quality of chart documentation has a large impact on abstract coding quality. The reabstractors noted several instances where documentation was missing, incomplete, inconsistently located, conflicting or not legible.

## A focus on hospital harm

The new Hospital Harm measure is being developed by CIHI and the Canadian Patient Safety Institute (CPSI). The approach focuses on harm that occurs after hospital admission and classifies it into clinical groups. The clinical groups reviewed in this study are outlined in Table 1; they were selected based on previous data quality reviews that indicated potential inconsistency in their reporting.

Table 1 shows the agreement rates for the selected Hospital Harm clinical groups examined in this study. It presents the proportion of charts included in the clinical group of interest based on the original DAD data that still met the criteria based on the chart review data.



**Table 1** Agreement for selected Hospital Harm clinical groups

Clinical group	Percentage agreement	Lower 95% CI	Upper 95% CI
Sepsis	77.2%	71.8%	82.7%
Obstetric Hemorrhage	89.5%	86.3%	92.7%
Infections Due to <i>Clostridium difficile</i> , MRSA or VRE	93.5%	90.6%	96.4%
Obstetric Trauma	97.0%	95.4%	98.6%
<b>Total</b>	<b>90.6%</b>	<b>88.7%</b>	<b>92.5%</b>

**Notes**MRSA: Methicillin-resistant *Staphylococcus aureus*.

VRE: Vancomycin-resistant enterococci.

CI: Confidence interval.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

For cases in the clinical groups Obstetric Trauma, Obstetric Hemorrhage and Infections, 89% or more were confirmed in the chart review, which means that the original hospital coders and the reabstractors both agreed that the case qualified for the specific Hospital Harm clinical group. Sepsis was the clinical group with the lowest agreement rate (77%). Patient complexity and documentation issues (particularly lack of chronological sorting of events) may explain some of the coding variation seen for this group. This group also had the smallest sample size, and the estimates are therefore less precise.

Most observations that were related to the impact of coding variations on Hospital Harm clinical groups fell into 1 of 3 categories:

1. Disagreement on the chronology of events, which resulted in exclusion of the chart from the Hospital Harm clinical group, as the measure is focused on harm that occurs after admission (or during/after delivery for obstetric cases). This was observed for cases in the groups Sepsis, Infections and Obstetric Hemorrhage.
2. Disagreement on the presence or absence of conditions, which resulted in exclusion of the chart from the specific clinical group, based on the Hospital Harm methodology. This was the reason for most of the excluded Sepsis group cases. For some of these, the reabstractor coded alternate conditions, such as staphylococcal or other bacterial infections. However, in certain cases, these conditions may fall into another Hospital Harm clinical group.
3. Other coding issues that did **not** affect the inclusion of the case in the Hospital Harm clinical group. The biggest issue of this type was the inconsistent use of post-intervention condition (PIC) diagnosis clusters for cases in the Sepsis clinical group.



Overall, this study confirms that the general quality of abstract coding in the DAD is high and supports the use of the data for monitoring hospital harm. Over time, as awareness of the importance of the link between quality documentation, coding and indicators increases among clinicians, the quality of the data used by the Hospital Harm measure will improve.

## Coding quality for selected indicators

The quality of abstract coding has a direct impact on the quality of indicators based on DAD data. The following summarizes the findings for the 2 additional indicators examined in this study, which were included in response to stakeholder and internal feedback that the coding should be assessed.

- Low-Risk Caesarean Section: Almost 100% of all sampled DAD charts that met the criteria for low-risk delivery continued to meet the criteria upon reabstraction and remained in the Low-Risk C-Section indicator. The clinical conditions used to risk-adjust the indicator were generally well coded.
- Time Waiting for Inpatient Bed (TWIB): 79% of charts had identical TWIB calculated based on the original DAD data and based on the chart review data, which is based on the reporting of admission and emergency department (ED) discharge times. The discrepancies did not have a statistically significant impact on indicator results that report the TWIB 90th percentile. The discrepancies are usually the result of inconsistent documentation of dates and times across systems and charts.

## Next steps and recommendations

This data quality study confirmed that the quality of abstract coding in the DAD is very high, which supports a wide variety of uses, including the production of health system performance indicators and new measures such as Hospital Harm. It is clear that hospital coders continue to do excellent work interpreting and coding increasingly complex patient charts. Reabstractors observed many practices within the hospitals that had a good impact on quality.

As with any reabstraction study, one of the objectives is to determine whether there are any systematic issues that should be addressed. Improving data quality is a joint effort between CIHI and other health system stakeholders.

For CIHI, some of the activities planned or already in progress include the following:

- Enhancement of CIHI's products that support high-quality data capture within hospitals, such as standards and educational offerings. 2 focus areas that were identified are diagnosis clusters and comorbidities, as they can affect resource and health performance indicators.

- Further investigation and analysis of issues identified in this report (e.g., impact of incorrect diagnosis clustering, consistency in the ED wait time data elements).
- An evaluation of the effects of this study to determine the extent and impact of any data that was corrected, which its open-year nature allowed for, as well as the monitoring of rates of hospital harm for any changes that may be affected by the study.

For health system stakeholders, CIHI offers the following recommendations:

- Hospitals that participated in this study review their hospital-specific results to identify where improvements may be needed to enhance the quality of DAD data submissions.
- All hospitals review the study findings to determine whether the issues discussed in this report are also present at their facilities and may need to be addressed.
- All hospitals avail themselves of the educational opportunities provided by CIHI, including web conferences, eLearning courses and Tips for Coders.
- Hospital coders review the standards related to aspects of coding that varied most in this study, such as the assignment of diagnosis types and the use of diagnosis clusters.
- Hospitals review their practices around the coding of optional diagnoses and interventions, which could place additional burden on coders.
- CIHI, hospitals and clinical leaders continue efforts to raise awareness among physicians of the important link between good-quality chart documentation and the quality of DAD data and its outputs, such as health system performance indicators.
- Hospitals increase the use of templates or other tools to improve the consistency of chart documentation.
- Hospitals provide regular opportunities for health records staff to consult with clinicians.

The study provided valuable insights into how hospitals currently capture the information within the DAD, which is essential to manage and improve health systems. Hospitals and jurisdictions are investing heavily in new digital health solutions, which provide both opportunities and challenges with regard to data quality. The new systems can have standards and quality checks built in and potentially transform and reduce the burden of data collection. As some reabstractors observed, these new systems can also lead to challenges, including having multiple sources of potentially conflicting information and information that is no longer sorted chronologically (which adds to the challenge of classifying pre- and post-admit comorbidities). As part of CIHI's new strategic plan, CIHI will be collaborating with data providers to capitalize on opportunities to auto-source data from these new digital health solutions, while ensuring that the resulting data is fit for use.

## For more information

For more information about this report or CIHI's Data Quality Program, please write to [dataquality@cihi.ca](mailto:dataquality@cihi.ca).

# 1 Background

## 1.1 About this report

This report presents findings from a recent study to examine the quality of data in the Discharge Abstract Database (DAD). The study was primarily focused on investigating the quality of data used in 6 of the 31 clinical groups of the Hospital Harm Framework currently under development by the Canadian Institute for Health Information (CIHI) and the Canadian Patient Safety Institute (CPSI) that were selected based on previous data quality reviews that indicated potential inconsistency in their reporting. The study also evaluated the quality of data for 2 other health system performance indicators (Low-Risk Caesarean Section and Time Waiting for Inpatient Bed), which were included in response to stakeholder and internal feedback that the coding should be assessed.

Sections 1 and 2 describe the background and methodology of the study. Section 3 provides information on the general coding quality of the sampled charts. Section 4 presents the Hospital Harm results and Section 5 presents findings relating to the other 2 indicators studied.

This report is a companion document to the report *Measuring Patient Harm in Canadian Hospitals*, as it provides more in-depth data quality information related to measuring hospital harm.<sup>1</sup>

## 1.2 Discharge Abstract Database

### Overview

The DAD captures clinical, demographic and administrative information on discharges (including deaths, sign-outs and transfers) from acute care hospitals from all provinces and territories except Quebec.

More than 3.2 million abstracts are submitted annually to the DAD, representing around 75% of all acute inpatient discharges in Canada. Data from Quebec is submitted to CIHI by the ministère de la Santé et des Services sociaux du Québec and appended to the DAD to form the Hospital Morbidity Database (HMDB).<sup>2</sup>

Some provinces and territories also use the DAD to capture data on day surgery procedures or other types of hospital care (e.g., rehabilitation, psychiatric).

## Data collection

Each record (called an abstract) in the DAD is a codified summary of a patient's stay in hospital. After a patient's discharge, the information documented by the physicians in the patient's health record is reviewed and coded by the hospital's health information management specialists (referred to as "coders"), according to standards set by CIHI.

The data collected on each abstract includes up to 25 diagnoses and up to 20 interventions, as well as patient demographic and administrative information. The diagnostic information is coded according to the International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada (ICD-10-CA); interventions are coded according to the Canadian Classification of Health Interventions (CCI). Additional standards and directives are provided in the [\*DAD Abstracting Manual\*](#)<sup>3</sup> and the [\*Canadian Coding Standards for ICD-10-CA and CCI\*](#).<sup>4</sup>

Abstracts are submitted to CIHI by hospitals directly or via their provincial ministries of health on a monthly basis.

## Use

DAD data is extensively used across all levels of Canada's health systems. Many of CIHI's publicly reported health system performance indicators and analytical reports are based on DAD data. CIHI provides comparative electronic reports and data back to data providers and provincial/territorial ministries of health on a regular basis. Information from the DAD is used by institutions to support institution-specific utilization management decisions and administrative research. Governments use the data for funding, policy-making, and system planning and evaluation. Universities and other academic institutions use the data for various research purposes.

## Data quality

Maintaining the quality of the information in the DAD is vital to ensuring continued national relevance and use. CIHI has a strong Data Quality Program to ensure the data's continued fitness for use.<sup>5</sup> Key quality practices built into CIHI's operations include

- Standards, education and client support programs to support consistent and accurate data capture;
- Systems that check records for key data requirements (such as completeness and valid values) on submission to CIHI;
- Monitoring, analysis and feedback mechanisms to identify issues and provide feedback to providers;

- Testing and verification processes to ensure quality of the reporting tools, analysis and indicators, and other information products;
- Validation and other special studies (such as this reabstraction study) to assess quality; and
- Stakeholder engagement to understand their information needs and to develop or evolve systems and products to meet them.

Improving data quality is a collaborative effort. CIHI works both with data providers to support their role in achieving high data quality and also with users of the data to ensure the resulting information meets their changing and expanding requirements and expectations.

## 1.3 Reabstraction studies

Reabstraction studies are designed to evaluate the quality of abstract coding, identify systemic issues and assess the impact of any coding issues on CIHI products.

They involve health information coding specialists external to the hospital (referred to as “reabstractors” in this report) performing a chart review of acute care diagnostic, intervention and other selected data elements that were previously collected and submitted to CIHI. The intent of these studies is not to find fault with the hospital coding specialists or the reabstractors, but rather to identify the extent of coding variations and to identify the underlying causes of the differences. When issues are identified they can be addressed, leading to improvements in data quality. Coding variations may occur for a variety of reasons:

- Lack of knowledge or misinterpretation of standards or directives;
- Hospital policies that negatively affect the quality of the data;
- The quality and completeness of the chart documentation, which affects the coding specialists’ ability to interpret the patient’s stay with respect to the coding standards; and
- Unintentional human error introduced during the abstracting and coding process.

CIHI conducts regular reabstraction studies of the DAD as part of its comprehensive Data Quality Program. From 2005 to 2010, CIHI conducted a 5-year program of large national studies on an annual basis; as a result, there is a wealth of information available on the overall data quality of the DAD.<sup>6, 7, 8, 9, 10</sup> This latest study on 2015–2016 data was smaller in scale and had a specific focus: to investigate the data used to calculate some of the Hospital Harm clinical groups and CIHI’s health system performance indicators.

Although the study designs were different, where applicable, comparisons are shown with the last national reabstraction study on 2009–2010 data. When results appeared to indicate significant differences, additional analysis was completed (not shown) to determine that the findings were the result of real change rather than just a product of the different study designs.

## Open-year data

This is the first study conducted on open-year data, while data collection and submission was still in progress. Previous studies were done on closed data, after the year-end data submission deadline, so data could not be updated or corrected. This meant that the studied abstracts could not actually be changed based on study findings and improvements could be made only in future years. In direct response to feedback from stakeholders, the timing of this study provided an opportunity for changes to be made to the original DAD data prior to year-end closure of the 2015–2016 database.

## 1.4 Hospital harm

To help provide hospital leaders with an overall measure of patient safety, CIHI and CPSI are collaborating with leading experts across Canada and internationally to create a new measure of hospital harm that uses DAD data.

The Hospital Harm Framework is made up of 31 individual clinical groups that measure different types of harm in hospitals. Based on previous data quality work carried out during the development process, the reabstraction study focused on the following 6 clinical groups:

- Infections Due to *Clostridium difficile*, MRSA or VRE;<sup>ii</sup>
- Obstetric Hemorrhage (2 clinical groups; 1 each in the categories Health Care–/Medication-Associated Conditions and Procedure-Associated Conditions);
- Obstetric Trauma (2 clinical groups; 1 each in the categories Health Care–/Medication-Associated Conditions and Procedure-Associated Conditions); and
- Sepsis.

Findings related to these clinical groups are found in Section 4 of this report (Hospital harm in focus). For more information on hospital harm, please refer to the report *Measuring Patient Harm in Canadian Hospitals*.<sup>1</sup>

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ii. Methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci.

## 2 Study method

### 2.1 Study design

This study was designed to compare the data captured and reported to the DAD for specific patient groups with data captured by the reabstractors for the same patient charts. A sample of charts was reviewed to provide national estimates of coding quality for the following patient groups of interest:

1. A subset of Hospital Harm clinical groups:<sup>iii</sup>
  - Infections Due to *Clostridium difficile*, MRSA or VRE
  - Obstetric Hemorrhage
  - Obstetric Trauma
  - Sepsis
2. Low-risk deliveries included in the Low-Risk Caesarean Section indicator<sup>11</sup>
  - With C-section (the numerator for the indicator)
  - Without C-section (additional abstracts included in the denominator)
3. Patients admitted through the emergency department (ED) to evaluate the quality of data used to calculate the indicator Time Waiting for Inpatient Bed (TWIB)<sup>iv</sup>.

Patient charts were selected based upon a 2-stage probability sample. Hospitals that met the following criteria were sampled in the first stage:

- They were defined as large community hospitals or teaching acute care hospitals; and
- They submitted at least 84 cases in the Hospital Harm clinical groups in the first 2 quarters of 2014–2015.

As some of the groups of interest (e.g., Sepsis, Infections) have generally low volumes of cases, the hospital selection was restricted to the above criteria to ensure sufficient sample sizes for effective statistical analysis. Due to the timing requirements of the hospital sampling (July), the 2014–2015 data was used to create the frame used to sample the hospitals, as this was the latest data available.

This first-stage probability sample resulted in 19 hospitals being selected (1 hospital was sampled twice and therefore had a double allocation of charts).

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iii. Technical notes for the Hospital Harm clinical groups can be found in the document [Measuring Patient Harm in Canadian Hospitals: Technical Report](#).

iv. CIHI's Time Waiting for Inpatient Bed indicator is derived from data submitted to the National Ambulatory Care Reporting System (NACRS); these dates and times are also captured in the DAD.



A sample of 2015–2016 charts to study was drawn from the sampled hospitals based on those in the DAD that were submitted to CIHI by September 30, 2015. This was due to the open-year nature of the study, which required that results be disseminated to facilities well in advance of the DAD year-end closure date to allow time for any potential data corrections related to the results to be submitted.

Charts could qualify for more than 1 patient group. For sampling, each chart was assigned to a single group (called a “stratum”) and was allocated to the group with the smallest overall volume that it qualified for. As the sample was a subset of charts based on the populations of interest and not a general sample of all charts within the hospitals, the results may not be representative of the hospitals’ overall coding quality.

Hospitalizations with longer lengths of stay (greater than 30 days) were excluded from the main sample population for reasons of efficiency. However, they were included for 2 groups (Sepsis and Infections) where longer-stay cases could not be ignored without compromising sample size.

**Figure 1** The 2015–2016 study by the numbers

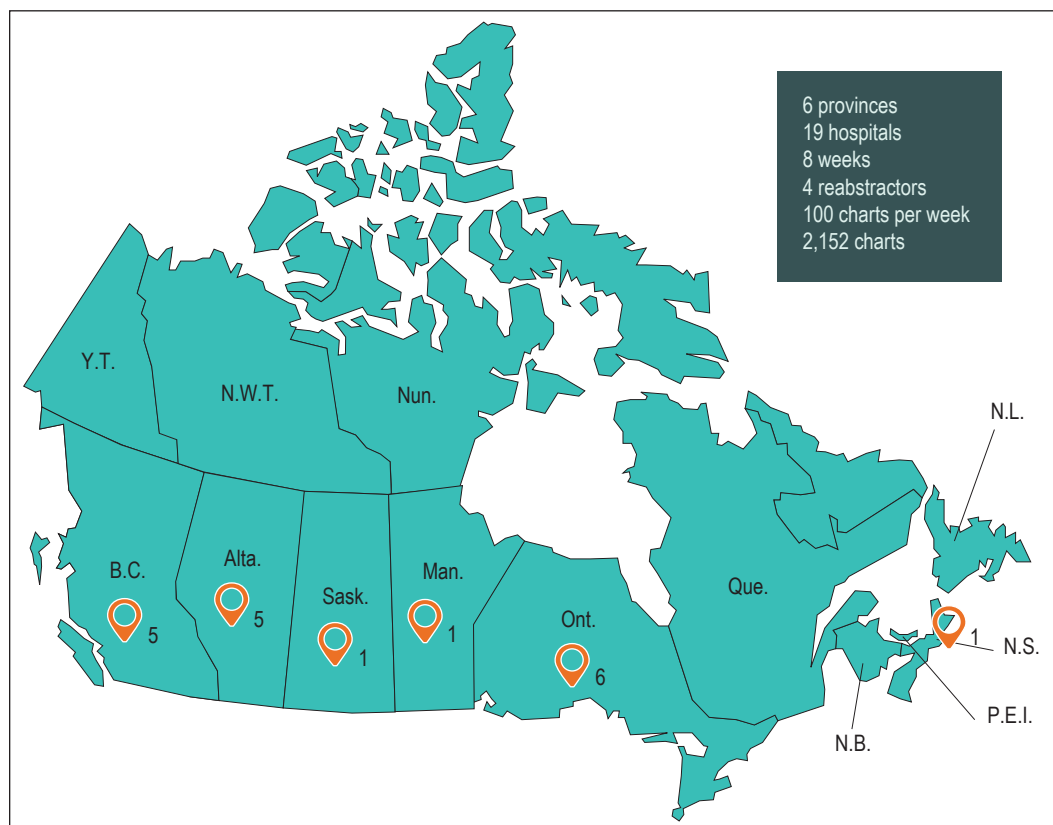


Table 2 shows the number of sampled charts and the volume in the DAD from the September 30 data cut.

**Table 2** Number of abstracts in the DAD and study sample by patient group

Patient group	DAD	Sample
Obstetric Hemorrhage	1,974	495
Obstetric Trauma	918	389
Sepsis	354	273
Infections	354	286
Low-Risk Delivery	15,310	1,114
Admitted Through ED	59,103	733

**Notes**

Charts may qualify for other clinical groups in addition to the one that they were sampled for; therefore, the sum of sampled charts will not equal the number of charts reviewed (2,152).

Number of abstracts in the DAD includes charts submitted for fiscal year 2015–2016, as of September 30, 2015.

**Sources**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study and Discharge Abstract Database.

## 2.2 Data collection

Data collection for this study occurred over 8 weeks from October to December 2015. CIHI classification specialists acted as reabstractors and carried out the data collection. They are certified health information management professionals with expertise in the development, maintenance and support of the ICD-10-CA/CCI classification systems and the Canadian Coding Standards.<sup>4</sup>

Training was provided; it focused on diagnosis typing and coding standards for the health conditions and interventions that pertain to the patient groups of interest and on the use of CIHI's reabstraction web application, which was developed specifically for the study. Inter-rater reliability testing was done using test charts to determine the level of coding agreement among the reabstractors; they were found to be coding consistently.

For data collection, reabstractors visited the sampled hospital, performed a review of the information in the sampled patient's chart and captured (reabstracted) the required data elements, diagnoses and interventions in the application. The application stored this data and then revealed the original data submitted to the DAD, noting wherever differences existed between the DAD data and the study data. The reabstractor then reconciled the data by recording a possible reason for each discrepancy.

While in the field, reabstractors get first-hand experience with hospital coding practices, systems and policies, and are instructed to document any observations related to these that may affect the quality of coding. Wherever possible in this report, reabstractor observations are included to provide context for the results presented.

## 2.3 Data processing and analysis

To ensure the accuracy of the study data, it underwent a series of edit, validation and logic checks after collection.

Weights were then applied to the sampled records. Weighting<sup>v</sup> was done so that the sampled charts represented the number of cases within each stratum within each hospital, and therefore contributed to the overall results relative to their distribution within the hospital. In general, relatively fewer charts were selected in larger strata, so they will have larger weights. For analysis, all qualifying charts were included for a patient group, irrespective of their sampling strata.

As the study was based on a sample of charts, the results are estimates of the true level of coding accuracy. 95% confidence intervals are included in the tables and figures to help with interpretation.

### What is a confidence interval?

Confidence intervals are an indication of sampling error. The sample reviewed in this study is only one of many samples, using the same design and size, that could have been selected from the same population. Sampling error is a measure of the variability among all possible samples. The 95% confidence intervals provided mean that the true value will fall within the confidence interval 19 times out of 20. The wider the interval, the greater the variability associated with the estimates, which is affected by the sample size and design. When comparing results, if the confidence intervals overlap, the differences are not statistically significant, meaning that the true values are unlikely to be different from one another.

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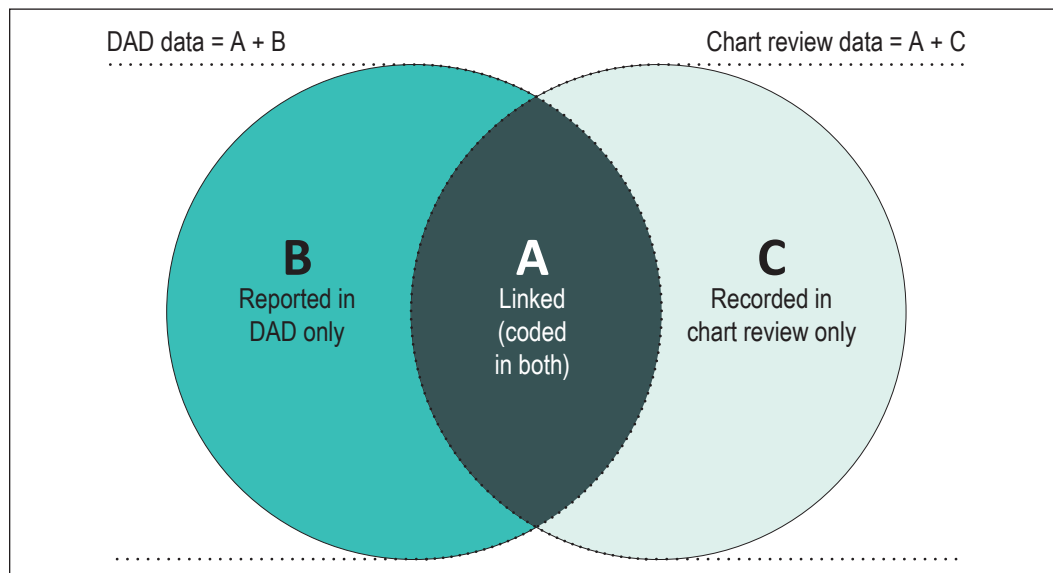
v. Weighting allows for representative estimation and variance estimation (which was done using the bootstrap method) of the study data.

## Coding scenarios

Figure 2 illustrates the reabstraction coding scenarios that the study results are based on:

- A. The reabstractor codes the same health condition or intervention as the original hospital coder, which is the ideal scenario. The rate of agreement of the codes used to describe these conditions/interventions is then assessed.
- B. The reabstractor does not code a health condition or intervention that was present in the original DAD abstract.
- C. The reabstractor codes a health condition or intervention that was not present in the original DAD abstract.




**Figure 2** Reabstraction coding scenarios



# An example chart

This example shows how the reabstraction coding scenarios outlined above apply to a chart.

**Figure 3** Reabstraction coding scenarios

DAD data		Reabstracted data		Reabstraction coding scenario
Dx code	Dx type	Dx code	Dx type	
K831	M	K831	M	
A419	2	A4150	2	
N179	1	N170	2	
N390	2	N390	1	
I100	3			
		E119	3	

**Note**  
Dx: Diagnosis.

When reabstractors confirm the presence of a health condition, they may use the exact same codes as the original coder or they may use *different* codes to describe the *same* condition. Coding is subjective, and there are more than 16,000 ICD-10-CA diagnosis codes and 18,000 CCI intervention codes to choose from. Often, codes within the same group are only subtly different from each other. Reabstractors may also interpret chart documentation in a subtly different way from the original coder. The reabstractors explicitly link the diagnosis codes from the original data with the reabstracted data in the reabstraction application when they agree on the presence of the same condition. Further information about the exact calculations carried out to create the reported statistics can be found in Appendix A.

## 3 Study findings

This section presents estimates of the general coding quality of the sampled charts, including

- Significant diagnoses, including the most responsible diagnosis (MRDx), pre- and post-admit comorbidities and diagnosis clusters;
- Interventions;
- Administrative data elements; and
- Derived case-mix variables.

Wherever possible, the overall results from the previous 2009–2010 DAD data quality study are provided.<sup>10</sup> It is important to note for comparison that the 2009–2010 study was larger in scale and had a different clinical focus,<sup>vi</sup> so the 2 study cohorts may not always be directly comparable.

### 3.1 Significant diagnoses

#### What is a significant diagnosis?

A diagnosis is considered significant if the condition

1. Required treatment beyond maintenance of the pre-existing condition;
2. Increased the patient's length of stay by at least 24 hours; or
3. Significantly affected the treatment received.

It is mandatory to code all significant diagnoses in a DAD abstract. A coder must therefore identify each condition documented in a patient's chart, assess whether it meets the criteria for significance based on the physician's documentation and then code it accordingly.

A diagnosis type accompanies every diagnosis on the DAD abstract, which differentiates the roles different conditions played in the patient's stay. Significant diagnosis types include the patient's most responsible diagnosis (type (M) or MRDx), proxy most responsible diagnosis (type (6)), pre-admit comorbidity (type (1)), post-admit comorbidity (type (2)) and service transfer diagnoses (types (W), (X) and (Y)).

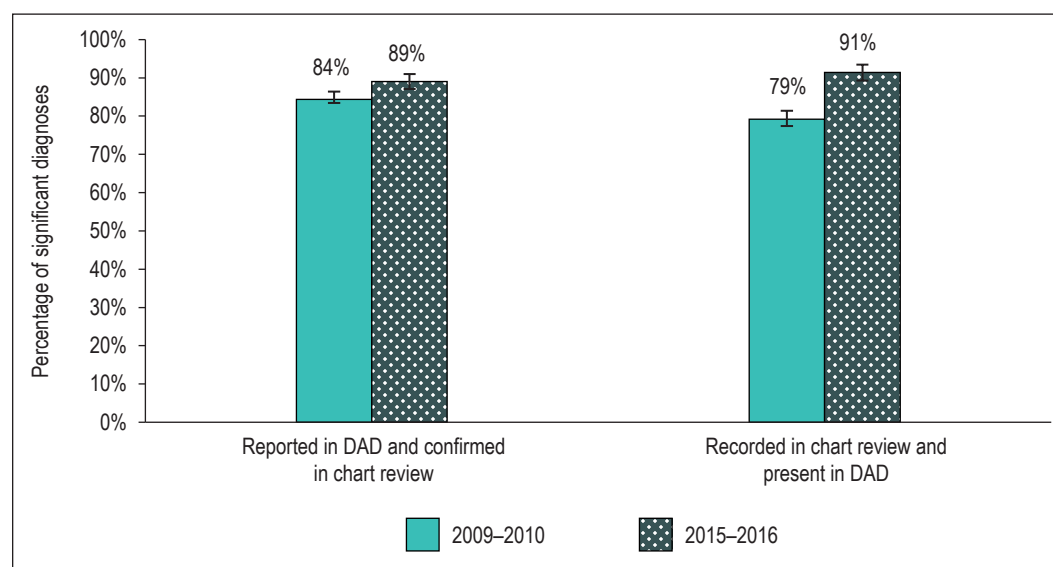
Other diagnosis types are sometimes reported to the DAD (such as admission, secondary or cause of death diagnoses); however, they are optional to report and were not assessed as part of this study.

vi. The 2009–2010 DAD Reabstraction Study included data from 85 hospitals and approximately 14,000 charts.

## Agreement on the reporting of significant diagnoses

Figure 4 shows how the reporting of significant diagnoses compared between the DAD and the chart review data. The percentage of significant diagnoses reported in the DAD and confirmed in the chart review was 89% (11% were reported in the DAD only). Of the significant diagnoses recorded in the chart review, 91% were reported in the DAD (9% were in the chart review only). Both of these results are improvements from the 2009–2010 study.<sup>vii</sup>

**Figure 4** Reporting of significant diagnoses



**Note**

i: 95% confidence intervals.

**Sources**

Canadian Institute for Health Information, 2009–2010 and 2015–2016 DAD reabstraction studies.

## Agreement on diagnosis codes

As described previously, a reabstractor may agree with the hospital coder on the presence of a diagnosis but use a different ICD-10-CA code to describe the condition.

vii. Although the study designs were different, when results appeared to indicate significant differences, additional analysis was completed (not shown) to determine that the findings were the result of real change rather than just a product of the different study designs.



## Coding consistency

Diagnosis codes are indexed within ICD-10-CA into categories, blocks and chapters, and they primarily describe an illness, a condition, a health problem, a circumstance or an external cause affecting the patient. Figure 5 shows the level of confirmed detail about a classification for fully and partially matching codes.

**Figure 5** Diagnosis code matching example

<b>Exact match</b>	<u>I21.1</u>	<u>I21.1</u>		Acute myocardial infarction — same site
<b>Category match</b>	<u>I21.1</u>	<u>I21.2</u>		Acute myocardial infarction — different site
<b>Block match</b>	<u>I21.1</u>	<u>I20.0</u>		Acute myocardial infarction versus unstable angina
<b>Chapter match</b>	<u>I21.1</u>	<u>I34.0</u>		Acute myocardial infarction versus acute mitral regurgitation
<b>Different chapter</b>	I21.1	R07.4		Acute myocardial infarction versus chest pain (symptom)

Confirmed details

This analysis examines the consistency of the ICD-10-CA codes used to describe significant diagnoses that were reported in the DAD and confirmed in the chart review. Exact ICD-10-CA code agreement (up to 6 characters) was observed for 93% of the significant diagnoses (Table 3).

Although not very common, diagnosis codes from different chapters are sometimes assigned to the same condition. This can happen, for example, if the original coder assigned a code for a symptom, such as chest pain (R-code from Chapter XVIII), whereas the reabstractor assigned a code for the underlying condition, such as heart attack (I-code from Chapter IX). This also tended to occur when diagnoses involved clustering and the hospital coder and reabstractor clustered the diagnoses differently (see the section on diagnosis clusters below for more details).

**Table 3** ICD-10-CA code agreement for significant diagnoses

Agreement level	Percentage agreement	Lower 95% CI	Upper 95% CI
Exact match (ANN.NNN format)	92.8%	91.2%	94.5%
Category match only (ANN format)	3.3%	2.3%	4.3%
Block match only (range of categories)	1.8%	0.8%	2.8%
Chapter match only (grouping of blocks)	0.5%	0.2%	0.7%
Codes used from different chapters	1.6%	0.6%	2.7%

**Notes**

A: Alpha character; N: Numeric character.

CI: Confidence interval.

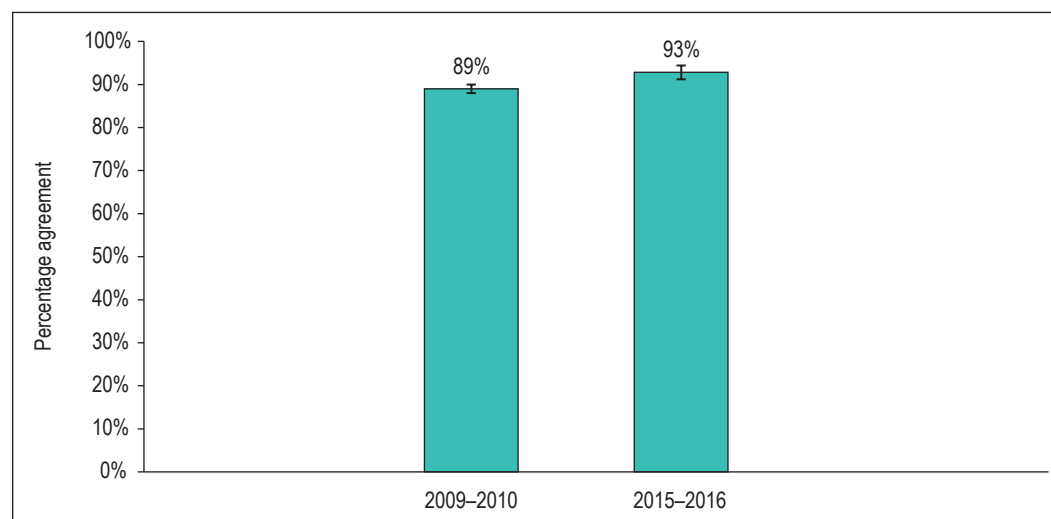
Percentages may not add up to 100% due to rounding.

Includes significant diagnoses coded in the DAD that were confirmed as being present in the chart review.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

The rate of exact ICD-10-CA code agreement for significant diagnoses (93%) is similar to the rate found in the 2009–2010 study (89%) (Figure 6).

**Figure 6** Exact ICD-10-CA code agreement for significant diagnoses**Notes**

I: 95% confidence intervals.

Includes significant diagnoses coded in the DAD that were confirmed as being present in the chart review.

**Sources**

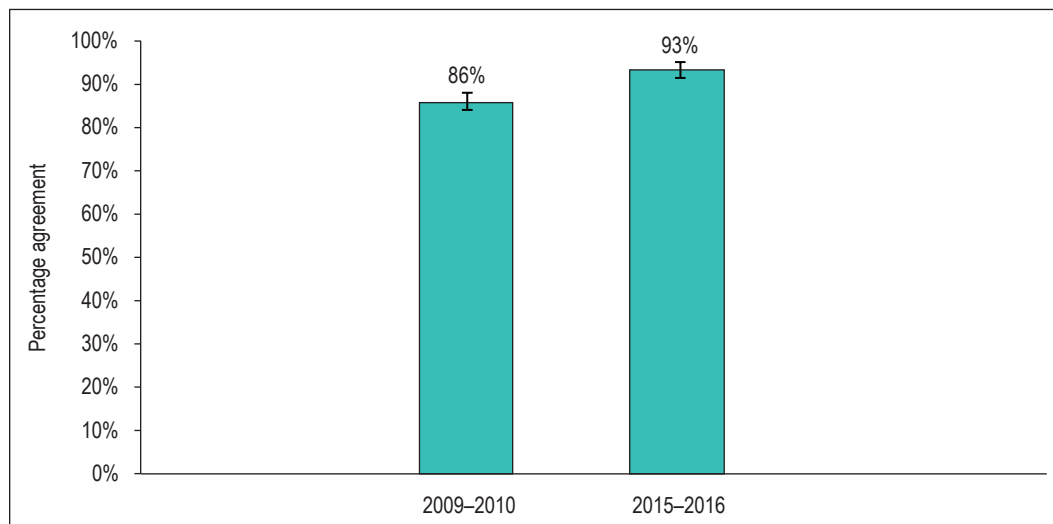
Canadian Institute for Health Information, 2009–2010 and 2015–2016 DAD reabstraction studies.

## 3.2 Most responsible diagnosis

A patient chart usually contains multiple diagnoses, 1 of which must be selected as the MRDx for the patient's stay in hospital. This is usually the diagnosis that accounts for the greatest portion of the patient's stay or the greatest use of resources, and it is the most frequently used diagnosis code in analysis and reporting. This section examines both the agreement on the selection of the MRDx and the agreement on the code used to describe the MRDx.

Figure 7 shows the agreement on the assignment of the MRDx between the DAD data and the chart review data (93%), and how it compares with the results of the 2009–2010 study (86%).

**Figure 7** Agreement on assignment of MRDx



**Note**

i: 95% confidence intervals.

**Sources**

Canadian Institute for Health Information, 2009–2010 and 2015–2016 DAD reabstraction studies.

Table 4 shows the ICD-10-CA code agreement rate at various levels for the MRDx. There was an exact MRDx code match for 85% of the charts.

Discrepancies in the ICD-10-CA code that represents the MRDx may be because different codes were selected for the same condition or because different conditions were selected as the MRDx (which occurred in 7% of charts).

**Table 4** ICD-10-CA code agreement for MRDx

Agreement level	Percentage agreement	Lower 95% CI	Upper 95% CI
Exact match (ANN.NNN format)	84.8%	81.4%	88.3%
Category match only (ANN format)	4.6%	2.7%	6.4%
Block match only (range of categories)	2.8%	1.1%	4.6%
Chapter match only (grouping of blocks)	2.5%	1.5%	3.5%
Codes used from different chapters	5.2%	2.8%	7.7%

**Notes**

A: Alpha character; N: Numeric character.

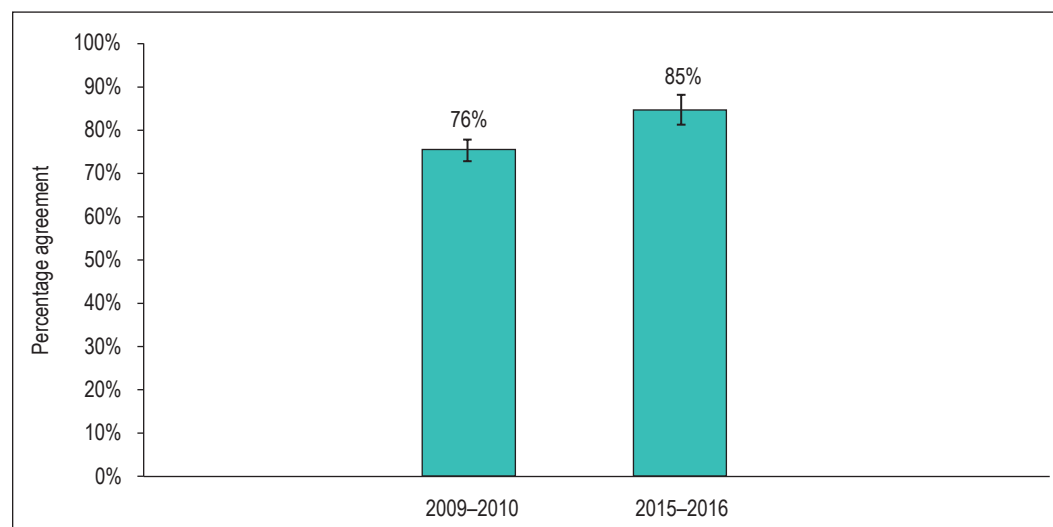
CI: Confidence interval.

Percentages may not add up to 100% due to rounding.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

Figure 8 shows how the exact ICD-10-CA code agreement rate for the MRDx (85%) is higher than the overall rate from the 2009–2010 study (76%).

**Figure 8** Exact ICD-10-CA code agreement for MRDx**Note**

i: 95% confidence intervals.

**Sources**

Canadian Institute for Health Information, 2009–2010 and 2015–2016 DAD reabstraction studies.

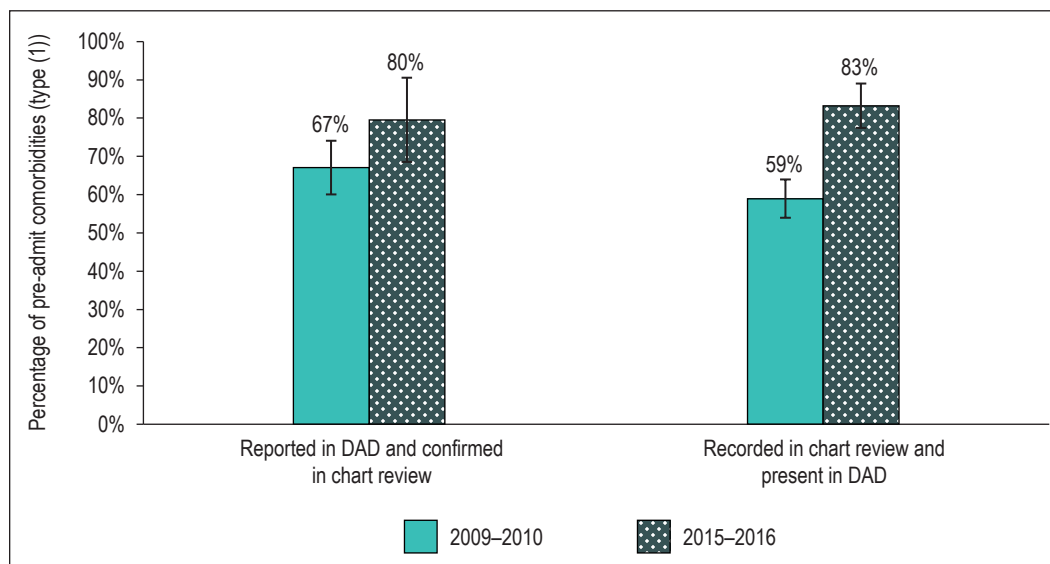
### 3.3 Comorbidities

In addition to identifying the MRDx, diagnosis typing is used to identify comorbidities — conditions that exist at the time of admission or that develop subsequently and meet at least 1 of the 3 criteria for significance. Generally, pre-admit comorbidities (type (1)) represent a condition that existed prior to admission and post-admit comorbidities (type (2)) represent a condition that arose after admission. It should be noted that the study population includes a significant proportion of obstetric conditions, and diagnosis typing for obstetric conditions is different from that for other acute care cases (it is related to whether the condition occurred before, during or after delivery).

#### Pre-admit comorbidities (type (1))

Figure 9 shows that in 2015–2016, 80% of type (1) comorbidities reported in the DAD were confirmed in the chart review, compared with 67% in the 2009–2010 study. Of type (1) diagnoses recorded in the chart review, 83% were reported in the DAD in 2015–2016, compared with 59% in 2009–2010.

**Figure 9** Reporting of pre-admit comorbidities



**Note**

i: 95% confidence intervals.

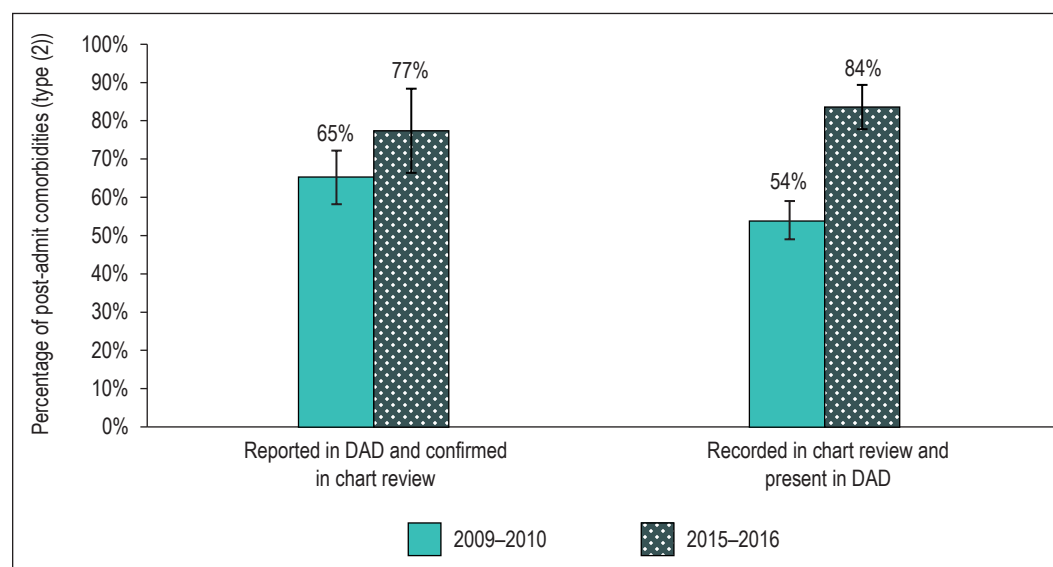
**Sources**

Canadian Institute for Health Information, 2009–2010 and 2015–2016 DAD reabstraction studies.

## Post-admit comorbidities (type (2))

Figure 10 shows that in 2015–2016, 77% of type (2) comorbidities reported in the DAD were confirmed in the chart review, compared with 65% in the 2009–2010 study. Of type (2) diagnoses recorded in the chart review, 84% were reported in the DAD in 2015–2016, compared with 54% in 2009–2010.

**Figure 10** Reporting of post-admit comorbidities



**Note**

i: 95% confidence intervals.

**Sources**

Canadian Institute for Health Information, 2009–2010 and 2015–2016 DAD reabstraction studies.

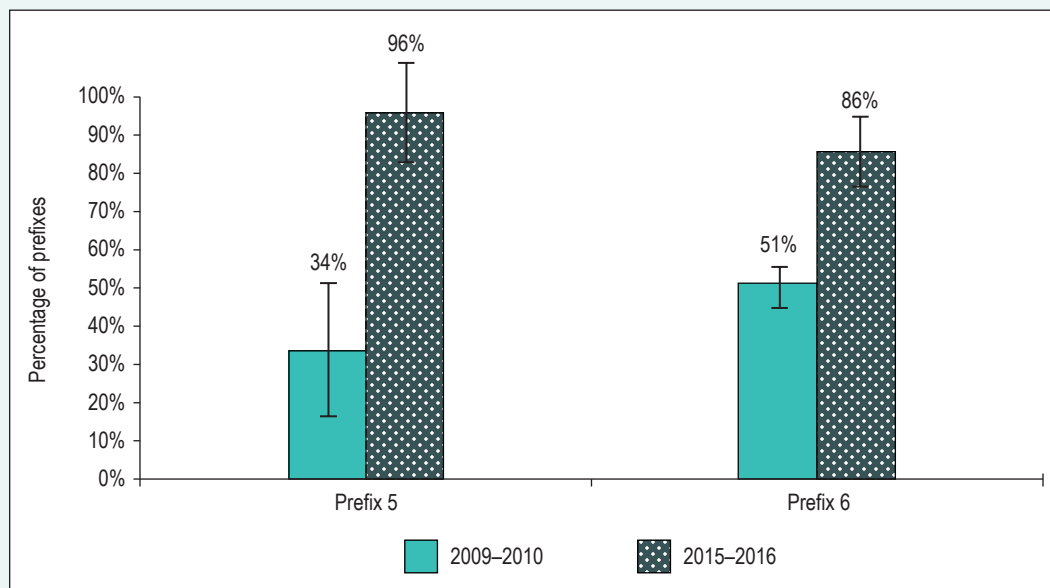
Although comorbidity coding results have improved, they still suggest uncertainty about when to assign diagnosis type (1) or (2). For the majority of conditions, the uncertainty seems to be about whether or not the conditions contributed significantly to the patient's hospital stay. In other cases, both the hospital coder and the reabstractor agreed that the condition was significant but disagreed on the typing. These differences may arise due to difficulties in determining the exact chronology of events from the documentation and whether the diagnosis was present prior to hospital admission (i.e., whether it was a type (1) or type (2) diagnosis). These issues are described in further detail in Section 4, as they impact the measurement of hospital harm.

Also, for obstetric cases, postpartum conditions (such as postpartum hemorrhage) should always be assigned a diagnosis type (2) because they occur *after* delivery, but there were several instances when a diagnosis type (1) was originally applied in the DAD data.

## Prefixes 5 and 6

Prefixes 5 and 6 are used to further qualify post-admit comorbidities by identifying whether the comorbidity arose before (prefix 5) or after (prefix 6) a qualifying intervention.<sup>viii</sup> They were introduced in 2009–2010, the same year as the last reabstraction study. Results from that study showed that there was uncertainty about their application.<sup>10</sup> Unsurprisingly, a large number of both prefixes 5 and 6 that were recorded in the 2009–2010 study, by reabstractors trained in their use, were not present in the original DAD data. Results from this study show that the agreement on prefixes 5 and 6 has improved significantly (Figure 11).

**Figure 11** Prefixes recorded in chart review and present in the DAD



**Note**

i: 95% confidence intervals.

**Sources**

Canadian Institute for Health Information, 2009–2010 and 2015–2016 DAD reabstraction studies.

<sup>viii</sup>. The intervention has to occur in the main operating room or cardiac catheterization room of the reporting hospital, or outside of hospital for selected cardiac interventions.



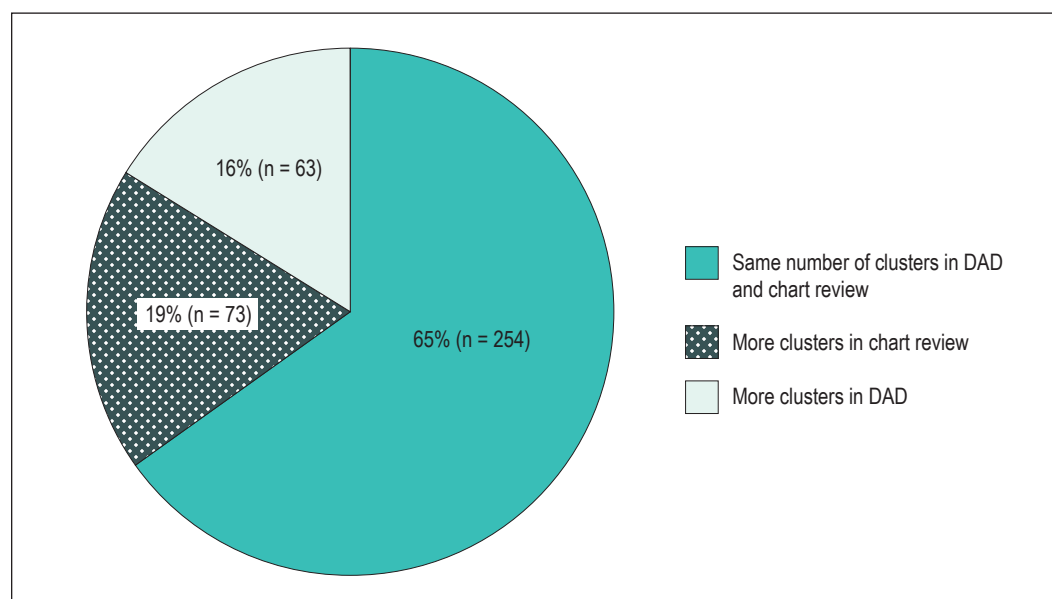
## Diagnosis clusters

### What is a diagnosis cluster?

A diagnosis cluster is an alpha character assigned to 2 or more ICD-10-CA codes to signify that they relate to one another. They were introduced to the DAD in 2009–2010. It is mandatory to assign a diagnosis cluster for certain conditions: post-intervention conditions (PICs); adverse effects in therapeutic use of drugs, medicaments or biologic substances; and drug-resistant microorganism infections. Clusters were prevalent in this study due to its focus on hospital harm. While the quality of the clusters used in the specific Hospital Harm clinical groups is discussed in the next section, information on the coding of all diagnosis clusters identified in the study is presented here.

Results from the 2009–2010 reabstraction study showed that there were some challenges with diagnosis clustering; that study was done the year diagnosis clusters were introduced.<sup>10</sup> There is evidence from this most recent study that the use of clusters remains problematic, as there were many differences in the coding between the original DAD data and the chart review data that affected the application of diagnosis clusters.

390 (unweighted) sampled charts had at least 1 diagnosis cluster coded in either the original DAD data or the chart review. Figure 12 shows that a third of these charts had a discrepancy in the number of diagnosis clusters applied. Most of the inconsistencies were due to disagreement between the original coder and the reabtractor on whether a condition was classified as a PIC or, for a smaller number, an adverse reaction to drugs or other substances. For the majority (119 out of 136, unweighted), there was agreement on the presence of 1 or more conditions despite disagreement on whether they should be part of a diagnosis cluster. For a small number (15) of complex charts with multiple clusters, the reabtractor split codes from 1 cluster in the DAD into 2 or more clusters, which indicated disagreement on how the diagnoses relate to each other.

**Figure 12** Charts with diagnosis clusters in the DAD and chart review**Notes**

Percentages are based on unweighted sample counts.

Percentages may not add up to 100% due to rounding.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

Further analysis was carried out on the PIC clusters; although they were not the primary focus of the study, many PICs are included in the Hospital Harm Framework. A total of 323 PIC clusters were found in the chart review data. When the content of the clusters was compared with the original DAD data,

- 83 chart review clusters had a matching cluster in the DAD with the exact same contents;
- 35 had no matching DAD cluster, but at least 1 of the conditions in the chart review cluster was linked to a condition reported in the DAD (i.e., the original coder had classified the condition differently, which did not require it to be clustered);
- 12 had no matching DAD cluster and no linked conditions were reported in the DAD; and
- 193 had a corresponding DAD cluster (based on 1 or more health conditions being linked in the DAD and chart review clusters), but the cluster content differed in some way.

Many of these mismatched PIC clusters had unlinked diagnoses included in the clusters (119 of 187 clusters). More often, the chart review clusters contained diagnosis codes that were not included in the original DAD. Many of the original DAD clusters were incomplete and usually missing primary complication codes, such as T-codes, which are mandatory to code to fully describe the condition. There were also clusters that had diagnosis codes included in the original DAD cluster but not in the chart review (these were sometimes chronic conditions or conditions that the reabstractor determined on review of the documentation were attributable to another cause).

Of note, more than half of the mismatched PIC clusters involved sepsis and infections, which tend to be complex cases. In the original DAD data, many PIC sepsis clusters were missing codes or had codes with the wrong diagnosis type. Many cases of infection due to *C. difficile* included the infection code A04.7 (Enterocolitis due to *Clostridium difficile*) in a cluster when it should not have been there, since it was not classified as a PIC because it was attributable to another cause.

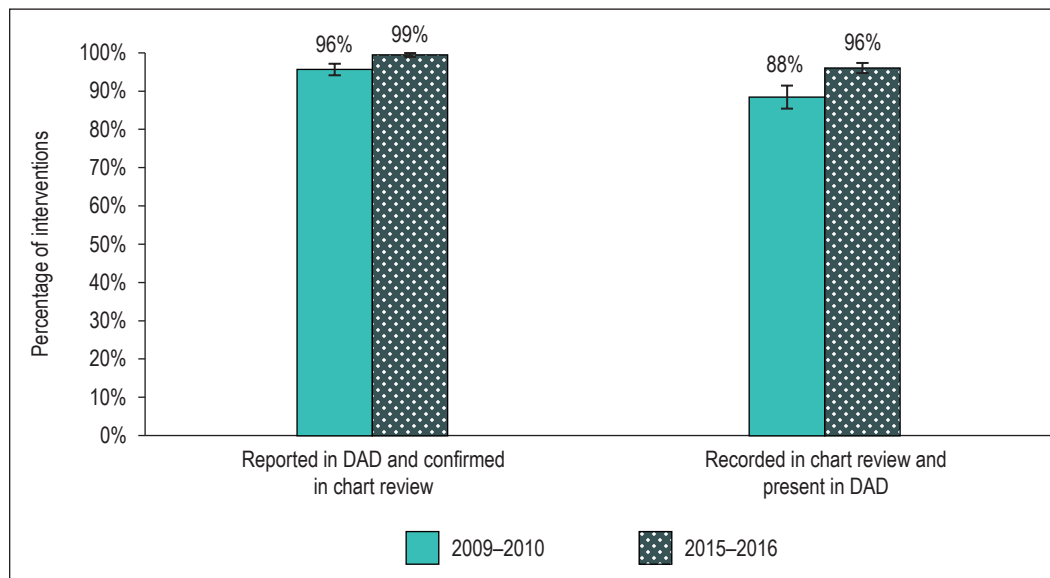
## 3.4 Intervention coding quality

### Agreement on the reporting of interventions

Not all clinical interventions carried out during an episode of care need to be captured on the DAD abstract. The Canadian Coding Standards identifies the minimum requirements, which include interventions that are invasive to the patient and/or require significant resources, along with other specific criteria.

Figure 13 shows that the reporting of interventions in the 2015–2016 study was very consistent and has improved from the 2009–2010 study. The percentage of interventions reported in the DAD and confirmed in the chart review was 99% (up from 96% in 2009–2010), and the percentage of interventions recorded in the chart review and present in the DAD was 96% (up from 88%).

Agreement on interventions has historically been higher than that on diagnosis coding as interventions are not as subject to interpretation (e.g., determining significance of diagnosis based on the physician's documentation).<sup>10</sup>

**Figure 13** Reporting of interventions**Notes**

r: 95% confidence intervals.

Includes only mandatory interventions according to the *Canadian Coding Standards for Version 2015 ICD-10-CA and CCI* and CIHI's Case Mix Group+ grouping methodology.

**Sources**

Canadian Institute for Health Information, 2009–2010 and 2015–2016 DAD reabstraction studies.

## Agreement on intervention codes

This analysis examines the consistency of the CCI codes used to describe interventions. The first 5 characters (the rubric) of the CCI code describe the intervention performed and on which anatomy site. The remaining 5 characters describe the approach, device or tissue involved. Table 5 shows that the exact CCI code match rate was 98%.

**Table 5** CCI code agreement

Agreement level	Percentage agreement	Lower 95% CI	Upper 95% CI
<b>Exact match (N.AA.NN.AA-AA-A format)</b>	98.1%	97.1%	99.1%
<b>Rubric match only (N.AA.NN format)</b>	0.9%	0.3%	1.5%
<b>Group match only (N.AA format)</b>	0.3%	0.0%	0.6%
<b>Block match only (range of groups)</b>	0.5%	0.0%	1.2%
<b>No match</b>	0.3%	0.1%	0.4%

**Notes**

A: Alpha character; N: Numeric character.

CI: Confidence interval.

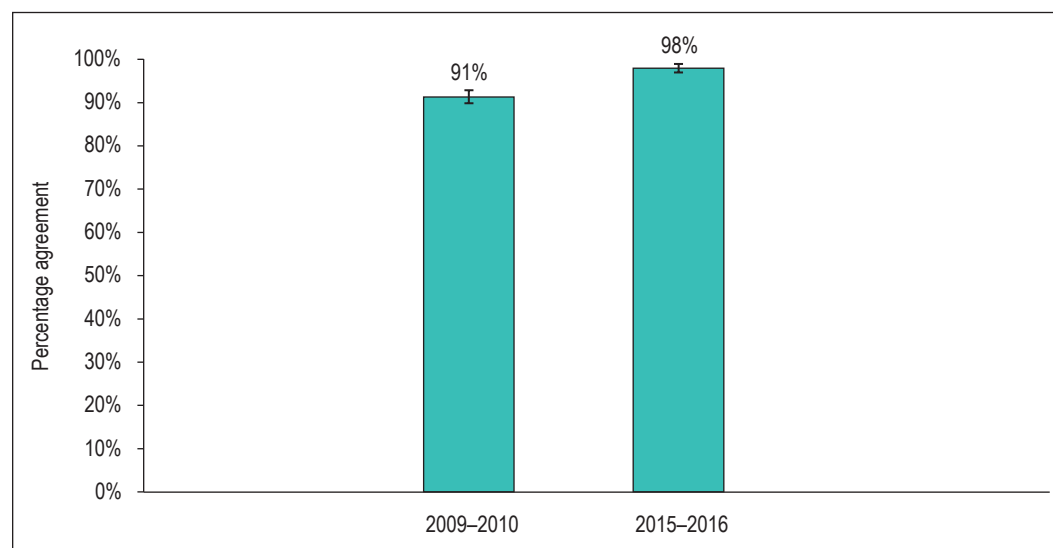
Percentages may not add up to 100% due to rounding.

Includes interventions coded in the DAD that were confirmed as being present in the chart review.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

Figure 14 shows that the exact CCI code match rate in the current study (98%) is higher than the result in the 2009–2010 study (91%).

**Figure 14** Exact CCI code agreement for interventions**Notes**

I: 95% confidence intervals.

Includes interventions coded in the DAD that were confirmed as being present in the chart review.

**Sources**

Canadian Institute for Health Information, 2009–2010 and 2015–2016 DAD reabstraction studies.

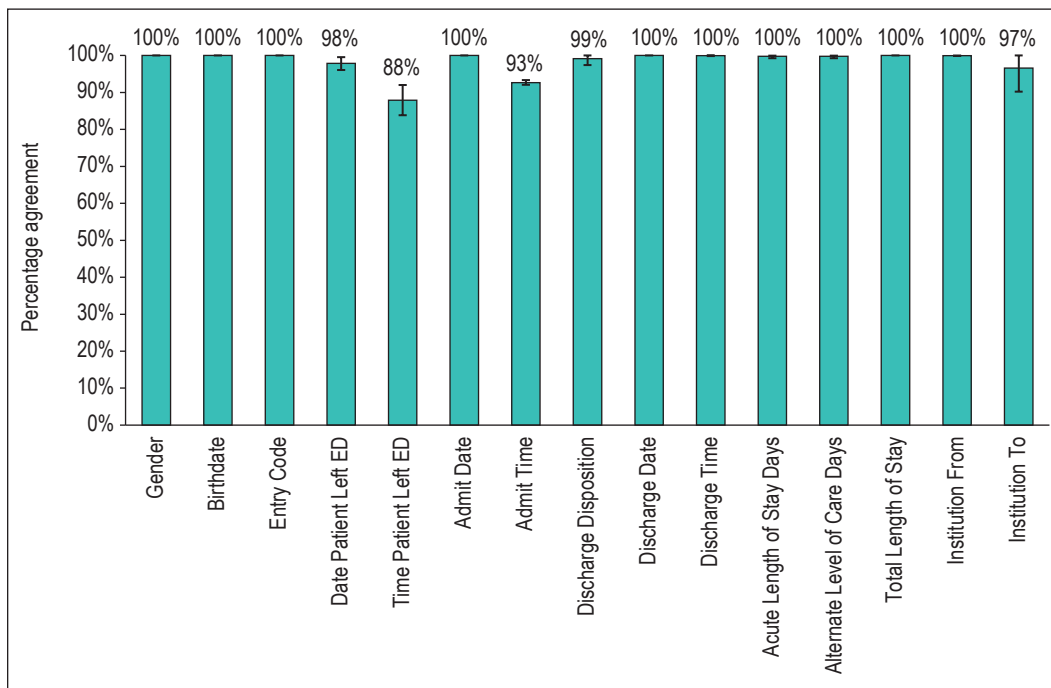
### 3.5 Quality of administrative data elements

In addition to clinical information, DAD abstracts contain patient demographic data (gender and birthdate), which matched fully between the DAD and chart review data in this study. Abstracts also contain administrative data that is used to calculate a patient's length of stay and wait time indicators and to describe transitions between settings.

Figure 15 shows that the agreement rates for these administrative data elements are very good overall, but the rates for the time the patient left the ED (88%) and the admit time (93%) are slightly lower. The impact of these issues on wait time calculations is described in Section 5.

As with previous studies, this study demonstrates that alternate level of care (ALC) days are coded accurately when documented. However, the ALC data captured in the DAD is not comparable across the country because underlying criteria used by clinicians to designate ALC varies within and across regions. In collaboration with the Western Patient Flow Collaborative, CIHI recently produced clinical guidelines and implementation resources to standardize ALC designation practices and subsequently improve ALC data in the DAD.

**Figure 15** Agreement for selected non-medical data elements



**Note**

i: 95% confidence intervals.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

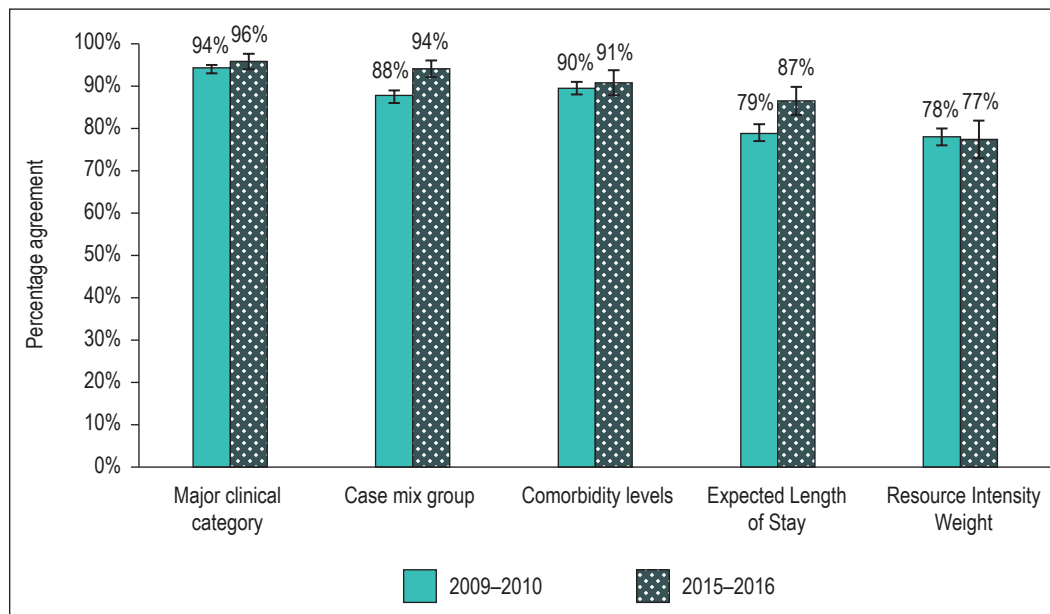
## 3.6 Case mix

Case-mix grouping methodologies categorize patients into statistically and clinically similar groups based on clinical and administrative data. Health care facilities use case mix and the accompanying resource indicators to effectively plan, monitor and manage the services they provide.<sup>12</sup> Although it was not a primary objective of the study to evaluate the impact of coding variations on the acute care grouping methodology, CMG+, given its extensive use, this section provides some summary analysis that could be carried out based on the available sample size.

CMG+ consists of 21 major clinical categories (MCCs) that identify either a body system or a specific type of clinical problem; individual case mix groups (CMGs) are ordered within these categories.<sup>13</sup> Factors, such as comorbidity level, age and flagged interventions, are applied after CMG assignment and used in the production of 2 resource indicators for every case: Resource Intensity Weight (RIW) and Expected Length of Stay (ELOS).

This analysis focuses on the CMG+ 2015 grouping methodology, which was applied to the reabstracted data and compared with the information derived from the original DAD abstract. Figure 16 shows the level of agreement on the case-mix variables from the 2015–2016 study and compares the rates with those from the 2009–2010 study (which was grouped using the 2009 version of the methodology). Agreement rates have remained stable or improved slightly. The higher agreement rates observed in the CMG assignment may reflect the higher consistency of MRDx coding. However, they may also reflect the different study designs — the 2009–2010 study was specifically designed to assess the overall quality of the CMG+ methodology, while the 2015–2016 study had a much narrower focus on selected patient populations.



**Figure 16** Agreement on case-mix variables**Note**

i: 95% confidence intervals.

**Sources**

Canadian Institute for Health Information, 2009–2010 and 2015–2016 DAD reabstraction studies.

## 3.7 Summary of findings

### Chart documentation

The availability and consistency of chart documentation has a significant impact on the quality of the data that is coded. For paper charts, physician handwriting can be an issue, and only conditions documented by physicians in the patient's health record can be captured by coding. For electronic or hybrid (mix of paper and electronic) charts, lack of chronological order makes it difficult to follow the sequence of events and distinguish between pre- and post-admission conditions. On the positive side, the reabstractors did observe several practices that had a good impact on quality, such as regular collaboration between clinicians and coders to improve clinical documentation to support administrative data, and the use of standard templates to help with consistency.

Enhancing the quality of the information and data in the DAD continues to be a shared responsibility among health care professionals, coding specialists, and those who maintain the DAD and develop national coding directives. This study shows that ongoing efforts to improve reporting to the DAD among these stakeholders have resulted in improvements to its data quality. Overall, the quality of abstract coding in the 2015–2016 study sample is as good as or better than what was seen in the 2009–2010 study.

**Table 8** Summary of findings on abstract clinical coding quality

Findings	Percentage agreement	Lower 95% CI	Upper 95% CI
<b>Reporting of significant diagnoses</b>			
Diagnoses reported in DAD, confirmed in chart review	89.0%	87.0%	91.0%
Diagnoses recorded in chart review, present in DAD	91.4%	89.3%	93.5%
<b>ICD-10-CA coding consistency</b>			
All diagnoses:* Exact match	92.8%	91.2%	94.5%
<b>Reporting of MRDx</b>			
Agreement on selection of MRDx	93.3%	91.4%	95.1%
Agreement on MRDx ICD-10-CA code	84.8%	81.4%	88.3%
<b>Reporting of comorbidities</b>			
Type (1) diagnoses reported in DAD, confirmed in chart review	79.6%	75.7%	83.5%
Type (1) diagnoses recorded in chart review, present in DAD	83.3%	79.4%	87.1%
Type (2) diagnoses reported in DAD, confirmed in chart review	77.4%	66.4%	88.4%
Type (2) diagnoses recorded in chart review, present in DAD	83.6%	77.8%	89.5%
<b>Reporting of interventions</b>			
Intervention reported in DAD, confirmed in chart review	99.3%	98.8%	99.8%
Intervention recorded in chart review, present in DAD	95.9%	94.6%	97.2%
<b>CCI coding consistency</b>			
All interventions:* Exact match	98.1%	97.1%	99.1%
<b>Agreement on coding of non-medical data elements</b>			
Gender	100.0%	100.0%	100.0%
Birthdate	100.0%	100.0%	100.0%
Entry Code	100.0%	100.0%	100.0%
Date Patient Left ED	97.9%	96.1%	99.6%
Time Patient Left ED	87.9%	83.8%	92.0%

Findings	Percentage agreement	Lower 95% CI	Upper 95% CI
Admit Date	100.0%	100.0%	100.0%
Admit Time	92.6%	92.0%	93.3%
Discharge Disposition	99.1%	97.4%	100.0%
Discharge Date	100.0%	100.0%	100.0%
Discharge Time	99.9%	99.8%	100.0%
Acute Length of Stay Days	99.8%	99.3%	100.0%
Alternate Level of Care Days	99.8%	99.3%	100.0%
Total Length of Stay	100.0%	100.0%	100.0%
Institution From	100.0%	99.9%	100.0%
Institution To	96.6%	90.2%	100.0%

**Notes**

\* Includes significant diagnoses/interventions coded in the DAD that were confirmed as being present in the chart review.  
CI: Confidence interval.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

Although the DAD remains a reliable source of data on inpatient hospital care in Canada, there are some areas that could benefit from additional quality improvement efforts such as templates, education and standards review:

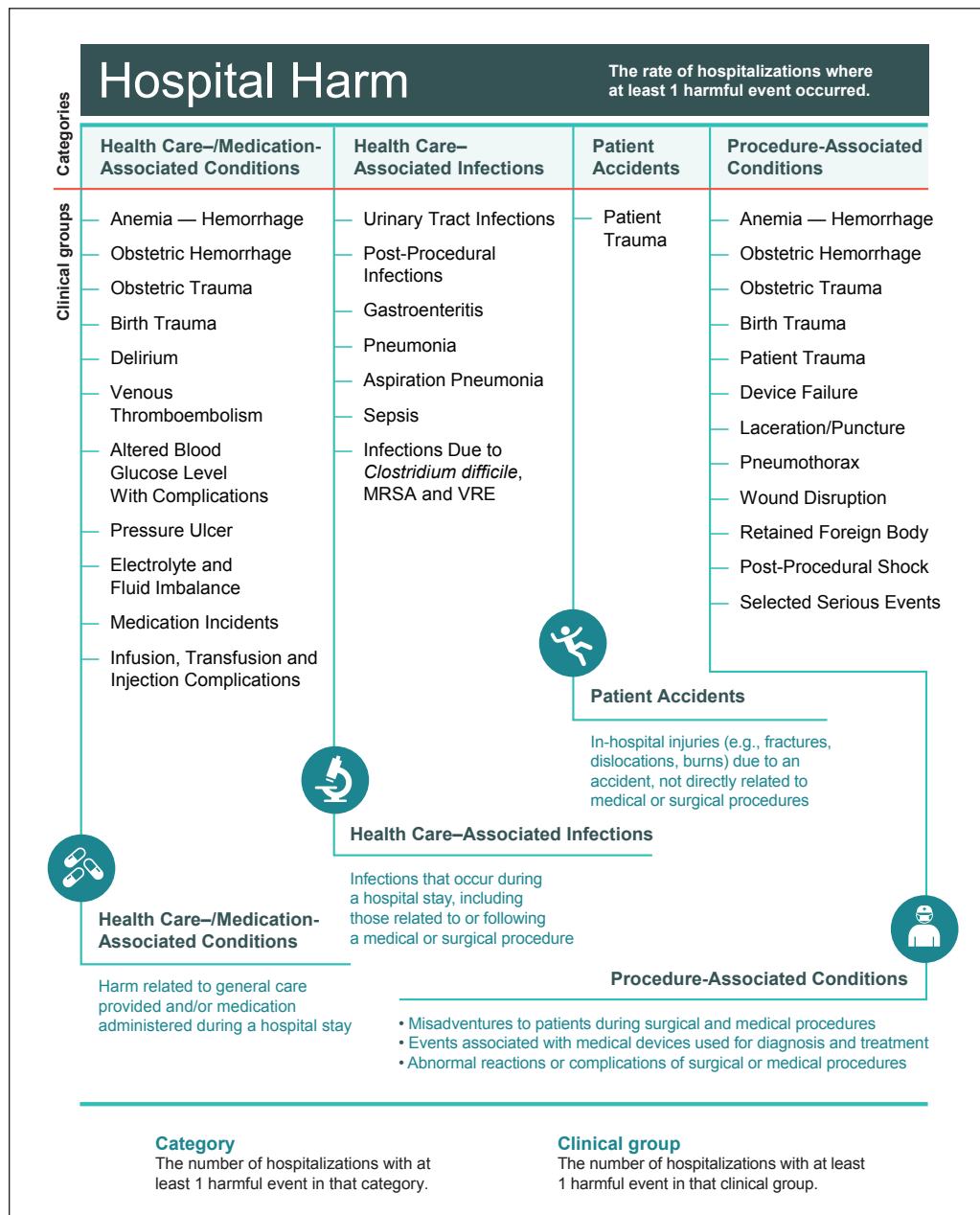
- Some confusion remains about the assignment of type (1) (pre-admit) and type (2) (post-admit) comorbidities. The uncertainty lies with whether a comorbidity significantly contributed to a patient's hospital stay and/or whether it was present at hospital admission or occurred during the hospital stay.
- Diagnosis typing for obstetric cases is different from that for other acute care cases (and relates to whether the condition occurred before, during or after delivery) but was not always applied correctly or consistently. For obstetric cases, diagnosis typing, particularly for postpartum conditions, varied. Also, the reabstractors noted that some mandatory interventions were not being captured, such as induction and augmentation of labour. This may impact how deliveries are categorized.

- The use of diagnosis clusters remains inconsistent. There were many cases where both the number of clusters and their content did not match between the DAD and chart review data. These inconsistencies can result in the misclassification of PICs, and they may also affect case-mix resource indicators. This was noted for the cases of PIC sepsis that were included in the section of this report on hospital harm, and also for other cluster scenarios, such as the coding of stem cell complications and adverse effects of chemotherapy sessions.
- There was some capturing of optional type (3) diagnosis codes and optional interventions, which can contribute to additional coder burden. When optional codes are captured to meet facility or jurisdictional data needs, it is important that this data be collected consistently by all coders; otherwise, the data captured is incomplete and may not be fit for use.
- As found in previous studies, the availability and quality of chart documentation has a large impact on abstract coding quality. The reabstractors noted several instances where documentation was missing, incomplete, inconsistently located, conflicting or not legible.

## 4 Hospital harm in focus

This section focuses on study results related to the new measure of hospital harm that is being developed by CIHI and CPSI.<sup>1</sup> Figure 17 shows the Hospital Harm Framework and the 31 clinical groups that it includes.

**Figure 17** Hospital Harm Framework



### Source

Canadian Institute for Health Information, Canadian Patient Safety Institute. [Measuring Patient Harm in Canadian Hospitals](#). 2016.

The development of the Hospital Harm Framework included specific activities to better understand the quality of the data involved, including

- An initial review of CIHI’s reabstraction study on 2009–2010 data, to evaluate the agreement between data in the patient’s health records (discharge summary, records, notes, charts, lab reports, etc.) and data collected in the DAD; and
- A clinical chart review study at 4 acute care facilities to examine agreement between harm captured in CIHI data and harm recorded in patients’ health records.

The results from these 2 activities determined the focus of this study on selected clinical groups where coding appeared to be most inconsistent:

- Infections Due to *C. difficile*, MRSA or VRE;
- Obstetric Hemorrhage (2 clinical groups; 1 each in the categories Health Care–/Medication-Associated Conditions and Procedure-Associated Conditions);
- Obstetric Trauma (2 clinical groups; 1 each in the categories Health Care–/Medication-Associated Conditions and Procedure-Associated Conditions); and
- Sepsis.

Abstracts meeting the selection criteria for these groups were included in the study sample. The study objective was to compare the DAD and chart review data to determine whether the reabstracted charts would still qualify for the same Hospital Harm clinical group (referred to as “agreement” in the analysis). Disagreement is an indication of false positives, meaning that the original DAD abstract was included in the Hospital Harm clinical group even though harm (as measured by the framework) was not found in the chart. False negatives, meaning harm was documented in the chart but not found in the DAD abstract, may also exist and affect the measurement of hospital harm, but these were not a focus of the study.

Table 9 shows the Hospital Harm clinical group agreement rates for the selected clinical groups included in this study. It measures the proportion of charts included in the clinical group of interest based on the original DAD data that still met the criteria based on the chart review data. There was 91% agreement across the clinical groups, ranging from 77% (Sepsis) to 97% (Obstetric Trauma). The following sections examine each clinical group separately.

**Table 9** Agreement for selected Hospital Harm clinical groups

Clinical group	Percentage agreement	Lower 95% CI	Upper 95% CI
Sepsis	77.2%	71.8%	82.7%
Obstetric Hemorrhage	89.5%	86.3%	92.7%
Infections Due to <i>Clostridium difficile</i> , MRSA or VRE	93.5%	90.6%	96.4%
Obstetric Trauma	97.0%	95.4%	98.6%
All selected clinical groups	90.6%	88.7%	92.5%

**Notes**MRSA: Methicillin-resistant *Staphylococcus aureus*.

VRE: Vancomycin-resistant enterococci.

CI: Confidence interval.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

## 4.1 Sepsis

Sepsis is included as hospital harm if it is identified as having arisen after admission to hospital. It is categorized 3 ways:

1. Post-admit (or medical) sepsis, identified by a single diagnosis code;
2. Post-intervention condition (PIC) sepsis, which requires clustered (multiple) diagnosis codes to fully describe the condition; and
3. Sepsis in obstetric cases.

Table 10 shows the agreement rates for each of these categories and the combined rate.

**Table 10** Agreement for Sepsis clinical group

Sepsis clinical group category	Percentage agreement	Lower 95% CI	Upper 95% CI
Post-admit (medical) sepsis	77.0%	70.9%	83.1%
PIC sepsis	76.3%	62.7%	89.9%
Sepsis in obstetric cases	84.6%	63.2%	100.0%
Total	77.2%	71.8%	82.7%

**Notes**

CI: Confidence interval.

PIC: Post-intervention condition.

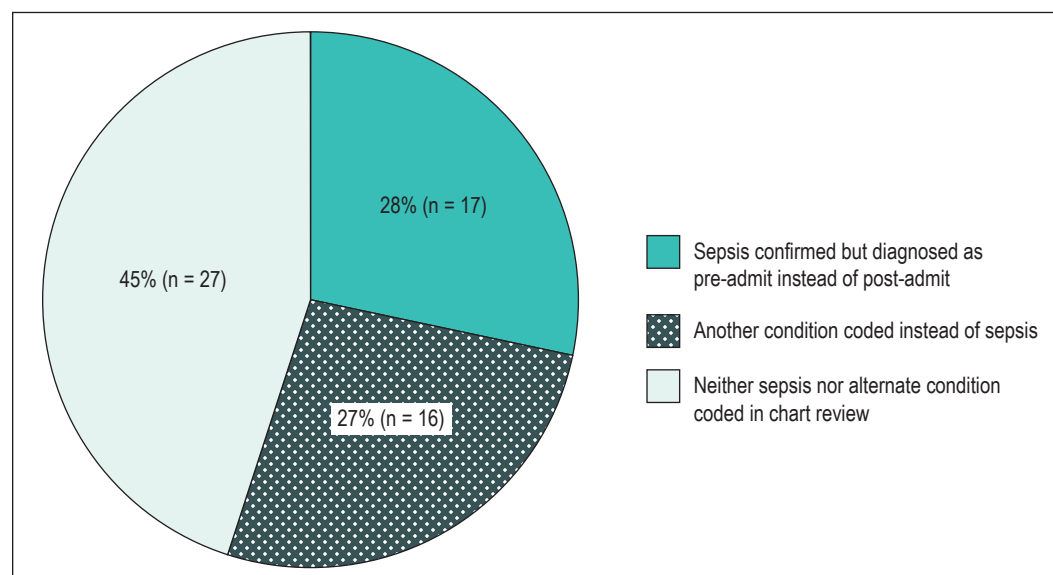
**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

Out of the groups included in this study, agreement was lowest for the Sepsis clinical group (77%). It should be noted that this group also had the smallest sample size, and as a result its estimates are less precise (have wider confidence intervals). These patients can be very complex and often have extended lengths of stay in hospital. Longer hospital stays can be more challenging to document and code accurately due to the amount of chart documentation that can accumulate if there are multiple comorbid conditions that arise or multiple interventions that occur while in hospital. This challenge is compounded if the chart documentation is not sorted chronologically, which the reabstractors often observed where electronic or hybrid chart systems were used. Patient complexity and documentation issues may explain some of the coding discrepancy between the DAD and chart review data that is seen in the results.

The cases that were excluded from the Sepsis clinical group upon reabstraction (23%) were further examined to see why they no longer met the selection criteria. Figure 18 shows that for more than a quarter of excluded cases (17 out of 60<sup>ix</sup>), sepsis was confirmed to be present, but the patient was already septic upon admission to hospital. For many of these cases, the reabstractor noted that signs of sepsis were present at admission but the diagnosis was not actually confirmed until later, which may be why the hospital coder incorrectly identified it as a post-admit condition.

**Figure 18** Sepsis cases excluded from clinical group after chart review



#### Notes

Percentages are based on unweighted sample counts.  
Percentages may not add up to 100% due to rounding.

#### Source

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

<sup>ix.</sup> These are unweighted sample counts.

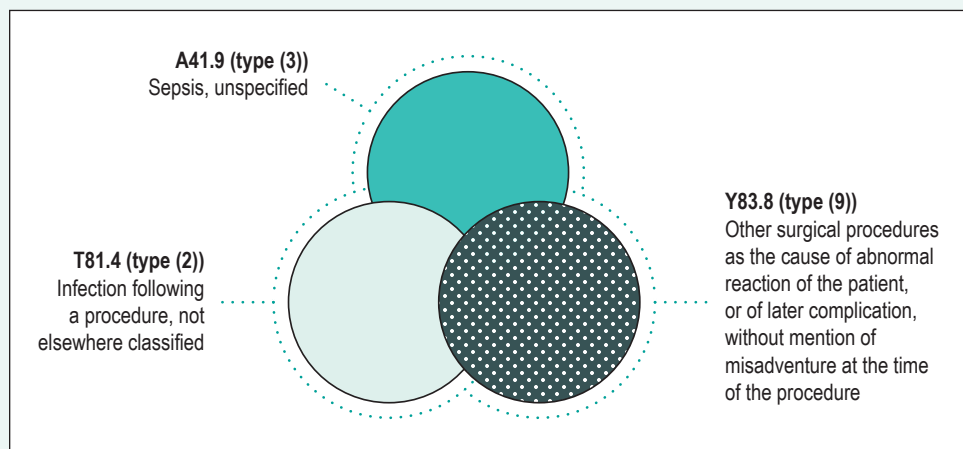


For another quarter of excluded sepsis cases (16 out of 60), the reabstractor agreed on the presence of a condition but found that the physician documentation did not support the coding of sepsis and coded another condition that no longer qualified the chart for the clinical group. The most common conditions that the reabstractors coded instead of sepsis were staphylococcal and other bacterial infections. These cases may still be included in the Hospital Harm Framework if they meet the criteria for another Health Care–Associated Infections clinical group. For the remaining excluded sepsis cases, neither sepsis nor an alternate condition was coded by the reabstractor.

## PIC sepsis

Sepsis from PICs requires a diagnosis cluster to fully describe the condition. The cluster must contain a T-code (indicating a complication from surgical or medical care) as a post-admit diagnosis type (2); a sepsis code assigned as a secondary diagnosis type (3); and an applicable external cause code (Y-code) as a type (9).

**Figure 19** PIC cluster example



The reabstractors noted many cases where the original DAD data for sepsis abstracts did not contain clusters when it should have, or it contained clusters with missing or incorrectly typed codes. When this happens, it does not affect a chart's inclusion in the Hospital Harm Sepsis clinical group because sepsis is *still* present. But it can potentially misclassify PIC sepsis as medical sepsis. A closer look at the 169 (unweighted) medical sepsis cases that were confirmed by the reabstractor revealed that a quarter of them should have been classified as PIC sepsis originally, but were not due to the codes used and/or how they were clustered (they did not follow the example shown in Figure 19). The same issues were found for PIC septic shock, which requires a shock code with an accompanying sepsis code, a T-code indicating that the shock was the result of a procedure and an external cause code.

## 4.2 Obstetric hemorrhage

Obstetric hemorrhage following delivery (postpartum) is captured in the Hospital Harm Framework.<sup>x</sup> Deliveries are categorized into 1 of 2 Hospital Harm clinical groups as either Health Care–/Medication-Associated Conditions (HCMAC), which are vaginal births where no instruments were used, or Procedure-Associated Conditions (PAC), which are instrument-assisted deliveries (e.g., forceps) and C-sections. Table 11 shows the Obstetric Hemorrhage clinical group agreement rates overall (89%) and for these 2 categories (86% for PAC deliveries and 91% for HCMAC deliveries).

**Table 11** Agreement for Obstetric Hemorrhage clinical group

Obstetric Hemorrhage clinical group	Percentage agreement	Lower 95% CI	Upper 95% CI
Health Care–/Medication-Associated Conditions	91.4%	87.8%	95.1%
Procedure-Associated Conditions	86.1%	80.3%	91.9%
<b>Total</b>	<b>89.5%</b>	<b>86.3%</b>	<b>92.7%</b>

**Note**

CI: Confidence interval.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

For the 10% of obstetric hemorrhage cases that were excluded from their clinical group upon reabstraction, 2 common scenarios were found to explain the discrepancy:

- Most often, the reabstractors did not find that the chart documentation supported a postpartum obstetric hemorrhage diagnosis and did not confirm the condition. There was some disagreement on the amount of blood loss and whether it was attributable to other factors. For a small number of these, alternate conditions were coded (e.g., retained placenta without hemorrhage).
- In many other cases, the reabstractors did confirm that a hemorrhage had occurred, but they coded it as intrapartum (occurring during delivery) rather than postpartum (occurring after delivery), excluding it from the Obstetric Hemorrhage clinical groups (which capture only hemorrhage that occurs after delivery).

<sup>x.</sup> The criteria for the Obstetric Hemorrhage clinical group were updated subsequent to this study and now also require a blood transfusion to have occurred to be included in the group.

There were also some coding issues detected that did not have any impact on the chart's inclusion in the Obstetric Hemorrhage clinical group. Out of the 439 confirmed obstetric hemorrhage cases, 119 were coded differently by the reabstractors (either a different obstetric hemorrhage code was chosen or a different diagnosis type was assigned to the same code).<sup>xi</sup> Most of these were related to the typing of the postpartum hemorrhage. Since postpartum hemorrhage occurs after delivery of the infant, it should be assigned a diagnosis type (2), whereas the hospital coder incorrectly assigned a diagnosis type (1).

## 4.3 Infections

Infections due to *C. difficile*, MRSA or VRE are included in the Hospital Harm Framework if they are identified as having arisen after admission to hospital. Table 12 shows the Infections clinical group agreement rates for these types of infections. Agreement for all types of infections combined was high (94%). The sample sizes for MRSA (29) and VRE (5) were small. The VRE results were suppressed due to small volumes, and the MRSA results should be interpreted with caution, as the estimate has much greater variability compared with the *C. difficile* results (based on a sample of 252).

**Table 12** Agreement for Infections Due to *C. difficile*, MRSA or VRE clinical group

Infections clinical group category	Percentage agreement	Lower 95% CI	Upper 95% CI
<i>C. difficile</i>	97.7%	95.8%	99.6%
MRSA*	64.2%	46.6%	81.8%
VRE†	—	—	—
<b>Total</b>	<b>93.5%</b>	<b>90.6%</b>	<b>96.4%</b>

### Notes

\* Small sample size (n = 29); results should be interpreted with caution.

† Results suppressed due to small sample size (n = 5).

— Not available.

CI: Confidence interval.

### Source

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

xi. These are unweighted sample counts.

For the small number of infection cases (6%) that were excluded from their clinical group upon reabstraction, 3 common scenarios, similar to the findings for sepsis cases, were found to explain the discrepancy:

- The reabstractors did not find that the chart documentation supported an infection diagnosis and did not confirm the condition. Reabstractors observed that at times a *C. difficile* infection protocol was launched based on symptoms, prompting the assignment of an infection code, even though the infection was later ruled out.
- The reabstractor confirmed that the patient was a carrier of drug-resistant bacteria but determined that there was no active infection.
- The reabstractor confirmed that the patient had an infection but found that it was present at the time of hospital admission.

Although there was no impact on inclusion in the Infections clinical group, there were many *C. difficile* infection cases where the infection code A04.7 (Enterocolitis due to *C. difficile*) was included in a cluster when it should not have been there, since it was not classified as a PIC because it was considered attributable to another cause.

## 4.4 Obstetric trauma

Obstetric trauma, which is injury to pelvic organs during delivery,<sup>xii</sup> is captured in the Hospital Harm Framework. Similar to the Obstetric Hemorrhage clinical group, deliveries are classified as either HCMAC or PAC. Table 13 shows the Obstetric Trauma clinical group agreement rates for these 2 categories and overall. This clinical group had the highest agreement (97%) out of those included in this study.

**Table 13** Agreement for Obstetric Trauma clinical group

Obstetric Trauma clinical group	Percentage agreement	Lower 95% CI	Upper 95% CI
Health Care–/Medication-Associated Conditions	94.9%	91.9%	97.9%
Procedure-Associated Conditions	99.3%	98.2%	100.0%
<b>Total</b>	<b>97.0%</b>	<b>95.4%</b>	<b>98.6%</b>

**Note**

CI: Confidence interval.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

<sup>xii.</sup> Includes only third- and fourth-degree lacerations, or other injury to pelvic organs as specified in the Hospital Harm Obstetric Hemorrhage clinical group selection criteria.

Only a very small number of obstetric trauma cases were excluded from their clinical group upon reabstraction (3%). For almost all of these cases, the reabstractor classified the injuries documented in the charts as first- or second-degree perineal lacerations; the injuries had originally been coded as third- or fourth-degree lacerations. Only third- and fourth-degree perineal lacerations (or their repairs) are included in the Hospital Harm Obstetric Trauma clinical group.

## 4.5 Summary of findings

This study confirms that the general quality of abstract coding in the DAD is high and supports the use of the data for monitoring hospital harm. The results that focus on the 6 Hospital Harm clinical groups included in this study corroborate this conclusion of fitness for use. For Obstetric Trauma, Obstetric Hemorrhage and Infections Due to *C. difficile*, MRSA or VRE cases, 89% or more were confirmed in the chart review. This means that the reabstractors interpreted the chart documentation similarly to the original hospital coders, with both agreeing that the case qualified for the specific Hospital Harm clinical group. There was minimal over-reporting of the diagnoses and infections included in the selection criteria for these clinical groups. Sepsis was the clinical group with the lowest agreement rate (77%).

The Hospital Harm Framework is designed to measure harm that occurs after admission and requires treatment, and therefore mostly relies on post-admit (type (2)) diagnoses. As described in Section 3, there are some inconsistencies in the general coding of post-admit comorbidities (77% of type (2) comorbidities were confirmed in the chart review). The coding of the specific post-admit comorbidities required to measure these Hospital Harm clinical groups is as good as or better than this overall rate.

Most observations related to the impact of coding variations on Hospital Harm clinical groups fell into 1 of 3 general categories:

1. Disagreement on the chronology of events, which resulted in exclusion of the chart from the Hospital Harm clinical group.<sup>xiii</sup> This was observed for a quarter of excluded sepsis cases and a small number of infections cases, where the reabstractors found that sepsis or infection was present at hospital admission. It was also observed for obstetric hemorrhage cases where there was some disagreement on whether the hemorrhage occurred during or after delivery. Determining the sequence of events was particularly challenging when charts (usually electronic) were not sorted chronologically.

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<sup>xiii</sup>. The Hospital Harm clinical groups consider only post-admit comorbidities and the timing of events in relation to delivery for obstetric cases.

2. Disagreement on the presence or absence of conditions, which resulted in exclusion of the chart from the Hospital Harm clinical group. This was the reason for most of the excluded sepsis cases. For some of these, the reabstractor coded alternate conditions, such as staphylococcal or other bacterial infections. This was also seen for infections and obstetric trauma cases, although overall agreement was very high for these 2 groups.
3. Other coding issues, which did not affect the inclusion of the case in the Hospital Harm clinical group but sometimes affected the categorization of the case within the group, or which were not captured according to the coding standards. The biggest issue of this type was the inconsistent use of PIC diagnosis clusters for sepsis cases.

The accurate capture of hospital harm is directly related to the quality of chart documentation done by physicians. Reabstractors observed that data quality was better where there was regular collaboration between clinicians and health records staff. Over time, as awareness of the importance of the link between documentation and coding increases among clinicians, the quality of the data required to measure hospital harm will improve.

## 5 Coding quality for selected indicators

This section looks at coding agreement on the data used to calculate the following 2 indicators, which were included in the study in response to stakeholder and internal feedback that the coding should be assessed:

1. Low-Risk Caesarean Section
2. Time Waiting for Inpatient Bed

### 5.1 Low-Risk Caesarean Section

The Low-Risk C-Section indicator looks at the rate of deliveries via C-section for women who meet the criteria for a low-risk delivery (women with certain high-risk conditions, such as a previous C-section, are excluded from this indicator).<sup>11</sup> The objective of this study was to assess whether the risk factors used in the indicator calculation were being accurately reported. The study examined low-risk delivery charts for women who delivered via C-section (the indicator numerator) and also for those who delivered vaginally (the additional cases included in the indicator denominator).

Table 14 shows that there was almost 100% agreement between the DAD and chart review data on risk factors that would move women out of the low-risk category (and thus exclude them from the indicator) for both C-section and vaginal births. Only 8 charts (0.3%) had high-risk factors identified by the reabstractor on the chart review that were not reported in the DAD: previous C-section (4), transverse or oblique lie (3) and placenta previa (1).

**Table 14** Agreement on low-risk delivery

Low-risk delivery category	Percentage agreement	Lower 95% CI	Upper 95% CI
All low-risk deliveries	99.7%	99.5%	100.0%
Low-risk deliveries, C-section	99.1%	97.8%	100.0%
Low-risk deliveries, vaginal delivery	99.8%	99.6%	100.0%

**Notes**

CI: Confidence interval.

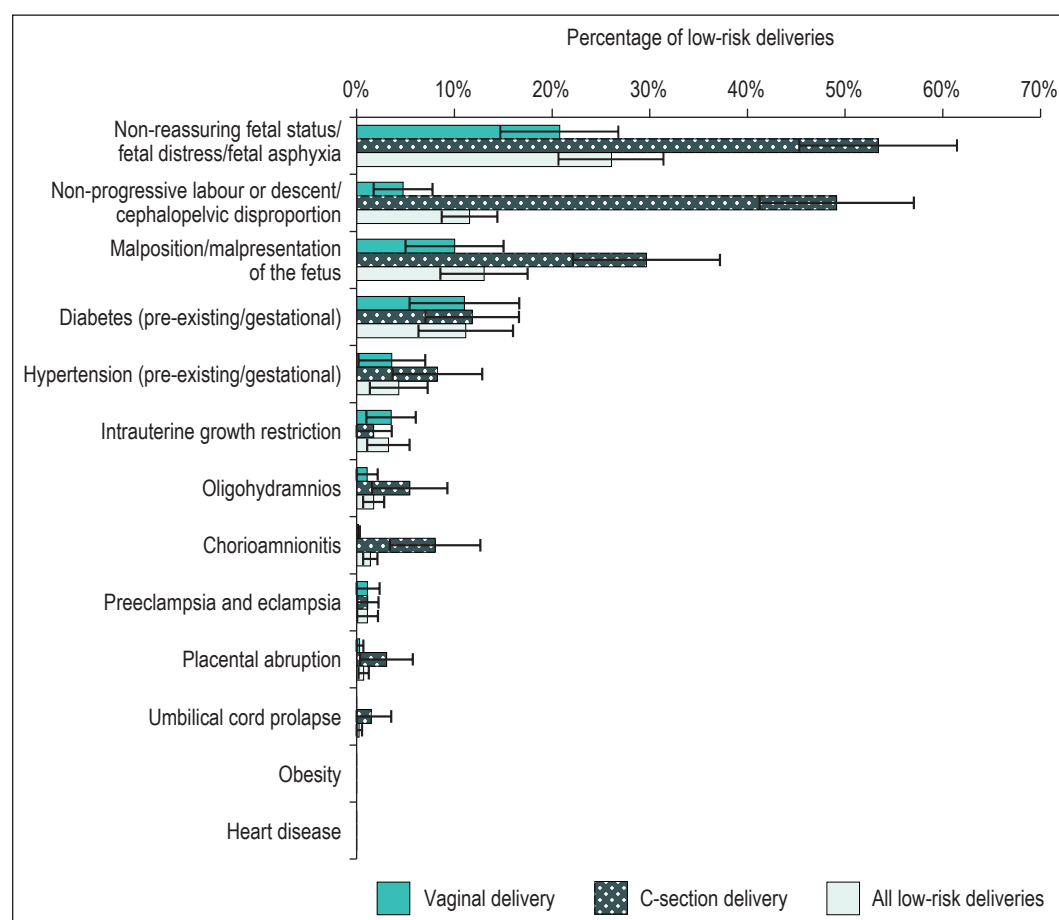
Percentages may not add up to 100% due to rounding.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

Other factors are used to adjust the indicator results to control for differences in patient characteristics to improve comparability. In addition to age, the Low-Risk C-Section indicator is adjusted by a series of clinical conditions, some of which are more common than others.<sup>14</sup> Figure 20 shows the rate at which these factors were reported in the study population (based on the chart review data), for all low-risk deliveries and separately for vaginal and C-section deliveries. The higher rates in the top 3 risk factors for the C-section delivery population are expected, as they are common reasons for emergent or urgent C-sections. All of these risk factors, with the exception of obesity, are mandatory to report in the DAD. Only morbid obesity is mandatory to report for obstetric cases; other types of obesity are optional. This may account for the fact that in the chart review, there were no charts with obesity reported.

**Figure 20** Rate of risk-adjustment factors for low-risk deliveries



**Note**

i: 95% confidence interval.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.



Generally, the risk-adjustment factors were well coded, with most being present in both the DAD and chart review data, with associated agreement rates<sup>xiv</sup> above 90%. Those with lower agreement rates tended to have wide confidence intervals indicating greater sample variability. There were no statistical differences found between vaginal and C-section deliveries in the quality of reporting of the risk factors; however, as noted, some sample sizes were small.

For some of the discrepancies that did occur, the original coder and the reabstractor both identified the presence of a significant condition but classified it differently. There were some observable patterns that may provide insight into areas for further data quality improvement.

In some instances, these discrepancies resulted in differences in whether or not the condition was included in the risk factor:

- Non-progression of labour: Prolonged labour (not included in the risk factor) was coded in the DAD and obstructed labour (included in the risk factor) was coded by the reabstractor, and vice versa.
- Fetal distress: Meconium in the amniotic fluid only (not included) was coded in the DAD and fetal heart rate anomaly with or without meconium in the amniotic fluid was coded by the reabstractor (included), and vice versa.

In other instances, the discrepancies resulted in the condition being included in a different risk factor:

- Non-progression of labour reported in the original DAD abstract was reabstracted as malposition/malpresentation of the fetus (which was the underlying reason for non-progression of labour).
- Preeclampsia reported in the original DAD abstract was reabstracted as hypertension.
- Oligohydramnios reported in the original DAD abstract was reabstracted as chorioamnionitis.

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<sup>xiv.</sup> The proportion of diagnoses reported in the DAD and confirmed in the chart review and the proportion of diagnoses recorded in the chart review and present in the DAD.

## 5.2 Time Waiting for Inpatient Bed

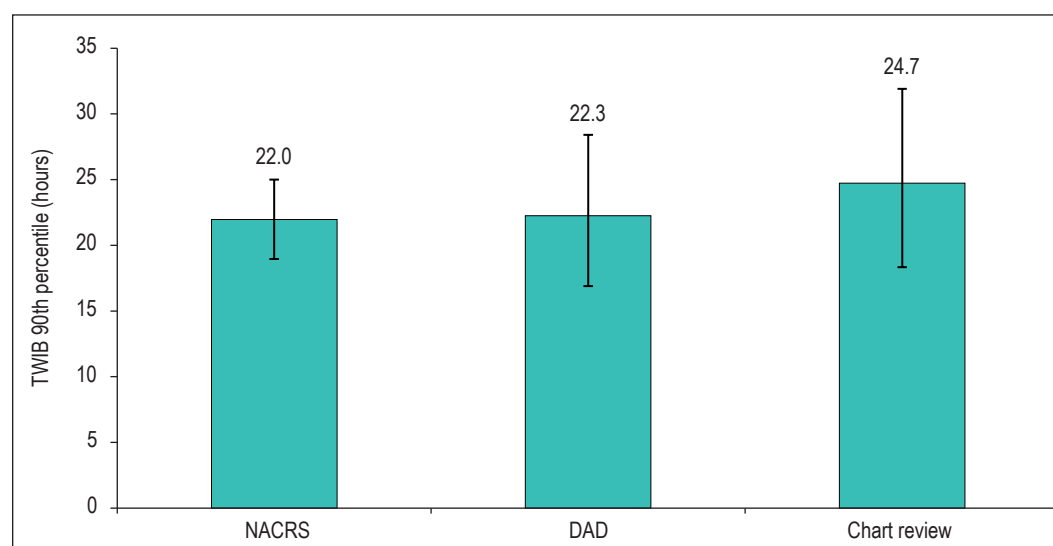
TWIB is an indicator that measures how long patients had to wait in the ED for an inpatient bed after the decision was made by a service provider to admit them.

Wait time performance indicators, including TWIB, report the 90th percentile wait time (90% of wait times are below this value). CIHI's TWIB indicator is derived from data submitted to the National Ambulatory Care Reporting System (NACRS<sup>15</sup>); however, the equivalent dates and times are also captured in the DAD:

NACRS	DAD
Disposition Date/Time	Admission Date/Time
Date/Time Patient Left ED	Date/Time Patient Left ED

Sampled DAD records were linked to the corresponding NACRS records that captured information on the ED visit that preceded the inpatient admission, and the TWIB 90th percentile was calculated for these linked records based on the original DAD data, the chart review data and the NACRS data.<sup>xv</sup> Figure 21 shows that there was no statistically significant difference between the indicator results calculated from the 3 sources.

**Figure 21** 90th Percentile for Time Waiting for Inpatient Bed



### Notes

i: 95% confidence intervals.

Includes charts where sampled DAD records could be linked to NACRS data.

### Sources

Canadian Institute for Health Information, National Ambulatory Care Reporting System and 2015–2016 DAD Reabstraction Study.

<sup>xv</sup>. Not all records could be linked (e.g., if the patient identifiers or other linkage variables were missing or inconsistent).

As previously shown in Figure 15, there were discrepancies in the data elements used to calculate TWIB, most often the time fields. Table 15 shows that TWIB matched exactly between the DAD and chart review data for 79% of charts. Where it did not match, the TWIB calculated using the chart review data was more likely to be longer than the original TWIB. There were also some differences between the data submitted to the DAD and NACRS, again usually in the time fields.

**Table 15** Time Waiting for Inpatient Bed agreement between the DAD and chart review data

Wait time difference	Percentage agreement	Lower 95% CI	Upper 95% CI
Wait time longer in chart review	14.2%	10.5%	17.9%
Exact agreement	79.0%	74.9%	83.1%
Wait time shorter in chart review	6.8%	3.4%	10.2%

**Notes**

CI: Confidence interval.

Percentages may not add up to 100% due to rounding.

**Source**

Canadian Institute for Health Information, 2015–2016 DAD Reabstraction Study.

TWIB agreement varied widely among hospitals that participated in this study: 11 had more than 90% exact agreement while 4 had 60% or less. Most dates and times are downloaded to an abstract from a hospital's admission–discharge–transfer (ADT) system. In several hospitals, the ADT dates/times were the only source of date/time information available to coders, so they achieved 100% agreement. In other hospitals, dates/times in the ADT system were compared with those in the clinical documentation (usually when it was still paper based). The reabstractors encountered different hospital practices regarding whether the system fields could be overwritten (e.g., if they conflicted with other chart documentation). Also, many dates/times are recorded within the clinical documentation and the reabstractors noted that it was sometimes challenging to identify the appropriate date or time to capture within the paper charts, which may explain some of the inconsistencies shown in the results.

## 5.3 Summary of findings

The quality of abstract coding has a direct impact on the quality of indicators based on DAD data. The following summarizes the findings for the 2 indicators examined in this section:

- Almost 100% of sampled DAD abstracts meeting the criteria for low-risk delivery continued to meet the criteria upon reabstraction and remained in that clinical group. Risk-adjustment factors for this indicator are also well coded, although there is some variation that is likely the result of differences in interpretation of chart documentation.
- 79% of charts had identical TWIB calculated based on the original DAD data and the chart review data, which is based on the reporting of admission and ED discharge times. The discrepancies did not have a statistically significant impact on indicator results: the TWIB 90th percentile. Discrepancies are usually the result of inconsistent documentation of dates and times across systems and charts.

## 6 Conclusion

This data quality study of the DAD has confirmed that the quality of abstract coding in the DAD is very high, which supports a wide variety of uses, including the production of health system performance indicators and new measures such as Hospital Harm. It is clear that hospital coders continue to do excellent work interpreting and coding increasingly complex patient charts.

As with any reabstraction study, one of the objectives is to determine whether there are any systematic quality issues that should be addressed. Improving data quality is a joint effort between CIHI and other health system stakeholders. This section outlines some activities undertaken by CIHI in response to the study findings, as well as general recommendations for all stakeholders to help improve data quality.

### 6.1 Next steps

CIHI will use the findings from this study to further enhance CIHI's products, such as coding standards, abstracting manuals and educational offerings. Some activities that are planned or in progress at the time of this report are

- Investigating the feasibility of adding edit checks at data submission to detect issues found through this study, such as incorrect cluster diagnoses and/or diagnosis types, incomplete coding of septic shock and incomplete coding of obstetric lacerations;
- Exploring educational opportunities to address issues outlined in this study (e.g., web conferences);
- Amending the future release of the *Canadian Coding Standards for Version 2018 ICD-10-CA and CCI*;
- Preparing an article for possible publication in a peer-reviewed journal on reabstraction data quality studies and their impact;
- Disseminating the study results internationally to members of the World Health Organization Family of International Classifications (WHO-FIC) network, and nationally to the Canadian Health Information Management Association (CHIMA);
- Investigating the impact of incorrect diagnosis clusters on case-mix resource indicators;
- Conducting analyses to determine the extent and impact of any DAD data that was corrected, which the open-year nature of this study allowed for; and
- Monitoring rates of hospital harm for any changes that may be affected by the study.

## 6.2 Recommendations

Stakeholders external to CIHI, such as administrators, physicians and health records staff, also affect the quality of DAD data. For these stakeholders, CIHI offers the following recommendations:

- Hospitals that participated in this study review their hospital-specific results to identify where improvements may be needed to enhance the quality of DAD data submissions.
- All hospitals review the study findings to determine whether the issues discussed in this report are also present at their facilities and may need to be addressed.
- All hospitals avail themselves of the educational opportunities provided by CIHI, including web conferences, eLearning courses and Tips for Coders.
- Hospital coders review the standards related to aspects of coding that varied most in this study, such as the assignment of diagnosis types and the use of diagnosis clusters.
- Hospitals review their practices around the coding of optional diagnoses and interventions, which could place additional burden on coders.
- CIHI, hospitals and clinical leaders continue efforts to raise awareness among physicians of the important link between good-quality chart documentation and the quality of DAD data and its outputs, such as health system performance indicators.
- Hospitals increase the use of templates or other tools to improve the consistency of chart documentation.
- Hospitals provide regular opportunities for health records staff to consult with clinicians.

CIHI remains committed to maintaining and improving the quality of the data in the DAD and would be pleased to collaborate with stakeholders on these or other data quality improvement activities.

# Appendix A: Calculations

A variety of statistics are used in this report to measure the quality of the data. These have different units of analysis, numerators and denominators. The calculations used are listed below.

## Agreement on the presence of clinical elements

For this analysis, the agreement rate for each clinical element (significant diagnoses, comorbidities, prefixes and interventions) is calculated 2 ways:

1. The percentage of a given clinical element in the DAD that was confirmed in the chart review:  

$$\text{Number in both DAD and chart review} \div (\text{Number in DAD only} + \text{Number in both DAD and chart review}) \times 100$$
2. The percentage of a given clinical element in the chart review that was present in the DAD:  

$$\text{Number in both DAD and chart review} \div (\text{Number in chart review only} + \text{Number in both DAD and chart review}) \times 100$$

## Agreement on MRDx

Every chart requires a most responsible diagnosis to be identified; therefore, the denominator for this agreement calculation is the total number of sampled charts. The calculation is as follows:

$$\text{Number of charts with matching MRDx} \div \text{Total number of charts} \times 100$$

## Agreement on codes

Exact and partial match rates are calculated for significant diagnosis codes, MRDx codes and intervention codes. This is done only for significant diagnoses and interventions in the DAD that were confirmed in the chart review (linked codes). The calculation is as follows:

$$\text{Number of code matches} \div \text{Total number of linked codes} \times 100$$

## Agreement on non-medical data elements and case-mix variables

Every chart has associated non-medical data elements and derived case-mix variables; therefore, the denominator for these agreement calculations is the total number of sampled charts. The calculation is as follows:

$$\text{Number of charts with matching variable} \div \text{Total number of charts} \times 100$$

### **Agreement on indicators**

Agreement on indicators is measured by calculating the proportion of DAD charts that continue to meet a given indicator's selection criteria upon reabstraction. The calculation is as follows:

Number of reabstracted charts that meet indicator criteria ÷ Number of DAD charts that meet indicator criteria × 100



## Appendix B: Text alternatives for images

**Data table for Figure 15: Agreement for selected non-medical data elements**

Data element	Percentage agreement	Lower 95% CI	Upper 95% CI
Gender	100%	100%	100%
Birthdate	100%	100%	100%
Entry Code	100%	100%	100%
Date Patient Left ED	98%	96%	100%
Time Patient Left ED	88%	84%	92%
Admit Date	100%	100%	100%
Admit Time	93%	92%	93%
Discharge Disposition	99%	97%	100%
Discharge Date	100%	100%	100%
Discharge Time	100%	100%	100%
Acute Length of Stay Days	100%	99%	100%
Alternate Level of Care Days	100%	99%	100%
Total Length of Stay	100%	100%	100%
Institution From	100%	100%	100%
Institution To	97%	90%	100%

**Note**

CI: Confidence interval.

**Data table for Figure 16: Agreement on case-mix variables**

Variable	2009–2010	2009–2010 Lower 95% CI	2009–2010 Upper 95% CI	2015–2016	2015–2016 Lower 95% CI	2015–2016 Upper 95% CI
Major clinical category	94%	93%	95%	96%	94%	98%
Case mix group	88%	86%	89%	94%	92%	96%
Comorbidity levels	90%	88%	91%	91%	88%	94%
Expected Length of Stay	79%	77%	81%	87%	83%	90%
Resource Intensity Weight	78%	76%	80%	77%	73%	82%

**Note**

CI: Confidence interval.

### **Text alternative for Figure 17: Hospital Harm Framework**

The framework for the Hospital Harm measure includes 4 broad categories of harm, which are further broken down into 31 clinical groups.

The first category is Health Care–/Medication-Associated Conditions, which includes the following clinical groups: Anemia — Hemorrhage; Obstetric Hemorrhage; Obstetric Trauma; Birth Trauma; Delirium; Venous Thromboembolism; Altered Blood Glucose Level With Complications; Pressure Ulcer; Electrolyte and Fluid Imbalance; Medication Incidents; and Infusion, Transfusion and Injection Complications.

The second category is Health Care–Associated Infections, which includes the following clinical groups: Urinary Tract Infections; Post-Procedural Infections; Gastroenteritis; Pneumonia; Aspiration Pneumonia; Sepsis; and Infections Due to *Clostridium difficile*, MRSA or VRE.

The third category is Patient Accidents, which includes the Patient Trauma clinical group.

The fourth category is Procedure-Associated Conditions, which includes the following clinical groups: Anemia — Hemorrhage; Obstetric Hemorrhage; Obstetric Trauma; Birth Trauma; Patient Trauma; Device Failure; Laceration/Puncture; Pneumothorax; Wound Disruption; Retained Foreign Body; Post-Procedural Shock; and Selected Serious Events.

The framework has 3 levels:

1. Hospital Harm: The rate of hospitalizations where at least 1 harmful event occurred.
2. Category: The number of hospitalizations with at least 1 harmful event in that category.
3. Clinical group: The number of hospitalizations with at least 1 harmful event in that clinical group.

**Data table for Figure 20: Rate of risk-adjustment factors for low-risk deliveries**

Risk-adjustment factor	Vaginal delivery	Vaginal delivery lower 95% CI	Vaginal delivery upper 95% CI	C-section delivery	C-section delivery lower 95% CI	C-section delivery upper 95% CI	All low-risk deliveries	All low-risk deliveries lower 95% CI	All low-risk deliveries upper 95% CI
Non-reassuring fetal status/fetal distress/fetal asphyxia	21%	15%	28%	54%	45%	62%	26%	21%	32%
Non-progressive labour or descent/cephalopelvic disproportion	5%	2%	8%	49%	41%	57%	12%	9%	14%
Malposition/malpresentation of the fetus	10%	5%	15%	30%	22%	37%	13%	9%	17%
Diabetes (pre-existing/gestational)	11%	5%	17%	12%	7%	17%	11%	6%	16%
Hypertension (pre-existing/gestational)	4%	0%	7%	8%	4%	13%	4%	1%	7%
Intrauterine growth restriction	4%	1%	6%	2%	0%	4%	3%	1%	5%
Oligohydramnios	1%	0%	2%	5%	2%	9%	2%	1%	3%
Chorioamnionitis	0%	0%	0%	8%	3%	13%	1%	1%	2%
Preeclampsia and eclampsia	1%	0%	2%	1%	0%	2%	1%	0%	2%
Placental abruption	0%	0%	1%	3%	0%	6%	1%	0%	1%
Umbilical cord prolapse	0%	0%	0%	1%	0%	4%	0%	0%	1%
Obesity	0%	0%	0%	0%	0%	0%	0%	0%	0%
Heart disease	0%	0%	0%	0%	0%	0%	0%	0%	0%

**Note**

CI: Confidence interval.

**Data table for Figure 21: 90th Percentile for Time Waiting for Inpatient Bed**

Source for TWIB calculation	90th percentile (hours)	Lower 95% CI	Upper 95% CI
NACRS	22.0	18.9	25.0
DAD	22.3	16.5	28.0
Chart review	24.7	17.9	31.5

**Note**

CI: Confidence interval.

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