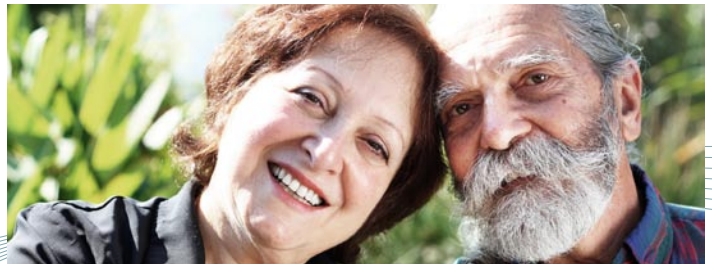

Data Quality Documentation for Users: Canadian Joint Replacement Registry, 2007–2008 to 2009–2010 Data

July 2011

Standards and Data Submission

Canadian Institute for Health Information
Institut canadien d'information sur la santé

Who We Are

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

Our Vision

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

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Introduction

Maintaining and enhancing the quality of incoming data is essential to CIHI's mandate to produce high-quality health information. CIHI's Data and Information Quality Program ensures the continued regular improvement of the quality of CIHI's databases and registries to meet changing and expanding user requirements and expectations.

CIHI's Data Quality Framework provides a common way to assess data quality across CIHI's databases and registries; within the framework, the data quality assessment tool helps users identify priority issues for quality by assessing databases and registries along the five broad dimensions of accuracy, comparability, timeliness, usability and relevance. The framework's implementation is part of the larger quality cycle in which problems are identified, addressed, documented and reviewed on a regular basis. Using the framework also standardizes information on data quality and helps to identify priority issues, which in turn leads to continuous improvements. The assessment tool highlights strengths (processes that work well) and identifies areas where existing practices can be improved.

The purpose of this document is to provide information from the user's perspective to assess the fitness for use of the data.

Purpose of the Report

The primary intent of this document is to provide users with sufficient information to assess whether the quality of the information presented by the Canadian Joint Replacement Registry (CJRR) fits their intended use. This document contains information on coverage, data limitations, comparability, major changes and revisions and their impact. It is restricted to the known limitations of the CJRR for 2007–2008, 2008–2009 and 2009–2010 (surgery dates from April 1, 2007, to March 31, 2010).

Canadian Joint Replacement Registry

The CJRR is a national registry that is based on voluntary data submissions by orthopedic surgeons. It collects clinical, demographic and administrative information on hip and knee replacement procedures performed in Canada.

The registry was formed as a collaborative effort between CIHI and the orthopedic surgeons of Canada. The goals of the registry are to collect, process and analyze data on hip and knee replacements performed in Canada; to support evidence-based decision-making to improve the quality of care for joint replacement recipients; and to conduct analyses pertaining to orthopedic devices and surgical techniques. The hip and knee data collection forms and a list of the registry's main data elements can be downloaded from CIHI's website at www.cihi.ca/cjrr.

Orthopedic surgeons submit information on a voluntary basis after obtaining consent from patients prior to or at the time of surgery. Patient consent is mandatory for all submissions—if patient consent is not completed, minimal data is captured in the CJRR.

The CJRR supports three different modes of data submission:

- Paper data collection forms;
- Electronic submission from surgeons' coordinators or vendors; and
- Web submission through the CJRR Web-Based Data Submission and Reports Tool (as of 2009–2010).

Paper forms are entered directly into the database via an internal web-based interface by CJRR data entry staff at the CIHI office in Toronto, Ontario. Electronic data is submitted directly by the physicians' coordinators or vendors based on pre-defined CJRR specifications. The CJRR Web-Based Data Submission and Reports Tool is a data submission application that enables surgeons or their designated staff to submit data electronically to the CJRR through a secure internet connection. The tool, available in both English and French, also allows users to run and view surgeon-specific summary reports.

For the period 2007–2008 to 2009–2010, a total of 97,671 records were processed. Of these, 78,325 (80.2%) were submitted via paper forms, 17,437 (17.8%) were submitted electronically and 1,909 (2.0%) were received through the web application.

Dissemination

Annual statistics are produced by the registry to provide epidemiological, clinical and surgical analyses on hip and knee replacement procedures across Canada.

The CJRR Comparative Reports are individual reports that are made available to only the surgeon who performed the joint replacement procedure and submitted data to the CJRR. Their objective is to provide surgeons with comparable indicators to support performance measurement of and quality improvement in joint replacement procedures.

The registry also responds to data requests from participating surgeons, governments, researchers and the general public. These data requests require conducting new analyses on surgical or clinical data, in the form of aggregate-level data and/or graphical summaries, or by record-level data extractions. All data requests are responded to in adherence with CIHI's privacy and confidentiality guidelines.

Users

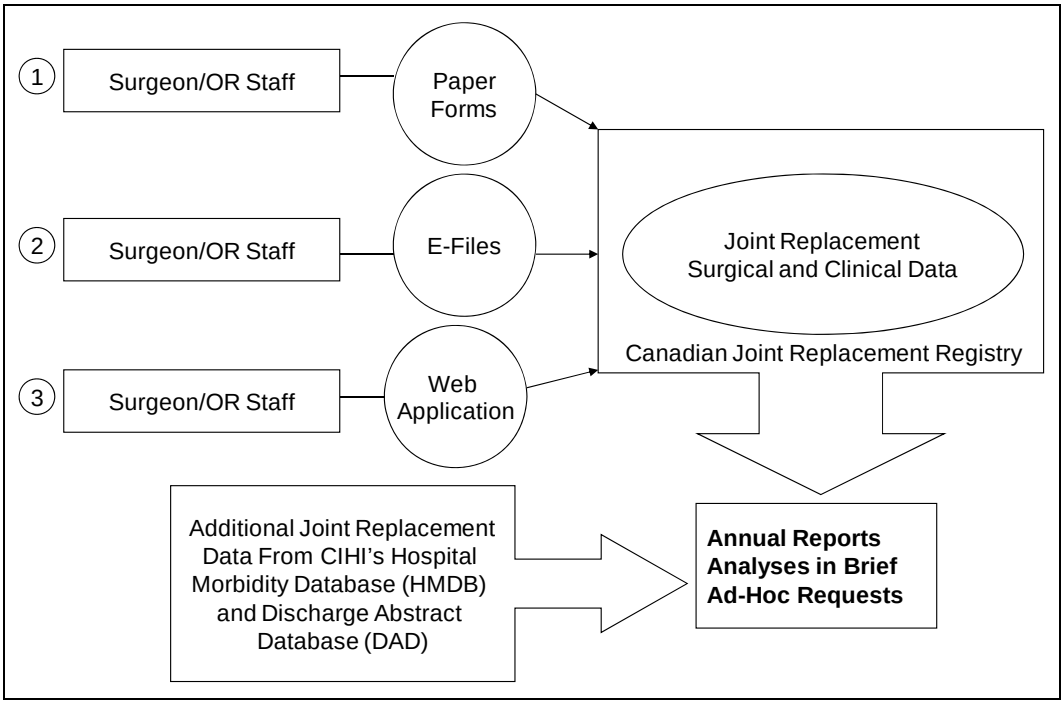
Primary users of CJRR data include orthopedic surgeons, health policy-makers, CJRR Advisory Committee members and health care administrators. Secondary users include allied health care clinicians, researchers and the general public.

1 Concepts and Definitions

1.1 Mandate/Purpose

The CJRR collects data from across Canada for hip and knee replacements performed in the country. Through the CJRR, CIHI provides information so orthopedic surgeons and health care managers can evaluate clinical procedures and monitor the progress of joint replacement recipients over time. Figure 1 shows the flow of data into the CJRR.

Figure 1: Canadian Joint Replacement Registry Data Flow Diagram



1.2 Core Data Elements and Concepts

The registry includes information on patient demographics, type of replacement (primary or revision procedure), surgical approach, fixation mode and implant type. The CJRR includes information on hip and knee joint replacements only. Primary (initial) and revision procedures—mostly elective—are included for the purposes of analysis and reporting. The registry receives information from surgeons who are eligible to participate. Eligibility is determined based on whether the surgeon is currently performing hip and knee replacements.

The reporting province refers to the location of the facility where the procedure was performed, which may not always be the province of residence for the patient. Bilateral procedures are recorded on two separate hip or knee forms, each one indicating a different side (right or left), as each is counted as a separate procedure.

For a list of data elements collected by the CJRR, see http://secure.cihi.ca/cihiweb/en/downloads/services_cjrr_e_elements.pdf.

1.3 Populations of Reference and Interest

The population of *interest* (ideal population or gold standard) is all hip and knee replacement procedures performed by all surgeons in Canada in acute or private facilities.

The population of *reference* is all hip and knee replacement procedures that were performed in acute care and private facilities from 2007–2008 to 2009–2010 in Canada by surgeons who are registered with the CJRR.

For the purpose of this document, CJRR data for 2007–2008 to 2009–2010 (patients' surgery dates from April 1, 2007, to March 31, 2010, inclusive) was reviewed.

1.4 CJRR Frame

The frame for the 2007–2008 to 2009–2010 CJRR data includes all knee and hip replacement procedures performed in Canada between April 1, 2007, and March 31, 2010, by orthopedic surgeons in Canadian acute care facilities who are eligible to participate in the registry. The CJRR includes data on all primary replacements and revisions for hip and knee procedures that was submitted on a voluntary basis.

1.4.1 Frame Maintenance

The following frame maintenance procedures were in place to ascertain surgeon participation and submission rates on a regular basis as part of routine CJRR activities:

- A master list of all participating and non-participating surgeons registered with the registry was maintained.
- Inactive orthopedic surgeons (those who moved to another country or retired or who no longer performed hip and knee replacements) were identified and excluded from the list of surgeons eligible to participate in the CJRR.
- A list of acute care institutions that performed hip and knee replacements was maintained separately. These institutions typically submit to the Discharge Abstract Database (DAD). The same institution numbers were used in the CJRR, where possible.

The frame maintenance process helped to monitor the participation rate and thereby evaluate the extent of over- and under-coverage across the country. Feedback was obtained from orthopedic surgeons on the CJRR Advisory Committee to determine the number of surgeons eligible for the CJRR. The CJRR will be working closely with the Canadian Orthopaedic Association in the future for frame maintenance.

2 Data Limitations

This section discusses the issues users should note when interpreting and using CJRR data.

2.1 Data Coverage

Coverage for the CJRR has been defined as the percentage of all hip and knee replacements performed in Canada during the reporting period, as recorded in the Hospital Morbidity Database (HMDB) and the DAD, which are actually submitted to (captured in) the CJRR—the number of cases captured in the CJRR divided by the number in the HMDB and the DAD.

The HMDB is a national data holding that captures administrative, clinical and demographic information on hospital inpatient events. Discharge data is received from acute care facilities and selected chronic care and rehabilitation facilities across Canada. The HMDB is populated by a subset of the DAD (acute care data) and Quebec data. Typically, HMDB data is used in CJRR reports because of its pan-Canadian coverage.

The DAD and the HMDB capture a finite set of administrative, clinical and demographic information on hospital inpatient events, including primary and revision joint replacement procedures. They are recognized as the only databases that are comparable to the CJRR for validation purposes. Using 2006–2007 data, the distribution of various elements was compared between the CJRR and the DAD, including patient age, gender, postal code of residence, type of joint replacement (type of intervention) and reason for primary joint replacement. The data distribution across these elements was found to be comparable between the two databases. Other CJRR elements that are comparable to those in the DAD are health card number, health card issuing province, procedure date and date of birth.

2.1.1 Over-Coverage

Procedure Over-Coverage

There is minimal over-coverage in the CJRR data, although the potential exists due to the possibility of duplicate records being entered into the CJRR database. Duplicate entries result when multiple forms for a single patient for the same procedure are submitted.

The CJRR system routinely identifies potential duplicate records in the database. Edit checks were implemented in the new relational CJRR database (effective April 2005) to prevent duplicate entries. Records that are not flagged as duplicates when accepted into the database are flagged as potential duplicates

in the data quality reports through nine data elements: patient date of birth, patient gender, patient health card number and issuing province, joint involved (hip or knee), surgery date, side of replacement (left or right), if the replacement was unilateral or bilateral and the status (primary or revision).

There were 340 potential duplicate records submitted to the registry from 2007–2008 to 2009–2010 that were investigated. Hence, over-coverage can be estimated as minimal.

Surgeon Over-Coverage

Surgeon over-coverage is not an issue in the CJRR database. Prior to submitting data, all surgeons must first register with the CJRR. Only registered and practising orthopedic surgeons are included in the population of reference. Further, information on surgeons who move, retire or cease to perform hip or knee replacements is tracked.

2.1.2 Under-Coverage

Procedure Under-Coverage

The CJRR's participating orthopedic surgeons voluntarily submit joint replacement information. Since not all surgeons participate, only a proportion of all hip and knee replacements are captured.

Although the increase in surgeon participation in the CJRR is relatively steady, a discrepancy remains between the number of procedures performed across Canada, based on the HMDB, and the number of procedures actually reported to the CJRR (tables 1 and 2).

Table 1: Hip Replacements in the CJRR as a Percentage of the HMDB, by Jurisdiction, 2007–2008 to 2009–2010

Jurisdiction	2007–2008	2008–2009	2009–2010
British Columbia	41%	43%	43%
Alberta	52%	54%	53%
Saskatchewan	64%	61%	67%
Manitoba	60%	83%	85%
Ontario	18%	19%	20%
Quebec	31%	36%	40%
New Brunswick	63%	63%	62%
Nova Scotia	79%	75%	54%
Prince Edward Island	6%	3%	1%
Newfoundland and Labrador	36%	32%	29%
Territories*	64%	64%	75%
Total	**35%**	**37%**	**38%**

Note
* Territories include the Yukon, the Northwest Territories and Nunavut.

Table 2: Knee Replacements in the CJRR as a Percentage of the HMDB, by Jurisdiction, 2007–2008 to 2009–2010

Jurisdiction	2007–2008	2008–2009	2009–2010
British Columbia	45%	51%	51%
Alberta	69%	68%	67%
Saskatchewan	89%	87%	97%
Manitoba	70%	98%	98%
Ontario	21%	20%	22%
Quebec	39%	43%	51%
New Brunswick	91%	92%	93%
Nova Scotia	95%	92%	76%
Prince Edward Island	3%	3%	2%
Newfoundland and Labrador	62%	50%	40%
Territories*	65%	60%	64%
Total	**42%**	**44%**	**47%**

Note
* Territories include the Yukon, the Northwest Territories and Nunavut.

Surgeon Under-Coverage

Participation in the CJRR is voluntary, and not all surgeons participate. However, only estimates of the number of orthopedic surgeons that perform hip and knee replacements exist in the orthopedic community. As a result, it is difficult to obtain the denominator for participation rates. Estimates are shown in Table 3 below.

Table 3: CJRR Estimated Surgeon Participation, by Jurisdiction, as of March 31, 2010

Province	Active Surgeons in the CJRR	Estimated Number of Eligible Surgeons*	Percentage Participation
British Columbia	80	97	82%
Alberta	54	56	96%
Saskatchewan	25	26	96%
Manitoba	31	31	100%
Ontario	83	241	34%
Quebec	123	193	64%
New Brunswick	26	27	96%
Nova Scotia	29	29	100%
Prince Edward Island	0	3	0%
Newfoundland and Labrador	9	15	60%
Yukon	0	0	N/A
Northwest Territories	2	3	67%
Nunavut	0	0	N/A
Total	**462**	**718**	**64%**

Note
* Based on estimates from the Canadian Orthopaedic Association, January 2010.

3 Collection and Non-Response

This section provides a summary of the data collection, processing and quality control activities undertaken by the CJRR and how they may affect an external user's analysis.

3.1 Data Collection

The following procedures and practices were in place from 2007–2008 to 2009–2010 to minimize response burden and ensure adherence to privacy standards.

Paper Forms

- CJRR staff provided clients with regular support and advice regarding paper submissions.
- Pre-paid, self-addressed express mail envelopes were supplied to the CJRR's participating surgeons to facilitate the return of completed data collection forms in a secure manner.
- Standard procedures existed for manually sorting, storing and entering data collection forms.

Electronic Submissions

- Client support was available for electronic submission by CJRR staff.
- CJRR released updated e-submission specification documents annually to clients who submitted electronically. These included changes to the database structure or to manual forms.
- The electronic data submission specifications were circulated as per CIHI's standards, ensuring that lead time for clients was accommodated.

Web Submissions

- CJRR staff provided regular support and advice to web submitters.

The following CJRR practices were in place to encourage new and ongoing participation and to enhance awareness of the registry:

- Professional development credits were offered as an incentive to CJRR participating surgeons, in collaboration with the Royal College of Physicians and Surgeons of Canada. One credit was issued for every six submitted records per calendar year.
- Analytical reports and Analyses in Brief were distributed at no cost to participating surgeons.
- Presentations were given at national and provincial orthopedic conferences.
- CJRR Advisory Committee meetings took place twice a year to foster consensus-building through collaboration.
- CJRR staff responded to data requests from participating surgeons or data suppliers via centralized email.
- Within the constraints of privacy and confidentiality guidelines, surgeons may request a return of their own submitted data to assist with reviews of their surgical practices or other studies.
- Specialized reports were produced for research and presentation at professional conferences.
- CIHI's privacy and confidentiality policies were adhered to.

Note that as of 2009–2010, the CJRR Web-Based Data Submission and Reports Tool was released as an additional mode of data submission with real-time reporting capacity.

Web-based data submission will continue to encourage new and ongoing participation in the CJRR.

3.2 Data Quality Control

The following quality control measures were applied to CJRR data:

- Data entry verification was done on 100% of the data processed for 2007–2008 and 2008–2009. Starting in 2009–2010, every form was micro-edited prior to being entered into the database, and verification was performed on 20% of the forms.
- Data was entered into the CJRR database according to pre-established data entry rules.
- Data entered into all fields in the data entry program was subjected to automated logic edits to ensure completion of mandatory fields and logic conditions.
- For records that failed the edit checks, appropriate validation notes were attached to the respective records and remained with the record until the error had been updated; this measure was necessary for data quality purposes.
- Two types of errors were generated if a record failed an edit check: warnings and severe errors.
  - Warnings occurred when optional data elements were missing from a record. An error log was produced at the end of the record displaying each field that had the error and the description of the error.
  - Severe errors occurred when mandatory data elements were left blank or the format of the data was invalid. Whenever this occurred, a pop-up message appeared on screen to alert the user to the nature of the error. Records with severe errors could not be saved into the database.
- Files submitted electronically were tested for compliance with the data entry rules, and errors were generated as above in a submission report. Errors were reported to the clients for correction and re-submission in accordance with CIHI's privacy and confidentiality policies.
- Data quality reports were produced to identify potential duplicate patient and/or procedure records, as discussed in Section 2.1.1. True duplicates were then deleted.

3.3 Non-Response

3.3.1 Unit Non-Response

In the CJRR, unit non-response is defined in two ways:

1. The number of active CJRR participating **surgeons** who submitted data, divided by the total number of surgeons who registered to participate; and
2. The number of joint replacement **procedures** received by the CJRR, divided by all joint replacement procedures performed in Canada as per the HMDB.

Table 4 shows the percentage of active surgeons who submitted data to the registry out of those who signed up to submit data (that is, to participate in the CJRR) for 2007–2008 to 2009–2010.

Table 4: Participating Surgeon Response Rate, by Jurisdiction, CJRR, 2007–2008 to 2009–2010

Jurisdiction of Participating Surgeon	2007–2008 Response Rate	2008–2009 Response Rate	2009–2010 Response Rate
British Columbia	66%	66%	64%
Alberta	85%	89%	93%
Saskatchewan	95%	87%	92%
Manitoba	30%	75%	81%
Ontario	34%	38%	40%
Quebec	75%	77%	76%
New Brunswick	83%	86%	93%
Nova Scotia	96%	100%	100%
Prince Edward Island	0%	0%	0%
Newfoundland and Labrador	91%	90%	90%
Northwest Territories	67%	67%	33%
Total	**66%**	**71%**	**72%**

The CJRR captured 38% of hip replacement procedures and 47% of knee replacement procedures conducted in public facilities, as reported in the HMDB in 2009–2010. The proportion of procedures conducted in private facilities captured by the CJRR is unknown, as private facilities do not report to the HMDB.

Several procedures were in place to minimize unit non-response, including standard procedures that permitted tracking on a monthly basis of the following:

- The total number of forms submitted to the CJRR;
- The total number of forms received with incomplete patient consent and other mandatory fields; and
- The total number of forms received with patient consent refusals.

3.3.2 Item (Partial) Non-Response

With the introduction of mandatory fields in the relational CJRR database at the beginning of April 2005, the completeness of the database improved significantly. Mandatory elements could not be saved into the database unless they were completed.

Data collection forms submitted by surgeons were checked regularly for invalid or missing values, and follow-up was done on a regular basis to correct inconsistencies in reporting.

In the newly developed CJRR Web-Based Data Submission and Reports Tool, introduced in 2009, all the mandatory fields are indicated with an asterisk, and the record cannot be saved unless all such fields are completed. Health card number, a key variable, is flagged if it is entered but is invalid. More than 50% of the data elements are mandatory and strong edit checks are in place, contributing to an increase in CJRR data quality.

3.4 Adjustment for Non-Response

Corrections were made from 2007–2008 to 2009–2010 to records based on the feedback received from surgeons and their offices. For example, missing or inconsistent admission dates (such as the surgery date being earlier than the admission date) were updated as necessary upon receiving surgeon feedback.

3.5 Measurement Error

Variables used were screened for validity, and several different types of errors were identified. The main error identified in paper forms was the use of a non-standardized date format when submitting items such as date of birth, surgery date and admission date. For example, one date may have been in the format mm/dd/yyyy, whereas another might have been dd/mm/yyyy or yyyy/mm/dd. This resulted in difficulty differentiating between month, day and year. The CJRR staff were trained to identify these types of errors and correct them.

3.6 Issues of Bias and Reliability

The extent of bias in the CJRR is unknown; however, several types of bias are possible, such as surgeon and procedure selection bias. There may be some degree of inconsistency; for example, what is considered a revision procedure by one surgeon may be considered a simple repair by another surgeon. Inconsistencies may also occur due to differences in defining techniques or procedures (for example, defining minimally invasive surgery in relation to body size or defining a procedure as bilateral when performed under one anesthetic or during one hospitalization).

All variables in the data set were subjected to CJRR database validity, logic, range and consistency checks. Validity rules pertaining to electronic submission specifications were documented in the CJRR electronic submission specifications. Edit checks in the CJRR relational database were applied to minimize data entry and electronic data submission errors. Consistency checks were supported through pre-existing look-up tables containing surgeon, facility and patient information.

Further, all core (mandatory) variables in the CJRR data set were checked for validity using SAS programs before these core variables were used for any analyses.

Records containing patients outside of pre-defined age and weight ranges were flagged for follow-up. Records containing admission and surgery dates that were out of chronological sequence were manually verified, and the appropriate corrections were applied once clarification was obtained from the surgeon's office.

4 Major Methodological Changes From Previous Years

4.1 Major Changes Compared With 2006–2007

No major changes were made between 2006–2007 (the data assessed in the previous *Data Quality Documentation for Users* report) and 2009–2010. In 2005–2006, mandatory fields were introduced in the relational CJRR database. This greatly increased the completeness of the database, as the fields had to be completed during data entry before progression to the next item was possible.

4.2 Changes Affecting Longitudinal Comparisons

No changes were made to the CJRR data collection forms between 2007–2008 and 2009–2010; however, significant changes will be made in 2012–2013. Based on consultation with and input from the CJRR Advisory Committee and members of the Canadian Orthopaedic Association, CIHI is moving toward a minimum data set (MDS) for hip and knee replacements. Work is under way to align the data currently collected by the Canadian registry with the MDS recommended by the International Society of Arthroplasty Registries. The MDS will significantly reduce the burden on data providers while retaining key data elements. The usefulness of the data will be greatly improved once CJRR identifies a sustainable way of accessing the comprehensive product information that can be leveraged in the implant product barcodes, a project of interest to CJRR.

5 Revision History

The CJRR data is subject to revision if any corrections are received from the data providers. The CJRR continues to accept data beyond the reporting period deadline; thus there may be slight variations in reported data over time.

6 External Comparability

This final segment of this document explores the comparability of CJRR data with other relevant sources that contain similar or the same information on the basis of geography, facility, time and person.

6.1 Geography

The CJRR contains the patient's province of residence and postal code along with the submitting facility's province code. Every Canadian province is denoted by a distinct province code in the registry. A Postal Code Conversion File (PCCF) can be used to map the patient's postal code to more aggregated regions. An edit check for valid postal codes is built into the CJRR database.

Note that release of information for geographic areas with very few counts is restricted for privacy and confidentiality reasons in conjunction with CIHI's privacy and confidentiality guidelines for all databases and registries.

6.2 Facility

The hip and knee data collection forms contain the name of the facility where the replacement procedure was performed. Since hip and knee replacements are performed largely in acute care facilities, the HMDB and the DAD serve as good sources for comparison with the CJRR and contain the acute care facility numbers and facility names.

6.3 Time

The CJRR began to publish data based on fiscal year of surgery beginning with 2003–2004 data. The date variables in the registry currently include the patient's admission date, surgery date and surgery decision date (if provided). These fields help to compare information across other databases, such as the HMDB and the DAD. Inclusion of the surgery date helped enhance comparability (against time) with other databases and registries, both within CIHI and with other international registries.

6.4 Personal Information

CJRR includes patient demographic information, such as health card number and date of birth. This information is not disclosed or released to third parties. For approved requests, age or age group is typically provided instead of date of birth, and health card numbers are encrypted. Linkages and the need to access restricted data elements require approval from CIHI's Privacy and Confidentiality team.

For additional information, refer to the CJRR's privacy impact assessment and CIHI's privacy policy on CIHI's website at www.cihi.ca/privacy.

6.5 External Source Validation

Other than the HMDB and the DAD, there are no other known national external sources of published information on hip and knee replacements performed in Canada that can be used to validate information in the CJRR.

7 Contact Information

For more information, please contact the CJRR team at cjrr@cihi.ca.

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