Hip and Knee Replacements in Canada, 2016–2017

Canadian Joint Replacement Registry Annual Report

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

Production of this document is made possible by financial contributions from Health Canada and provincial and territorial governments. The views expressed herein do not necessarily represent the views of Health Canada or any provincial or territorial government.

Unless otherwise indicated, this product uses data provided by Canada's provinces and territories.

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

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

ISBN 978-1-77109-723-9 (PDF)

How to cite this document:
Canadian Institute for Health Information. *Hip and Knee Replacements in Canada, 2016–2017: Canadian Joint Replacement Registry Annual Report*. Ottawa, ON: CIHI; 2018.

Cette publication est aussi disponible en français sous le titre *Arthroplasties de la hanche et du genou au Canada, 2016-2017 : rapport annuel du Registre canadien des remplacements articulaires* .
ISBN 978-1-77109-724-6 (PDF)

Table of contents

Acknowledgements 4

Key findings 6

About this report 8

Hip replacement surgeries in Canada 9

- A national snapshot 9
- Examining risks for hip revision surgery 10

Knee replacement surgeries in Canada 15

- A national snapshot 15
- Examining risks for knee revision surgery 16

Summary and future directions 18

Figures and tables 20

- Hip replacements 20
- Knee replacements 31

Appendix 1: CJRR coverage for 2016–2017 36

Appendix 2: Methodological notes 37

Appendix 3: Glossary 41

Appendix 4: Text alternative for figures 44

References 49

Acknowledgements

Canadian Joint Replacement Registry (CJRR) data is provided by ministries of health, regional health authorities, orthopedic surgeons, nurses, medical records staff and others across Canada.

The Canadian Institute for Health Information (CIHI) thanks the Canadian Orthopaedic Association for its ongoing collaboration, which is essential to CJRR. We also thank the CJRR Advisory Committee for its invaluable advice and support in the delivery and uptake of the CJRR program, as well as the Scientific Working Group for its advice in the development of the revision risk curves. A special note of appreciation goes to the CJRR Advisory Committee chairs, Dr. Eric Bohm and Dr. Michael Dunbar, for their leadership and support in advancing CJRR over the past several years.

CJRR Advisory Committee members

- Chair: Dr. Eric Bohm, Concordia Joint Replacement Group, Department of Surgery, University of Manitoba
- Co-Chair: Dr. Michael Dunbar, Queen Elizabeth II Health Sciences Centre, Nova Scotia
- Dr. Keegan Au, St. Clare's Mercy Hospital, Newfoundland and Labrador
- Ms. Brie DeMone, Manitoba Health, Seniors and Active Living
- Ms. Sandra Feltham, British Columbia Ministry of Health
- Dr. Jeffrey Gollish, Holland Orthopaedic and Arthritic Centre, Ontario
- Dr. Olga Huk, Sir Mortimer B. Davis Jewish General Hospital, Quebec
- Ms. Aleksandra Jokovic, Ontario Ministry of Health and Long-Term Care
- Dr. Darren Kerr, Saint John Regional Hospital, New Brunswick
- Dr. Paul Kim, The Ottawa Hospital, Ontario
- Dr. Martin Lavigne, Hôpital Maisonneuve-Rosemont, Quebec
- Dr. Brendan Lewis, Western Memorial Regional Hospital, Newfoundland and Labrador
- Dr. Bassam Masri, Vancouver General Hospital, British Columbia
- Ms. Joan McQuay, Patient Representative
- Dr. Emil Schemitsch, Canadian Orthopaedic Association
- Ms. Nancy Schuttenbeld, Canadian Orthopaedic Nurses Association
- Mr. Douglas Thomson, Canadian Orthopaedic Association
- Dr. Johannes van der Merwe, Saskatoon City Hospital, Saskatchewan
- Dr. James Waddell, St. Michael's Hospital, Ontario
- Dr. Jason Werle, Alberta Hip and Knee Clinic, Alberta

Scientific Working Group members

- Dr. Eric Bohm
- Dr. Michael Dunbar
- Dr. Paul Kim
- Dr. Bassam Masri
- Dr. Emil Schemitsch
- Dr. James Waddell
- Dr. Jason Werle
- Dr. Gavin Wood

CIHI also wishes to acknowledge the following individuals for their contribution to the development of this report:

- Carolyn Sandoval, Program Lead, CJRR
- Julia Di Bella, Senior Analyst, CJRR
- Alina Dragan, Senior Analyst, CJRR
- Catherine Yu, Senior Analyst, CJRR
- Nicole de Guia, Manager, Joint Replacement Registry, Patient-Reported Outcomes and Experiences
- Greg Webster, Director, Acute and Ambulatory Care Information Services

Key findings

Hip and Knee Replacements in Canada, 2016–2017: Canadian Joint Replacement Registry Annual Report provides updated information on hip and knee replacement surgeries performed in Canada based on national hospitalization and day surgery data sources. The report also includes cumulative revision risk estimates for up to 5 years based on almost 290,000 primary surgeries from provinces mandated to report to CJRR (Ontario, Manitoba and British Columbia).

The Canadian Joint Replacement Registry (CJRR) was launched in 2001 as a collaborative effort between the Canadian Institute for Health Information (CIHI) and the Canadian Orthopaedic Association. This pan-Canadian program was established to record and analyze clinical information and outcomes for primary and revision hip and knee replacements over time to improve outcomes for these patients.

Over the 5 years from 2012–2013 to 2016–2017, the number of hip and knee replacement surgeries performed in Canada increased.

- In 2016–2017 in Canada, 55,981 hip replacements and 67,169 knee replacements were performed. This represents increases of 17.8% and 15.5%, respectively, compared with 5 years earlier.
- Based on an average inpatient cost of more than $9,100 per joint replacement surgery in Canada (excluding physician payments and rehabilitation), more than $1 billion is spent annually; these surgeries also represent more than 594,000 acute care bed days.[1] Joint replacements are costly to health care systems, so it is important to look for opportunities to reduce negative outcomes such as the need for revision surgery.
- More than 9,400 hip and knee revision surgeries are performed every year. In 2016–2017, these represented 8.3% and 7.1% of all hip and knee replacements, respectively. While the volume of hip revisions stayed relatively the same over the 5 years, knee revisions increased by almost 18% during the same period.
- While revisions may represent a relatively small proportion of all joint replacements, these types of surgeries are more complex than primary surgeries and have implications for both patients and health care systems, such as reduced function, longer patient recovery time and higher health care costs. Based on available inpatient cost data, the estimated cost for a revision surgery is more than $13,700 — more than 56% higher than for a primary joint surgery (more than $8,800).[1]
- Examining risk factors for early revision can inform clinical best practices for joint replacement patients and decisions affecting health system costs.

For hip replacements performed to treat acute hip fractures, the cemented fixation method is associated with lower risk of early revision.

- Usually, a partial hip replacement (hemiarthroplasty) is used to treat a hip fracture. Using a cementless fixation method for partial hip replacement resulted in a higher revision risk within 3 years (4.2%) compared with using cement to secure the prosthesis in place (2.8%). This finding can be applied to reduce revision rates among this defined patient group, resulting in improved patient outcomes and experiences as well as reduced health system costs.
- The revision risk for cementless partial hip replacement was also higher when the surgeon had performed fewer than 50 hip replacements that year — an effect not seen for cemented partial hip replacements. This finding can inform surgeon training and organization of health system delivery.

For knee replacements, sex, age and extent of procedure influenced the risk of having an early revision surgery.

- Men had a higher 4-year revision risk (2.9%) than women (2.1%).
- For both sexes, revision risk of total knee replacements decreased significantly with increasing age (2.0% for men age 75 and older compared with 5.9% for those younger than 55; 1.5% for women age 75 and older compared with 4.3% for those younger than 55).
- Compared with total knee replacement surgeries, partial knee replacement surgeries had a significantly higher risk of revision within 2 years of the primary surgery (ranged from 3.5% to 6.1% for partials, and from 1.6% to 1.9% for totals).

CIHI is continuing efforts to collect hip and knee data that supports person-centred, value-based health care delivery.

- We will continue to work with jurisdictions to increase the overall national coverage of hip and knee medical device information that is linkable to the patient and to further explore revision rates based on other factors, such as implant characteristics.
- CIHI is currently engaged in several activities related to patient-reported experience measures (PREMs) and outcome measures (PROMs) that will help provide a more comprehensive picture of the journey of hip and knee replacement patients. These include
  - Collecting standardized patient experiences survey data on inpatient care through the Canadian Patient Experiences Reporting System (CPERS).
  - Establishing national standards for the collection of PROMs for hip and knee replacement patients and facilitating standards uptake by jurisdictions, starting in Ontario.
  - Leading, with the Organisation for Economic Co-operation and Development (OECD), an international pilot project to report internationally comparable PROMs indicators for hip and knee replacement patients across participating countries for 2019.

About this report

Hip and Knee Replacements in Canada, 2016–2017: Canadian Joint Replacement Registry Annual Report provides an overview of key statistics related to hip and knee replacement surgeries performed in Canada based on national hospitalization and day surgery data sources (patients age 18 and older). This year's report includes an expanded set of revision risk curves with a longer follow-up period of up to 5 years, based on data from almost 290,000 primary surgeries from provinces that are mandated to report to CJRR: Ontario, Manitoba and British Columbia. Revision arthroplasty is a key complication of hip and knee arthroplasty: it reflects poor patient outcomes and results in additional hospital stays and health care system costs. Reporting on revision risks helps policy-makers and clinicians better understand who is at highest risk of revision and how to minimize this risk.

Companion data tables for this report are available on CIHI's website at cihi.ca/cjrr. *Hip and Knee Replacements in Canada: Canadian Joint Replacement Registry 2016–2017 Quick Stats* includes provincial and territorial results.

Refer to Appendix 3: Glossary for definitions of arthroplasty-related and statistical terms used in the report.

Please direct any questions or feedback to the CJRR team at cjrr@cihi.ca.

About the Canadian Joint Replacement Registry

CJRR is a pan-Canadian source of information about hip and knee replacements. It was launched in 2001 as a collaborative effort between CIHI and the Canadian Orthopaedic Association. CJRR was established to record and analyze clinical information and outcomes of primary and revision hip and knee replacements over time to improve care for these patients.

CJRR provides patient and prosthesis information that complements demographic and administrative information captured in other CIHI databases: the Discharge Abstract Database (DAD), the Hospital Morbidity Database (HMDB) and the National Ambulatory Care Reporting System (NACRS).

As of 2016–2017, submission to CJRR has been mandatory for 3 provinces (Ontario, Manitoba and British Columbia) and 2 regions in Saskatchewan (Regina Qu'Appelle Health Region and Saskatoon Health Region). Submissions from all other provinces are voluntary. As shown in Appendix 1, coverage for 2016–2017 remained consistent at 71% nationally, with variations by province. Mandatory submission from all jurisdictions would be the most effective way to ensure comprehensive capture of prosthesis and outcome information for all hip and knee replacement patients in Canada.

More information on CJRR can be found at cihi.ca/cjrr.

Hip replacement surgeries in Canada

A national snapshot

Over the 5 years from 2012–2013 to 2016–2017, the number of hip replacement surgeries performed in Canada increased.

- In 2016–2017 in Canada, 55,981 hip replacements were performed. This was a 17.8% increase from 5 years earlier, when there were 47,541 of these surgeries.
- Age-standardized rates also increased. In 2016–2017, the rate was 175 per 100,000 population age 18 and older — 4.8% higher than in 2012–2013 (167 per 100,000).
- Overall, 2 of every 3 patients who had a hip replacement were age 65 and older. Among women who had a hip replacement, 72.6% were in this age group, compared with 60.3% of men.
- Almost all hip replacements were performed in an inpatient setting and required an overnight stay, with a median length of stay (LOS) of 3 days. Among women, the median LOS was 4 days; for men, it was 3 days.
- Only 106 (0.1%) hip replacements were performed in day surgery settings in 2016–2017.
- The most common reasons for having a primary hip replacement were degenerative arthritis (81.2%) and acute hip fracture (15.1%).

In 2016–2017 in Canada, 4,664 hip revisions were performed, representing 8.3% of all hip replacements done that year.

- While revisions account for a relatively small proportion of all joint replacements, these types of surgeries are more complex than primary surgeries and have implications for both patients and health care systems, such as reduced function,[2, 3] longer patient recovery time[2, 3] and higher procedure costs.[1]
- The number of hip revisions performed in Canada in 2016–2017 decreased slightly (by 1.4%) compared with 5 years earlier, when there were 4,729 such surgeries.
- The most common reason for revision was aseptic loosening (29.5%), followed by instability (16.1%) and infection (15.5%).[i]

i. For this report, to determine the most common reasons for revision, only procedures associated with a specific reason for revision were included (i.e., those with “other” indicated as the reason for revision were excluded). In addition, “infection” included only single-stage revisions and the first stage of a 2-stage revision.

- Revision surgery may involve the replacement of one or more components. Among all hip revisions reported in CJRR for 2016–2017,
  - 22.6% had the femoral head[ii] replaced (with or without acetabular liner);
  - 24.2% had the acetabular component replaced (with or without femoral head);
  - 26.4% had the femoral component replaced (with or without acetabular liner);
  - 25.7% involved the replacement of both the femoral component and acetabular component; and
  - 1.1% involved insertion of cement spacers or the replacement of the acetabular liner only.

Jurisdiction-level results and annual trends, as well as additional clinical- and hospital-related information, can be found in the companion data tables at cihi.ca/cjrr (*Hip and Knee Replacements in Canada: Canadian Joint Replacement Registry 2016–2017 Quick Stats*).

Examining risks for hip revision surgery

This section provides the cumulative revision risks for hip replacement surgeries by selected factors, including new analyses investigating the effect of bearing surface on revision risk (figures 1 to 6). Where possible, we also looked at reasons for revision within each subgroup.

Similar to last year's report, we analyzed cumulative revision risks separately for patients with degenerative arthritis and for patients with acute hip fracture. Surgeons have noted clinical differences between these 2 patient groups as well as different treatment pathways.[4, 5]

Study population

From 2012–2013 to 2016–2017, there were 123,673 primary hip replacement surgeries reported to CJRR from Ontario, Manitoba and British Columbia (the 3 provinces with mandated submission over this period). Only data from CJRR-mandated provinces was included to ensure representativeness of the revision findings based on a high coverage rate. Details regarding the methodology can be found in Appendix 2.

ii. Refer to Appendix 2 for details about how the components were identified in CJRR.

A closer look at patients with degenerative arthritis

During the period analyzed, 89,695 patients had a primary total hip replacement due to degenerative arthritis, comprising 92% of patients with primary total hip replacement. Of these, 1,707 (1.9%) had at least one revision based on data from the 5-year study period.[iii] We looked at early risk of revision by 2 important demographic factors, age and sex, which are readily available in our data and which have been identified as potential risk factors for having a revision surgery. To account for potential interaction effects, this year's report presents curves stratified by age and sex together (Figure 1).

Most hip replacement patients were women and were age 55 and older.

- Women received more than half (55.2%) of all primary total hip replacements due to degenerative arthritis.
- One-third of replacements (34%) were performed in patients age 65 to 74, followed by those 75 and older (27.2%) and 55 to 64 (26.8%). The lowest proportion of total hip replacements for degenerative arthritis was found in patients younger than 55 (12.1%).
- Women who had hip replacements (mean age 68.9) were significantly older than men (mean age 66.4).

The risk of having an early revision after a total hip replacement was similar for all age groups.

- The cumulative percentage revision at 4 years for total hip replacement for osteoarthritis was 2.4%. This did not vary significantly by age and sex, as can be seen in Figure 1.

Infection was a common reason for revision among both sexes.

- Among women, instability and infection were the most common reasons for revision for those younger than 65 (Table 1). Periprosthetic fracture was the most common reason for those 65 and older.
- Among men, infection was the most common reason for revision across all age groups (Table 1). Notably, periprosthetic fracture prevalence increased with age.

iii. Only the first revision was considered. For methodology details, refer to Appendix 2.

A closer look at patients with total hip replacement and the effect of bearing surface types

During the 5 years analyzed, among the 97,462 primary total hip replacements (with any diagnosis), 1,995 (2.1%) required at least one revision surgery. In total hip replacement surgery, the bearing surface is a combination of the materials used for the femoral head and for the acetabular liner or cup. Choosing which materials to use for the bearing surface of the implant is an important decision that is made by the orthopedic surgeon and can influence revision rates.[6, 7]

For the first time, the CJRR annual report includes analysis on cumulative revision risk for total hip replacement by bearing surface. We included the most common categories of bearing surfaces and included only those associated with products from more than one manufacturer. Bearing surface implant characteristics were obtained by linking CJRR data with the Global Arthroplasty Product Library maintained by the International Consortium of Orthopaedic Registries (ICOR) and the International Society of Arthroplasty Registers (ISAR).[8] See Appendix 2 for details on methodology.

The risk of having an early revision after a total hip replacement appeared to be similar among all bearing surfaces.

- The most common bearing surface combinations were metal-on-cross-linked-polyethylene (72.5%), ceramic-on-cross-linked-polyethylene (9.8%), ceramic-on-ceramic (3.2%) and metal-on-non-cross-linked-polyethylene (2.5%).
- Revision risks were similar across the different bearing surface combinations investigated (Figure 2).
- Infection was the most common reason for revision for all bearing surfaces except for ceramic-on-cross-linked-polyethylene, which was most commonly revised due to instability reasons (Table 2).

A closer look at patients who had a hip fracture

Among the 123,673 primary hip replacements in the study cohort, 18,632 (15.1%) were done to treat acute hip fracture. Patients treated for hip fracture were predominantly women (69.0%, compared with 57.9% for all primary hip replacements) and were older than the general hip replacement population (mean age 81.5 for hip fractures, 70.5 for all hip replacements). Partial hip replacement, also known as hemiarthroplasty, was the most common surgical treatment for hip fracture when a joint replacement was required: 87.8% of hip replacements for hip fracture were partial hip replacements, compared with 19.0% of all hip replacements.

Among the 18,632 primary hip replacements performed to treat acute hip fractures in the study cohort, 581 (3.1%) required at least one revision surgery based on data from the 5-year study period. For these patients, we examined the type of arthroplasty surgery performed and the femoral fixation method[iv] used.

New for this year's report, we stratified partial hip replacements into bipolar, monopolar modular and monopolar monoblock types in order to look for possible differences in revision risk. For details on types of partial hip replacement, refer to Appendix 3: Glossary.

We also examined partial hip replacement types by age to take into account potential confounding. Only curves for patients 75 and older are presented, since the number of qualifying procedures in the other age groups was too small to show meaningful results.

Another addition to this year's report is an examination of the effect of femoral fixation method by age group and also by surgeon volume. For this analysis, low volume was defined as the surgeon performing less than 50 hip replacements within a given year. Conversely, high volume included surgeons performing 50 or more hip replacements within a year. For more details about the categorization, refer to Appendix 2.

Early revision risks for primary total and partial hip replacement for acute hip fracture were similar.

- 87.8% of hip replacement surgeries to treat acute hip fracture were partial hip replacements; among these, bipolar hemiarthroplasty was most common, followed by modular monopolar hemiarthroplasty (59.2% and 20.6% of partial hip replacements, respectively).
- Cumulative percentage revision at 2 years was lowest for modular monopolar hemiarthroplasty and highest for total hip replacement (3.1% versus 3.7%, respectively), but there was no significant difference between early revision risks for the different procedure types (Figure 3).
- In patients age 75 and older, at 2 years post-surgery, bipolar hemiarthroplasty had the lowest cumulative percentage revision and monoblock monopolar hemiarthroplasty had the highest (2.7% versus 3.4%, respectively); however, the differences were not statistically significant (Figure 4).
- All hip replacement types for acute hip fracture had periprosthetic fracture as the most common reason for revision, ranging from 25.3% of modular monopolar arthroplasty revisions to 31.4% of bipolar hemiarthroplasty revisions.

iv. Refer to Appendix 3: Glossary for a definition of femoral fixation.

Method of femoral fixation appeared to have a significant impact on short-term revisions for primary partial hip replacements in patients age 75 and older.

- Cementless femoral fixation was far more common than cemented femoral fixation in partial hip replacements for acute hip fracture (73.7% versus 26.3%); however, cement use increased with patient age (21.9%, 23.1% and 27.2% in patients age younger than 65, 65 to 74, and 75 and older, respectively).
- In general, risk of revision for cementless fixation was higher than for cemented, for all age groups (and particularly for older ones). However, for some age groups the numbers were too small to compare beyond 1 or 2 years.
  - For patients younger than 65, the 1-year cumulative percentage revision was the same for both cemented and cementless fixation (at 4.1%) (Figure 5).
  - For patients age 65 to 74, cemented partial hip replacements had lower cumulative percentage revision at 1 year than cementless ones (2.8% versus 3.9%, respectively), but the difference was not statistically significant (Figure 5).
  - For patients age 75 and older, there was a significant difference at 2 years (2.2% for cemented versus 3.0% for cementless) (Figure 5).

Surgeon arthroplasty volume and method of femoral fixation played a role in the revision risk for partial hip replacement as a treatment for hip fracture.

- Studies have shown that the risk for short-term complications, including early revisions, is approximately inversely proportional to the volume of procedures carried out by the operating surgeon.[9]
- 6,946 of 11,921 cementless partial hip replacements (58%) were performed by surgeons who performed 50 or more hip replacements in that fiscal year, while 2,093 of 4,286 (48.8%) of cemented partial hip replacements were performed by high-volume surgeons.
- For both high- and low-volume surgeons, cementless femoral fixation was associated with higher risk of revision than cemented femoral fixation for partial hip replacement after hip fracture (Figure 6).
- For cemented partial hip replacements, surgeon arthroplasty volume did not appear to show a difference in risk in our study period. However, for cementless partial hip replacements, low-volume surgeons had a higher cumulative percentage revision at 3 years than high-volume surgeons (4.5% versus 3.9%, respectively); however, the differences are not statistically significant (Figure 6).

Knee replacement surgeries in Canada

A national snapshot

Over the 5 years from 2012–2013 to 2016–2017, the number of knee replacement surgeries performed in Canada increased.

- In 2016–2017 in Canada, 67,169 knee replacements were performed. This was a 15.5% increase compared with 5 years earlier, when there were 58,138 knee replacements.
- The age-standardized rate remained relatively steady over the 5 years studied. In 2016–2017, the rate was 205 hospitalizations per 100,000 population age 18 and older, representing a 1.5% increase from 2012–2013.
- Among patients undergoing a knee replacement, the age distribution by sex was very similar. More than half of patients were age 65 and older: 61.9% of women and 62.7% of men.
- The median LOS in hospital was 3 days (excluding procedures submitted as day surgeries), with similar results for women and men.
- While still rare, knee replacements were done as day surgery in 227 (0.3%) procedures in 2016–2017.
- Degenerative arthritis was by far the most common diagnosis grouping captured in CJRR for these patients (98.8%).

In 2016–2017 in Canada, 4,736 knee revisions were performed, representing 7.6% of all knee replacements done that year.

- While revisions may represent a relatively small proportion of all joint replacements, these types of surgeries are more complex than primary surgeries and have implications for both patients and health care systems, such as reduced function,[2, 3] longer patient recovery time[2, 3] and higher procedure costs.[1]
- The number of knee revisions performed in Canada in 2016–2017 increased by 17.6% compared with 5 years earlier, when there were 4,026 such surgeries.
- The most common reasons for revision were aseptic loosening (27.5%), infection (20.4%) and instability (14.2%).[v]

v. For this report, to determine the most common reasons for revision, only procedures associated with a specific reason for revision were included (i.e., those with “other” indicated as the reason for revision were excluded). In addition, “infection” included only single-stage revisions and the first stage of a 2-stage revision.

- Revision surgery may involve the replacement of one or more components. Among all knee revisions reported to CJRR for 2016–2017,
  - 51.4% had both the femoral[vi] and tibial components replaced;
  - 23.1% had the tibial insert replaced;
  - 13.6% had the femoral component replaced (with or without the tibial insert);
  - 7.9% had only the tibial component replaced (with or without insert);
  - 3.9% involved the replacement or insertion of patellar component; and
  - 0.1% involved insertion of cement spacers.

Jurisdiction-level results and annual trends, as well as additional clinical- and hospital-related information, can be found in the companion data tables at cihi.ca/cjrr (*Hip and Knee Replacements in Canada: Canadian Joint Replacement Registry 2016–2017 Quick Stats*).

Examining risks for knee revision surgery

This next section provides the cumulative revision risk estimates for knee replacement surgeries by selected factors as identified by clinical experts (figures 7 and 8). In this year's report, we investigated the knee revision risk differences among age groups by sex. We also looked at reasons for revision within each subgroup.

Similar to last year's report, we looked at the early revision risk for the main types of knee replacements, which can be broadly classified into 2 categories: partial and total. A total knee replacement typically involves both the medial and lateral compartments of the tibiofemoral joint, with or without resurfacing of the patella. A partial knee replacement typically involves one of the medial, lateral or patellofemoral compartments of the knee. Because patients who require these surgeries are commonly diagnosed with degenerative arthritis, we had a closer look at cumulative revision risks for patients with this diagnosis.

Study population

From 2012–2013 to 2016–2017, there were 165,712 primary knee replacement surgeries reported to CJRR from Ontario, Manitoba and British Columbia (the 3 provinces with mandated submission over this period). Only data from CJRR-mandated provinces was included to ensure representativeness of the revision findings based on a high coverage rate. Details regarding the methodology can be found in Appendix 2.

vi. Refer to Appendix 2 for details about how the components were identified in CJRR.

Among all knee replacements performed in the study period, the vast majority were total knee replacements (95.0%), with the remaining being partial knee replacements (4.5% medial, 0.3% lateral and 0.2% patellofemoral replacements). This year, we report separately on the revision risk of total knee replacements performed with and without resurfacing of the patella.

1.7% of total knee replacements had a revision within 5 years, while 3.9% of partial knee replacements required a revision.

The early revision risks for all types of partial knee replacements (medial, lateral and patellofemoral) were significantly higher than those for total knee replacements.

- The revision risks for total knee replacements with or without patella resurfacing were significantly lower than the risks for the partial replacement types, with a cumulative percentage revision at 4 years of 2.2% and 2.9%, respectively, compared with 5.4% for medial unicompartmental partial replacements (Figure 7).
- Medial unicompartmental arthroplasty had a significantly lower cumulative percentage revision at 2 years than lateral unicompartmental arthroplasty (3.5% versus 6.1%, respectively) (Figure 7).
- The cumulative percentage revision of total knee replacement at 4 years was significantly higher when the patella was not resurfaced compared with when it was (2.9% versus 2.2%, respectively) (Figure 7).

Infection and instability were common reasons for revision for total knee replacements.

- Regardless of whether resurfacing of the patella was involved, infection was the most common reason for revision, followed by instability and aseptic loosening (Table 3).

A closer look at patients with degenerative arthritis

Among all patients who underwent knee replacement procedures in this analysis, nearly all were diagnosed with degenerative arthritis as the most responsible diagnosis (98.1%). Out of 154,025 primary total knee replacements for degenerative arthritis, 2,561 (1.7%) required at least one revision during the study period. We investigated the risk of having an early knee revision by age and sex together.

Most knee replacement patients were women and were age 55 and older.

- Women received the majority of primary total knee replacements (61.5%).
- The most common age group in which primary total knee replacements for degenerative arthritis were performed was 65 to 74 (38.4%), followed by 55 to 64 (29.6%) and 75 and older (24.5%). The youngest age group (younger than 55) had the fewest surgeries (7.6%).
- The mean age for men and women was 68.4 and 68.1, respectively.

Men and younger patients had significantly higher risks of having an earlier revision surgery.

- Across all patients, the revision risk decreased significantly with increasing age (Figure 8).
- Men age 55 and older had a significantly higher revision risk than women (Figure 8).

Instability and infection were common reasons for revision.

- Among all patients, the proportion of revisions due to instability decreased with increasing age, from 30.5% and 23.6% in women and men younger than 55, respectively, to 18.8% and 15.2% in women and men 75 and older, respectively (Table 4).
- Conversely, the proportion of revisions due to infection increased with age, from 21.9% and 28.1% in women and men younger than 55, respectively, to 40.9% and 59.8% in women and men 75 and older, respectively (Table 4).

Summary and future directions

The CJRR program continues to expand and evolve with the intent to improve quality and outcome reporting for patients who have undergone hip or knee replacement surgeries in Canada.

We will continue to report on clinical patient outcomes, with a focus on revision risk as a key outcome measure for ongoing monitoring.

- While our findings show that revision risk is relatively low up to 5 years post-surgery, it is expected that a person's risk increases over time. It has been reported that the risk of revision for total hip and knee replacements could be as high as 12% after 10 years.[10] Therefore, longer follow-up is required to more clearly assess differences between some of the subgroups, such as bearing surfaces. Other international registries report on cumulative revision risks with much longer follow-up post-surgery; our findings for up to 5 years are consistent with those reported by other national joint replacement registries.[11–13]
- Regular reporting by Canadian and other international arthroplasty registries influences and shapes best clinical practices for joint replacement patients for this defined population. Analyzing revision risk can help identify implant, surgical and patient characteristics associated with earlier revision, which can lead to more informed decisions for patient care.

We will continue to work with jurisdictions to increase coverage of CJRR to 90% across Canada.

- While CIHI captures data on all hip and knee replacements performed in acute and day surgery settings through the DAD, HMDB and NACRS, our hip and knee replacement implant data is currently at 71% (an increase from 42% in 2011–2012). Increased coverage would enable more data for comparative reporting within Canada and with other countries.
- As of 2018–2019, submission of CJRR data will be integrated into the DAD, thereby leveraging an existing pan-Canadian database to collect medical device prosthesis information. This will enable hip and knee prosthesis information to be associated with the hospitalization record at a national level.

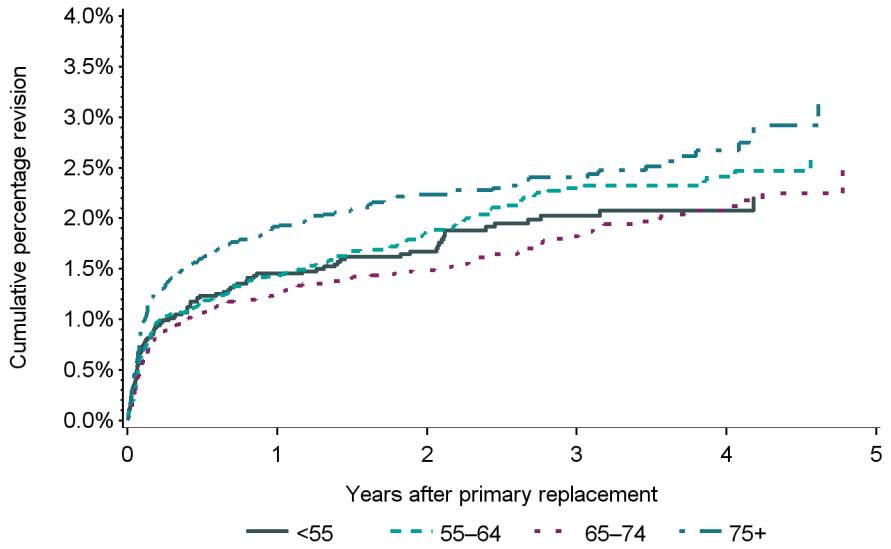
In the near future, CIHI will expand outcome measure reporting to include the patient's perspective, including PREMs and PROMs.

- CIHI's new CPERS collects standardized patient experiences survey data on inpatient care. Depending on data availability, future reports may include information from the perspective of hip and knee replacement patients in terms of their experience while in the hospital.
- CIHI has also launched a national PROMs program, with hip and knee replacements being areas of focus. A hip and knee PROMs working group has been established and national data collection standards were finalized in November 2017, including collection time points, instruments (EQ-5D-5L and Oxford Hip/Knee Score) and a minimum data set.
- CIHI has secured national licences for the Oxford Hip/Knee Score and EQ-5D for collection in routine care, and has also developed validated Canadian versions for the Oxford Hip/Knee Score in English and French.
- CIHI is working with jurisdictions to facilitate the adoption of the national PROMs standards for hip and knee replacements for routine care. CIHI is supporting Ontario as the first province to implement the national hip and knee PROMs standards, with pilot data collection starting in spring 2018.
- At the international level, there is interest in standardizing PROMs collection and reporting for hip and knee replacements. CIHI, on behalf of Canada, is partnering with the OECD to lead a pilot project to report internationally comparable PROMs indicators, with the goal of providing comparable reporting across a subset of member countries in the OECD's *Health at a Glance 2019 report*.

Figures and tables

Hip replacements

Figure 1a, men Cumulative percentage revision for primary total hip replacement for men by age (primary diagnosis of degenerative arthritis), 2012–2013 to 2016–2017



Age	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
<55	1	1.45	1.14–1.76	4,623
	2	1.67	1.33–2.02	3,412
	3	2.03	1.63–2.43	2,191
	4	n/r	n/r	n/r
55–64	1	1.42	1.20–1.64	8,908
	2	1.88	1.62–2.15	6,390
	3	2.30	1.98–2.62	3,945
	4	n/r	n/r	n/r
65–74	1	1.25	1.05–1.45	9,833
	2	1.49	1.27–1.71	6,957
	3	1.82	1.55–2.09	4,351
	4	2.12	1.79–2.45	1,972
75+	1	1.92	1.63–2.21	6,842
	2	2.23	1.91–2.55	4,821
	3	2.41	2.06–2.75	3,049
	4	2.67	2.26–3.08	1,385

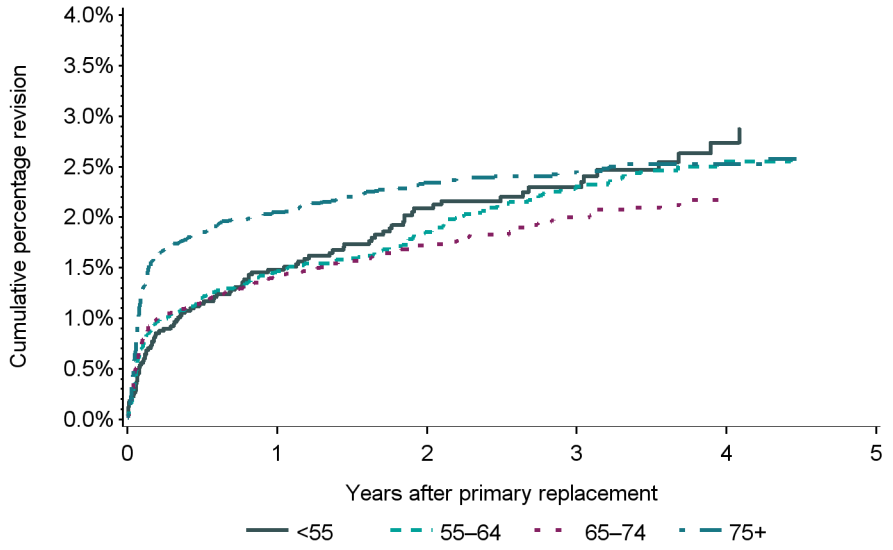
Note

n/r: Not reportable. Data has been suppressed due to small numbers.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 1b, women Cumulative percentage revision for primary total hip replacement for women by age (primary diagnosis of degenerative arthritis), 2012–2013 to 2016–2017



Age	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
<55	1	1.48	1.13–1.83	3,771
	2	2.09	1.65–2.53	2,792
	3	2.30	1.82–2.77	1,775
	4	2.74	2.14–3.33	803
55–64	1	1.47	1.25–1.69	9,150
	2	1.86	1.60–2.12	6,603
	3	2.30	1.99–2.61	4,147
	4	2.55	2.19–2.91	1,911
65–74	1	1.41	1.23–1.59	13,003
	2	1.72	1.51–1.93	9,159
	3	2.00	1.76–2.24	5,746
	4	2.17	1.91–2.44	2,640
75+	1	2.05	1.82–2.28	11,531
	2	2.34	2.09–2.59	8,230
	3	2.46	2.19–2.73	5,215
	4	n/r	n/r	n/r

Note

n/r: Not reportable. Data has been suppressed due to small numbers.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Table 1 Reasons for revision of total hip replacement for degenerative arthritis by age and sex, 2012–2013 to 2016–2017

Sex	Age	Aseptic loosening	Infection	Instability	Periprosthetic fracture	Remaining reasons
Women	<55	9 (15.5%)	11 (19.0%)	15 (25.9%)	8 (13.8%)	15 (25.9%)
	55–64	32 (20.6%)	40 (25.8%)	31 (20.0%)	28 (18.1%)	24 (15.5%)
	65–74	30 (16.5%)	41 (22.5%)	34 (18.7%)	56 (30.8%)	21 (11.5%)
	75+	28 (14.6%)	45 (22.4%)	34 (17.7%)	66 (34.4%)	19 (9.9%)
Men	<55	11 (18.6%)	17 (28.8%)	13 (22.0%)	5 (8.5%)	13 (22.0%)
	55–64	32 (23.2%)	51 (37.0%)	22 (15.9%)	15 (10.9%)	18 (13.0%)
	65–74	33 (24.8%)	54 (40.6%)	18 (13.5%)	20 (15.0%)	8 (6.0%)
	75+	19 (17.3%)	35 (31.8%)	16 (14.5%)	25 (22.7%)	15 (13.6%)

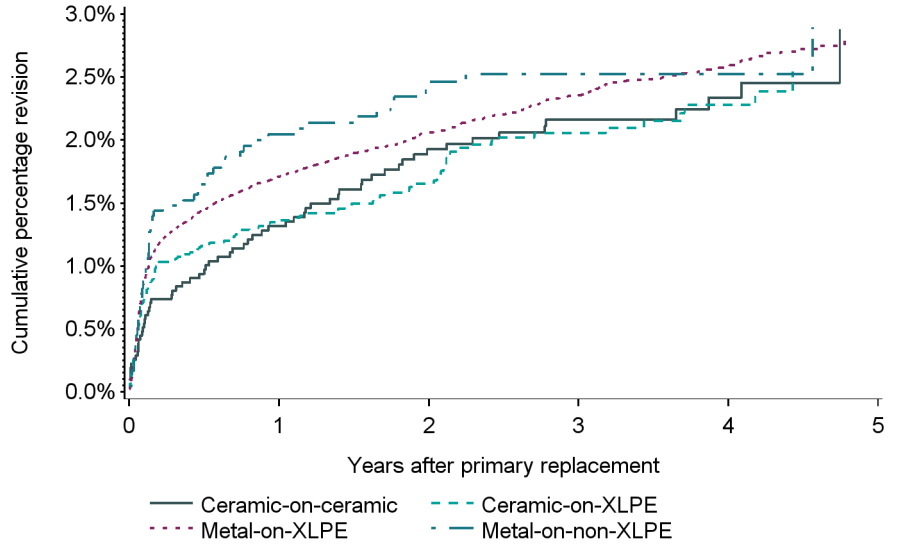
Note

Only procedures with a specific diagnosis were included. Records with reason for revision listed as “other” (n = 260) were excluded, as were those where the revision record in the DAD could not be linked to a reason for revision in CJRR (n = 420). Remaining reasons for revision included bearing wear, osteolysis, pain of unknown origin, implant fracture, implant dissociation, acetabular erosion, leg length discrepancy and stiffness.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 2 Cumulative percentage revision for primary total hip replacement by bearing surface, 2012–2013 to 2016–2017



Bearing surface of primary replacement	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
Ceramic-on-XLPE	1	1.36	1.12–1.61	6,018
	2	1.65	1.37–1.94	3,989
	3	2.06	1.70–2.41	2,490
	4	n/r	n/r	n/r
Ceramic-on-ceramic	1	1.31	0.91–1.72	2,772
	2	1.93	1.43–2.43	2,357
	3	2.16	1.62–2.70	1,784
	4	n/r	n/r	n/r
Metal-on-XLPE	1	1.71	1.61–1.81	53,919
	2	2.06	1.95–2.17	38,605
	3	2.36	2.23–2.48	24,009
	4	2.59	2.44–2.73	10,832
Metal-on-non-XLPE	1	2.04	1.48–2.61	2,154
	2	2.46	1.83–3.10	1,673
	3	n/r	n/r	n/r
	4	n/r	n/r	n/r

Notes

XLPE: Cross-linked polyethylene.

n/r: Not reportable. Data has been suppressed due to small numbers.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information. International Consortium of Orthopaedic Registries–International Society of Arthroplasty Registries (ICOR-ISAR). Global Arthroplasty Product Library. November 9, 2017, version.

Table 2 Reasons for revision of total hip replacement by bearing surface, 2012–2013 to 2016–2017

Bearing surface	Aseptic loosening	Infection	Instability	Periprosthetic fracture	Acetabular erosion
Ceramic-on-XLPE	16 (20.5%)	17 (21.8%)	29 (37.2%)	16 (20.5%)	0
Ceramic-on-ceramic	9 (26.5%)	12 (35.3%)	8 (23.5%)	5 (14.7%)	0
Metal-on-XLPE	168 (22.7%)	233 (31.5%)	144 (19.5%)	187 (25.3%)	7 (1.0%)
Metal-on-non-XLPE	5 (10.4%)	21 (43.8%)	13 (27.1%)	9 (18.8%)	0

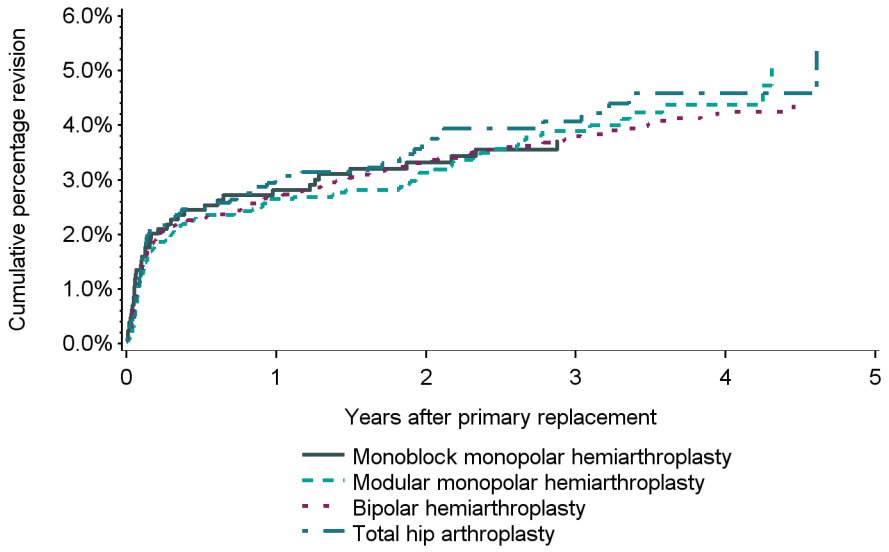
Note

Only procedures with a specific diagnosis were included. Records with reason for revision listed as “other” (n = 282) were excluded, as were those where the revision record in the DAD could not be linked to a reason for revision in CJRR (n = 432). Due to low cell counts, reasons such as bearing wear, osteolysis, pain of unknown origin, implant fracture, implant dissociation, leg length discrepancy and stiffness were not included (n = 132).

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 3 Cumulative percentage revision for primary hip replacement by type of procedure (primary diagnosis of acute hip fracture), 2012–2013 to 2016–2017



Type of hip arthroplasty	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
Monoblock monopolar hemiarthroplasty	1	2.81	1.88–3.74	1,027
	2	3.32	2.29–4.34	853
	3	n/r	n/r	n/r
	4	n/r	n/r	n/r
Modular monopolar hemiarthroplasty	1	2.64	2.10–3.18	2,529
	2	3.13	2.52–3.75	1,749
	3	3.89	3.13–4.65	987
	4	n/r	n/r	n/r
Bipolar hemiarthroplasty	1	2.69	2.37–3.01	7,415
	2	3.31	2.94–3.68	5,085
	3	3.80	3.38–4.23	3,053
	4	4.25	3.74–4.76	1,413
Total hip arthroplasty	1	3.01	2.25–3.76	1,475
	2	3.66	2.78–4.53	1,048
	3	n/r	n/r	n/r
	4	n/r	n/r	n/r

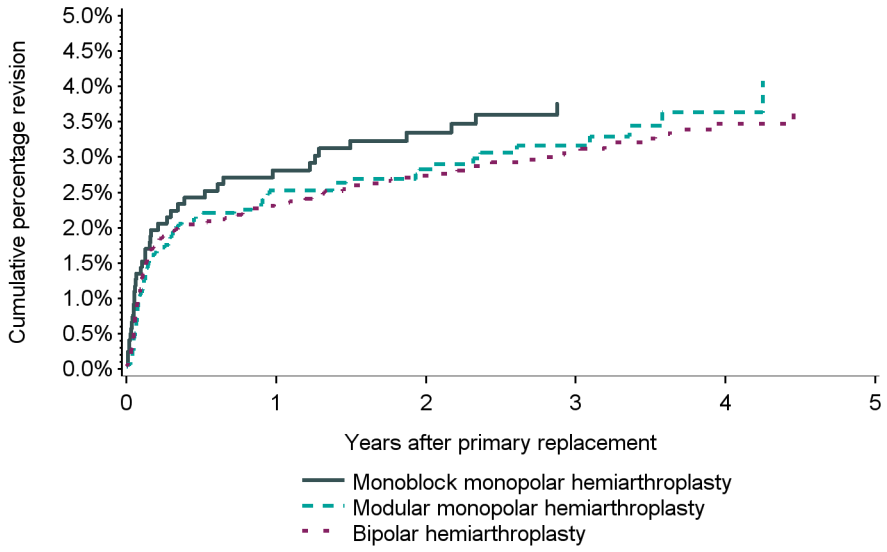
Note

n/r: Not reportable. Data has been suppressed due to small numbers.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 4, age 75+ Cumulative percentage revision for primary partial hip replacement by type of procedure (primary diagnosis of acute hip fracture, patients age 75 and older), 2012–2013 to 2016–2017



Type of hip arthroplasty	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
Monoblock monopolar hemiarthroplasty	1	2.81	1.85–3.78	970
	2	3.35	2.28–4.41	810
	3	n/r	n/r	n/r
	4	n/r	n/r	n/r
Modular monopolar hemiarthroplasty	1	2.53	1.94–3.11	2,055
	2	2.83	2.18–3.47	1,400
	3	n/r	n/r	n/r
	4	n/r	n/r	n/r
Bipolar hemiarthroplasty	1	2.32	1.99–2.66	5,813
	2	2.74	2.36–3.11	3,978
	3	3.07	2.65–3.50	2,367
	4	3.47	2.95–4.00	1,061

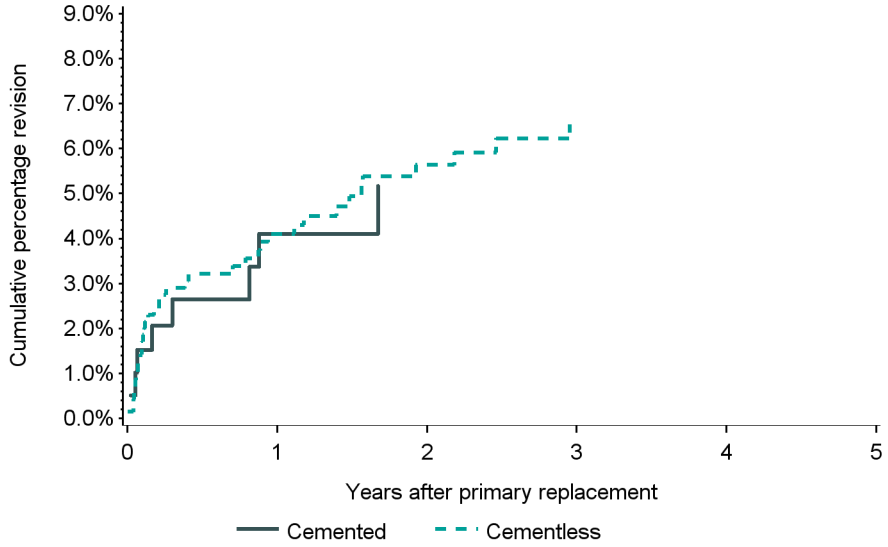
Note

n/r: Not reportable. Data has been suppressed due to small numbers.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 5a, age <65 Cumulative percentage revision for primary partial hip replacement by femoral fixation and age (primary diagnosis of acute hip fracture, patients younger than 65), 2012–2013 to 2016–2017



Femoral fixation	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
Cemented	1	4.10	1.08–7.12	124
	2	n/r	n/r	n/r
	3	n/r	n/r	n/r
	4	n/r	n/r	n/r
Cementless	1	4.11	2.58–5.63	505
	2	5.64	3.76–7.52	362
	3	n/r	n/r	n/r
	4	n/r	n/r	n/r

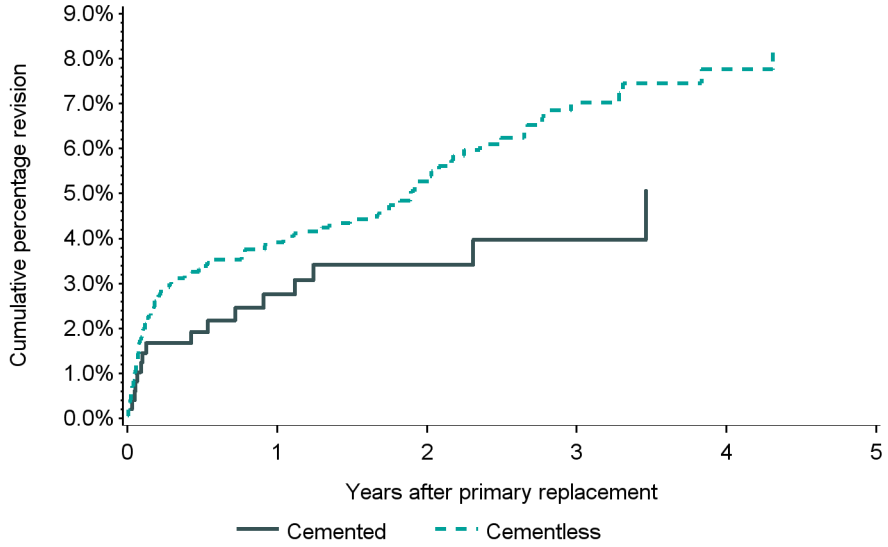
Note

n/r: Not reportable. Data has been suppressed due to small numbers.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 5b, age 65 to 74 Cumulative percentage revision for primary partial hip replacement by femoral fixation and age (primary diagnosis of acute hip fracture, patients age 65 to 74), 2012–2013 to 2016–2017



Femoral fixation	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
Cemented	1	2.75	1.20–4.30	320
	2	n/r	n/r	n/r
	3	n/r	n/r	n/r
	4	n/r	n/r	n/r
Cementless	1	3.91	2.95–4.87	1,184
	2	5.27	4.09–6.46	849
	3	7.03	5.52–8.53	518
	4	n/r	n/r	n/r

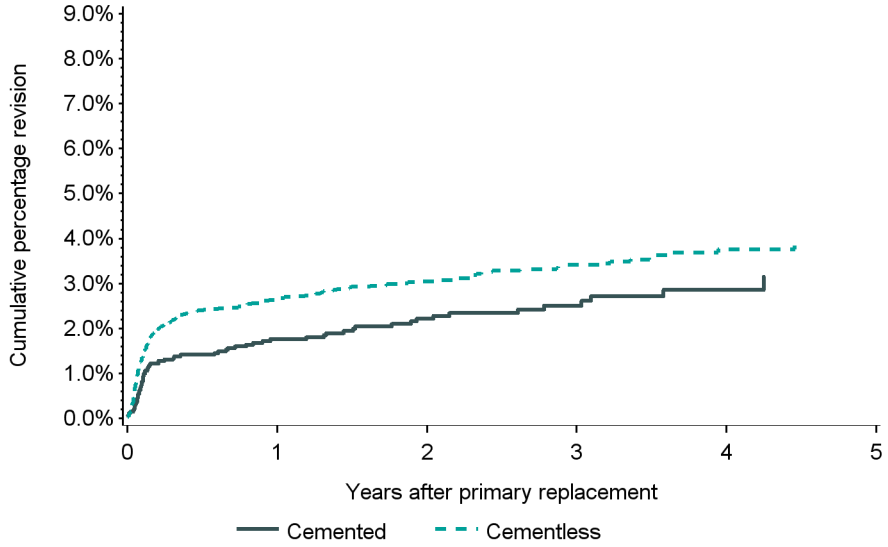
Note

n/r: Not reportable. Data has been suppressed due to small numbers.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 5c, age 75+ Cumulative percentage revision for primary partial hip replacement by femoral fixation and age (primary diagnosis of acute hip fracture, patients age 75 and older), 2012–2013 to 2016–2017



Femoral fixation	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
Cemented	1	1.76	1.29–2.22	2,367
	2	2.21	1.66–2.76	1,618
	3	n/r	n/r	n/r
	4	n/r	n/r	n/r
Cementless	1	2.66	2.32–3.00	6,471
	2	3.04	2.67–3.42	4,570
	3	3.41	2.99–3.83	2,773
	4	3.76	3.27–4.26	1,206

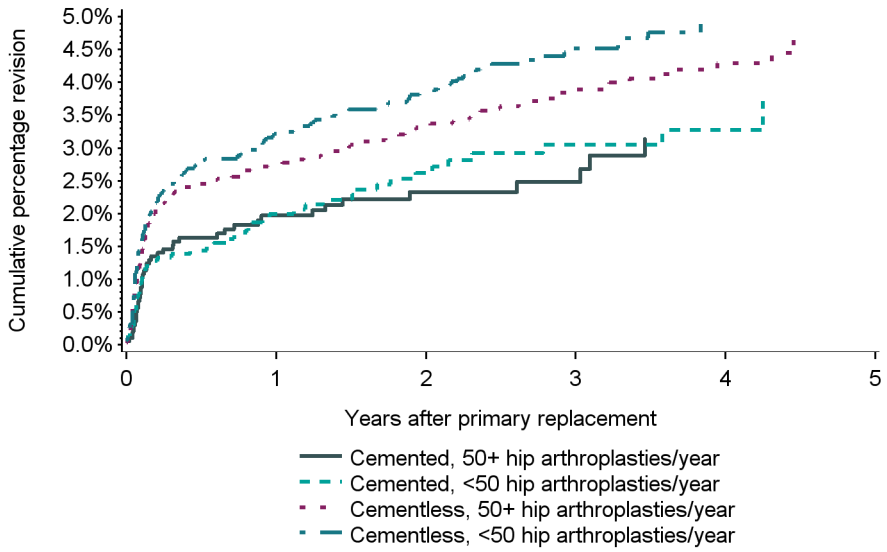
Note

n/r: Not reportable. Data has been suppressed due to small numbers.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 6 Cumulative percentage revision for primary partial hip replacement by femoral fixation and surgeon volume (primary diagnosis of acute hip fracture), 2012–2013 to 2016–2017



Femoral fixation	Surgeon volume	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
Cemented	50 or more procedures a year	1	1.97	1.33–2.61	1,337
		2	n/r	n/r	n/r
		3	n/r	n/r	n/r
		4	n/r	n/r	n/r
	Fewer than 50 procedures a year	1	1.99	1.36–2.63	1,474
		2	2.62	1.86–3.39	1,049
		3	n/r	n/r	n/r
		4	n/r	n/r	n/r
Cementless	50 or more procedures a year	1	2.74	2.33–3.14	4,776
		2	3.31	2.85–3.77	3,357
		3	3.89	3.35–4.43	2,035
		4	4.29	3.66–4.92	918
	Fewer than 50 procedures a year	1	3.22	2.70–3.73	3,384
		2	3.85	3.26–4.44	2,424
		3	4.52	3.84–5.20	1,489
		4	n/r	n/r	n/r

Notes

n/r: Not reportable. Data has been suppressed due to small numbers.

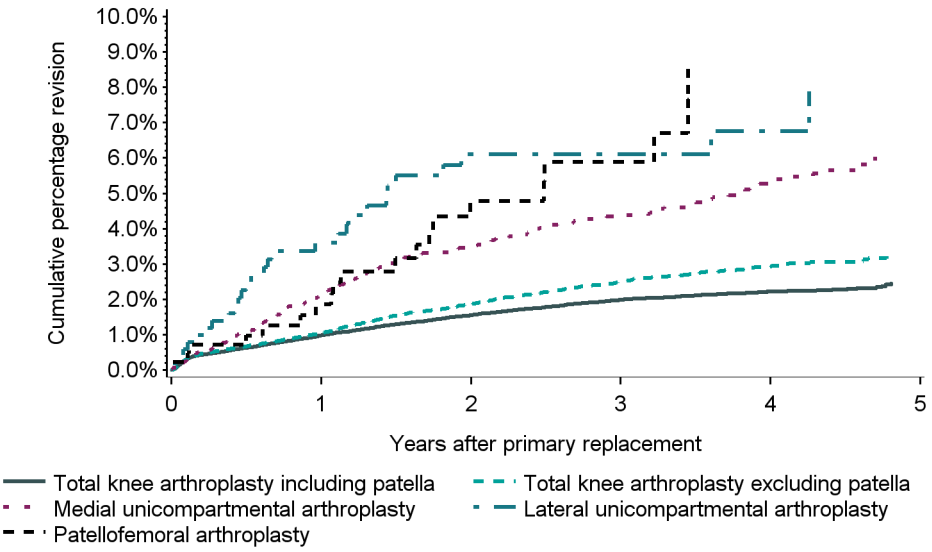
Surgeon volume refers to the number of arthroplasties performed by the surgeon in a fiscal year.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Knee replacements

Figure 7 Cumulative percentage revision for primary total and partial knee replacement by type of procedure (all diagnoses), 2012–2013 to 2016–2017



Type of knee arthroplasty	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
Total knee arthroplasty including patella	1	0.98	0.92–1.04	84,770
	2	1.55	1.47–1.63	61,883
	3	1.98	1.88–2.08	39,982
	4	2.22	2.11–2.34	19,146
Total knee arthroplasty excluding patella	1	1.05	0.95–1.14	35,945
	2	1.86	1.73–2.00	25,452
	3	2.48	2.31–2.66	15,925
	4	2.93	2.72–3.14	7,257
Medial unicompartmental arthroplasty	1	2.12	1.77–2.46	5,782
	2	3.50	3.04–3.97	4,252
	3	4.34	3.80–4.89	2,794
	4	5.40	4.70–6.10	1,476
Lateral unicompartmental arthroplasty	1	3.60	1.92–5.29	386
	2	6.12	3.81–8.43	295
	3	n/r	n/r	n/r
	4	n/r	n/r	n/r
Patellofemoral arthroplasty	1	1.85	0.48–3.22	318
	2	4.78	2.37–7.20	217
	3	n/r	n/r	n/r
	4	n/r	n/r	n/r

Note

n/r: Not reportable. Data has been suppressed due to small numbers.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Table 3 Reasons for revision of total knee replacement, 2012–2013 to 2016–2017

Primary procedure type	Infection	Instability	Aseptic loosening	Arthritis in previously unresurfaced compartment	Remaining reasons
Total knee arthroplasty including patella	378 (38.4%)	224 (22.7%)	162 (16.5%)	6 (0.6%)	215 (21.8%)
Total knee arthroplasty excluding patella	152 (31.0%)	95 (19.4%)	84 (17.1%)	22 (4.5%)	138 (28.0)

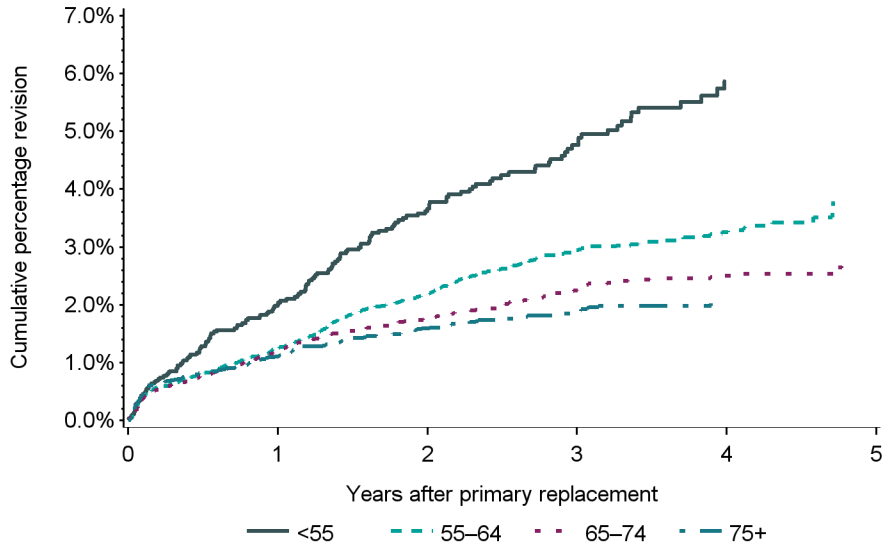
Note

Only procedures with a specific diagnosis were included. Records with reason for revision listed as "other" (n = 455) were excluded, as were those where the revision record in the DAD could not be linked to a reason for revision in CJRR (n = 801). Remaining reasons included pain of unknown origin, patella maltracking or instability, periprosthetic fracture (femur or tibia), bearing wear, implant dissociation, implant fracture, osteolysis and stiffness.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 8a, men Cumulative percentage revision for primary total knee replacement for men by age (primary diagnosis of degenerative arthritis), 2012–2013 to 2016–2017

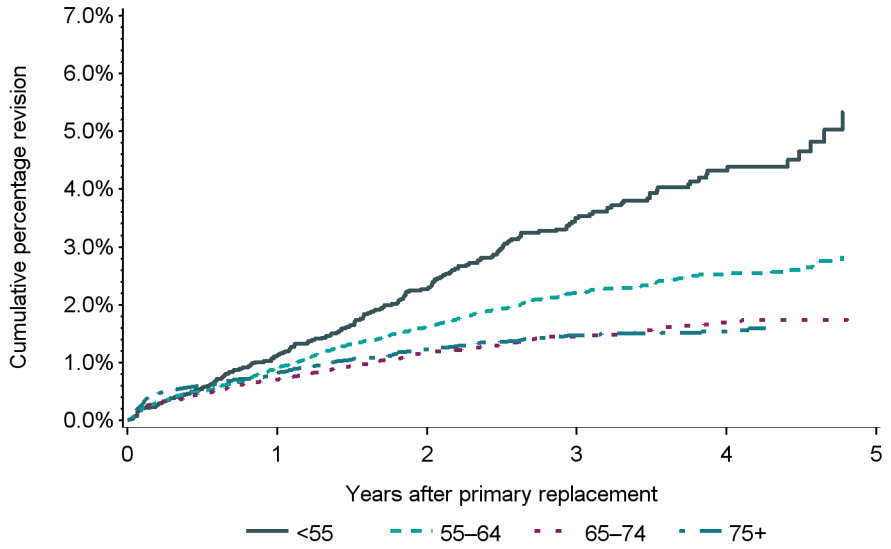


Age	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
<55	1	2.01	1.55–2.46	3,178
	2	3.66	3.02–4.31	2,387
	3	4.76	3.98–5.55	1,512
	4	5.87	4.88–6.86	716
55–64	1	1.25	1.08–1.42	13,508
	2	2.19	1.95–2.43	9,721
	3	2.94	2.64–3.25	6,104
	4	3.26	2.91–3.61	2,898
65–74	1	1.21	1.06–1.36	17,529
	2	1.76	1.57–1.95	12,417
	3	2.25	2.02–2.48	7,921
	4	2.50	2.24–2.76	3,659
75+	1	1.10	0.93–1.28	11,316
	2	1.59	1.37–1.81	8,111
	3	1.86	1.61–2.12	5,175
	4	2.02	1.74–2.29	2,441

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 8b, women Cumulative percentage revision for primary total knee replacement for women by age (primary diagnosis of degenerative arthritis), 2012–2013 to 2016–2017



Age	Years after primary replacement	Cumulative percentage revision (%)	95% confidence interval	Number at risk
<55	1	1.12	0.87–1.37	6,003
	2	2.26	1.88–2.64	4,483
	3	3.50	2.99–4.01	2,876
	4	4.32	3.68–4.95	1,356
55–64	1	0.91	0.79–1.03	21,551
	2	1.61	1.44–1.78	15,724
	3	2.20	1.99–2.41	10,109
	4	2.54	2.29–2.79	4,810
65–74	1	0.70	0.61–0.79	27,683
	2	1.17	1.04–1.29	19,719
	3	1.46	1.31–1.61	12,561
	4	1.69	1.51–1.87	5,743
75+	1	0.83	0.71–0.95	17,636
	2	1.23	1.07–1.38	12,961
	3	1.46	1.28–1.64	8,470
	4	1.54	1.34–1.73	4,149

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Table 4 Reasons for revision of total knee replacement for degenerative arthritis by age and sex, 2012–2013 to 2016–2017

Sex	Age	Aseptic loosening	Infection	Instability	Remaining reasons
Women	<55	26 (20.3%)	28 (21.9%)	39 (30.5%)	35 (27.3%)
	55–64	61 (21.9%)	73 (26.3%)	71 (25.5%)	73 (26.3%)
	65–74	33 (13.6%)	80 (33.1%)	47 (19.4%)	82 (33.9%)
	75+	20 (13.4%)	61 (40.9%)	28 (18.8%)	40 (26.9%)
Men	<55	13 (14.6%)	25 (28.1%)	21 (23.6%)	30 (33.7%)
	55–64	40 (18.1%)	84 (38.0%)	50 (22.6%)	47 (21.3%)
	65–74	36 (16.6%)	100 (46.1%)	35 (16.1%)	46 (21.2%)
	75+	11 (9.8%)	67 (59.8%)	17 (15.2%)	17 (15.2%)

Note

Only procedures with a specific diagnosis were included. Records with reason for revision listed as “other” (n = 414) were excluded, as were those where the revision record in the DAD could not be linked to a reason for revision in CJRR (n = 711). Remaining reasons for revision included bearing wear, osteolysis, pain of unknown origin, patellar maltracking, periprosthetic fracture, implant fracture, implant dissociation, arthritis in previously unresurfaced compartment and stiffness.

Sources

Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Appendix 1: CJRR coverage for 2016–2017

CJRR coverage is estimated by comparing it with the total number of hip and knee replacements performed in Canada as submitted to the DAD, HMDB and NACRS.

Note that CJRR data is based on surgery date, whereas DAD, HMDB and NACRS data is based on discharge date. However, for comparative purposes, the impact is estimated to be minimal.

For more information, please see *Data Quality Documentation for Users: Canadian Joint Replacement Registry, 2016–2017 on* CJRR's metadata page.

Table A1 Hip and knee replacement coverage in CJRR, compared with DAD/HMDB and NACRS, by jurisdiction of treatment

Jurisdiction	Number of procedures submitted to CJRR in 2016–2017	Number of procedures expected in CJRR* in 2016–2017	2015–2016 coverage	2016–2017 coverage
Newfoundland and Labrador	396	2,137	18.4%	18.5%
Prince Edward Island	0	576	0.0%	0.0%
Nova Scotia	2,569	4,040	54.0%	63.6%
New Brunswick	2,971	3,556	88.4%	83.5%
Quebec	5,693	23,832	23.5%	23.9%
Ontario†	49,235	52,077	94.5%	94.5%
Manitoba†	4,235	4,363	98.6%	97.1%
Saskatchewan	3,745	4,435	86.9%	84.4%
Alberta	4,206	12,962	33.9%	32.4%
British Columbia†	15,910	16,914	96.7%	94.1%
Territories‡	0	86	0%	0%
Canada	88,960	124,978	71.3%	71.2%

Notes

* Sourced from the DAD/HMDB and NACRS, which report number of hospitalizations/discharges rather than procedures. Hospitalizations for bilateral procedures were counted as 2 separate procedures to be consistent with CJRR.

† Provinces with mandated submission to CJRR.

‡ Territories include Yukon and the Northwest Territories.

Numbers are based on the province/territory in which the joint replacement was performed.

Sources

Canadian Joint Replacement Registry, Discharge Abstract Database, Hospital Morbidity Database and National Ambulatory Care Reporting System, 2015–2016 and 2016–2017, Canadian Institute for Health Information.

Appendix 2: Methodological notes

Revision risk curves

Study population

Primary hip and knee replacement surgeries (total or partial) performed in patients age 18 and older in provinces that have mandatory submission to CJRR (Ontario, Manitoba, British Columbia), followed up to a maximum of 5 years.

Data sources

- **Primary replacements:** Canadian Joint Replacement Registry, 2012–2013 to 2016–2017; Ontario, Manitoba and British Columbia only.
- **Revision surgeries:**[vii] Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017.
- The first occurrence of a revision surgery was identified by linkage to the primary surgery using encrypted health care number and the jurisdiction issuing the health care number, as well as a match for joint type (hip or knee) and replacement side (left or right). As such, surgeries with an invalid health care number or surgery side were excluded from the analysis.
- Note that same-day revisions were excluded from this analysis, as were primary procedures (from CJRR) for which a revision of the same side was found in the DAD at a date earlier than the primary surgery date.

Methodology

- Stratified Kaplan–Meier survival analysis.

Unit of analysis

- 1 primary hip or knee joint replacement surgery.

vii. For codes used to identify hip and knee replacement revision surgeries in the DAD and NACRS, refer to *Hip and Knee Replacements in Canada: Canadian Joint Replacement Registry 2016–2017 Quick Stats* available on CIHI's website at cihi.ca/cjrr.

Study outcome

- Time from the primary replacement to the first revision for a revised joint event. For censored surgeries, time from primary replacement to in-hospital death or the end of the study period (March 31, 2017) was used.[viii]
- Cumulative percentage revision at 1 to 4 years, presented with 95% confidence interval (95% CI) at each year.[ix] Number of cases at risk is also reported.
- Statistical significance was assessed by determining whether the 95% confidence interval for the difference between the cumulative percentage revision excludes 0 (i.e., at the 5% level).

Limitations

- The revision surgery could have been performed in any Canadian province or territory; however, each jurisdiction manages its own health care numbers, so any patient movements may result in slight under-reporting.
- Quebec does not provide CIHI with information on procedures done on individuals from out of province; thus any revision surgery done in Quebec following a primary surgery performed outside of Quebec for non-Quebec residents is not available for this analysis.
- This analysis assumes that the survivorship of a replacement on one side is independent from survivorship on the other side, even if performed on the same patient.
- Bilateral replacement patients are double-counted because different implant prostheses may be used for each side.
- Re-revisions are not included, even though patients may have more than one revision on the same side.
- Only in-hospital deaths could be identified using the data sources for this analysis, which could potentially influence the results for the oldest age group. As a result, the true probability of revision may be over-estimated.[11]
- Kaplan–Meier confidence intervals are less reliable when the numbers at risk are small; in this case, one should not rely on them for making inferences about the differences between groups.[12]

viii. In-hospital death was identified using the DAD or NACRS. Patients who died during the primary replacement surgery were excluded from analysis.

ix. The probabilistic complement of the Kaplan–Meier survivorship function at a given time point, multiplied by 100.

Definitions for derived categories

Revision procedures: Components replaced

- Component information is obtained from product information collected in CJRR.
- Hip revision procedures were grouped as follows:
  - Both femoral component and acetabular component replaced (with or without femoral head or acetabular liner)
  - Femoral head replaced (with or without acetabular liner)
  - Acetabular component replaced (with or without acetabular liner; with or without femoral head)
  - Femoral component replaced (with or without femoral head; with or without acetabular liner)
  - Other procedures, including temporary insertion of cement spacers
- Knee revision procedures were grouped as follows:
  - Both femoral component and tibial component replaced (with or without tibial insert or patellar component)
  - Tibial insert replaced (with or without patellar component)
  - Femoral component replaced (with or without tibial insert; with or without patellar component)
  - Tibial component replaced (with or without tibial insert; with or without patellar component)
  - Patellar component only
  - Other procedures, including temporary insertion of cement spacers

Bearing surface for total hip replacement

- Determined as the bearing surface of the femoral head on the bearing surface of the acetabular articulating surface (the insert if one existed; otherwise the acetabular component).
- CJRR catalogue numbers for parts involved in a total hip replacement were linked to the Global Arthroplasty Product Library,[8] which is a standardized implant library that was born out of a collaboration with more than 70 stakeholders and more than 30 international orthopedic registries for total hip and knee replacement representing 14 nations.[14]
- Bearing surfaces for parts were categorized as ceramic, metal, cross-linked polyethylene and non-cross-linked polyethylene. A joint replacement's bearing surface was considered missing (11%) if

  - Linkage to the Library had a missing bearing surface for the femoral or acetabular articulating surface; and/or
  - Linkage to the Library gave it more than one femoral or acetabular articulating surface.

Monopolar hemiarthroplasty: Monoblock versus modular

- Collected in CJRR using the data element Primary Procedure Type.
- Among procedures identified as monopolar hemiarthroplasties, the following criteria were used:
  - If it had a femoral component but no femoral head, it was considered a **monoblock** monopolar hemiarthroplasty (25%).
  - If it had a femoral component and a femoral head, it was considered a **modular** monopolar hemiarthroplasty (72%).
  - If it did not have a femoral component, the procedure type was **unknown** (3%). These were removed from the cohort for analyses examining the procedure type of partial hip replacements.

Femoral fixation for partial hip replacement: Cemented versus cementless

- Determined based on cement information reported in CJRR.
- If no femoral component was reported, the fixation method was determined to be not available (1%); these were excluded from the cohort for analyses examining the effect of femoral fixation of partial hip replacements.

Surgeon arthroplasty volume

- Determined as the number of hip replacements a surgeon performed in a fiscal year. It was dichotomized as low volume (fewer than 50 hip replacements a year) and high volume (50 or more hip replacements a year) based on the univariate distribution of the variable.

Cost estimates

Cost estimates provided by CIHI's Patient Cost Estimator (PCE)[1] represent the estimated average hospital cost of services provided to the average typical patient. Hospital-related expenditures do not include other expenditures such as physician payments and rehabilitation costs. Atypical cases were included in the calculation of the estimated total costs provided in this report. Volumes are from 2016–2017 DAD/HMDB data and include adult inpatients only; estimated average costs are from 2014–2015 PCE data.

Appendix 3: Glossary

acetabulum

The acetabulum is the cup-shaped socket of the hip joint. In Latin, the word “acetabulum” means cup, specifically a vinegar cup. The acetabulum is a feature of the pelvis. The head (upper end) of the femur (the thigh bone) fits into the acetabulum and articulates with it, forming a ball-and-socket joint.

age-standardized rate

Age standardization is a common analytical technique used to compare rates over time, since it takes into account changes in age structure across populations and time.

aseptic loosening

Aseptic loosening is the loosening of the total joint without involvement of bacteria.

bipolar hemiarthroplasty

A bipolar hemiarthroplasty is a type of partial hip replacement in which the natural femoral head is replaced with a prosthetic femoral stem and head that articulates with an additional head that matches the size of the natural femoral head.

cumulative percentage revision

Cumulative percentage revision, also known as a joint replacement failure rate, is calculated as the probabilistic complement of the Kaplan–Meier survivorship function at the given time point, multiplied by 100. This estimates the percentage of replacements revised up until that time point (e.g., 2 years), accounting for right censoring due to death and to the end of the most recent fiscal data year.

degenerative arthritis

Degenerative arthritis refers to deterioration of the articular cartilage that lines a joint, which results in narrowing of the joint space and pain; it is also referred to as osteoarthritis.

fixation method

As hip and knee joint prostheses are inserted, they are fixed securely into position in the joint. The 3 major categories of fixation methods are *cemented*, where components involved (femoral and acetabular for hip; femoral, tibial and patellar for knee) are fixed by bone cement; *cementless*, where initial fixation is achieved through a press-fit, followed by bone ingrowth for long-term stability; and *hybrid*, where a mixture of cemented and cementless fixation is used.

hemiarthroplasty

See *partial hip replacement*

hip bearing surface

The acetabular cup and the femoral head of a hip prosthesis unite to form an articulation. The site at which the movable parts unite is the bearing surface. This is the part of the implant that is subjected to the most wear and tear. Bearing surface options include combinations such as metal-on-polyethylene, metal-on-ceramic, ceramic-on-ceramic, etc.

hip replacement

This surgery is performed to replace all or part of the hip joint with an artificial implant. The hip is essentially a ball-and-socket joint, linking the ball at the head of the thigh bone (femur) with the cup-shaped socket in the pelvic bone. A hip prosthesis is surgically implanted to replace the damaged bone within the hip joint.

knee replacement

Knee joint replacement is surgery to replace a painful damaged or diseased knee joint with an artificial joint. The orthopedic surgeon makes a cut over the affected knee. The patella (kneecap) is moved out of the way, and the ends of the femur (thigh bone) and tibia (shin bone) are cut to fit the prosthesis. Similarly, the under-surface of the patella cap is often cut to allow for placement of an artificial component.

median

The median is a measure of central tendency — the middle of a distribution. The median is less sensitive to extreme scores than the mean, which makes it a better measure for highly skewed distributions.

monopolar modular hemiarthroplasty

A monopolar modular hemiarthroplasty is a partial hip replacement that replaces the natural femoral head with a femoral stem prosthesis and an exchangeable head.

monopolar monoblock hemiarthroplasty

A monopolar monoblock hemiarthroplasty is a partial hip replacement that replaces the natural femoral head with a femoral stem prosthesis with a fixed head.

partial hip replacement (also known as hemiarthroplasty)

This surgical procedure replaces half of the hip joint with an artificial surface and leaves the other part in its natural (pre-operative) state. This usually refers to replacing the femoral head.

primary replacement

A primary replacement is the first replacement procedure, where the natural bone is replaced with an artificial joint prosthesis.

revision

Revisions are modifications to or replacements of an existing artificial hip or knee joint prosthesis/component. A revision procedure may be necessary when an existing old or worn-out hip or knee component needs to be removed and replaced with a new or improved prosthesis. This may include removing one or more hip or knee components as necessary.

survival curve (or revision risk curve)

A plot of the proportion of subjects who have not yet experienced a defined event such as death or revision of prosthesis, versus time. It is also known as the cumulative percentage revision. The Kaplan–Meier estimator is the most commonly used method to calculate the survival curve. The curve takes account of subjects whose ultimate survival time is not known, a phenomenon called “censoring.”

Appendix 4: Text alternative for figures

Figure 1a, men: Cumulative percentage revision for primary total hip replacement for men by age (primary diagnosis of degenerative arthritis), 2012–2013 to 2016–2017

The cumulative percentage revision for each age group is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 4.0%. The 4 curves have a similar shape: a steep increase, to around 1%, quite close to the baseline (year 0). After that, the increase is quite flat. The curve for age 75 and older is higher than the curves for the other 3 age groups, with a more profound steep increase, to about 1.5% close to year 0. None of the curves reach the 5-year mark. The table below the figure includes the related statistics.

Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 1b, women: Cumulative percentage revision for primary total hip replacement for women by age (primary diagnosis of degenerative arthritis), 2012–2013 to 2016–2017

The cumulative percentage revision for each age group is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 4.0%. 3 out of the 4 curves (age groups younger than 55, 55 to 64 and 65 to 74) have a very similar shape with a steep increase, to about 1%, quite close to the baseline (year 0). The curve for age 75 and older is considerably higher than those for the other 3, with a more profound steep increase, to about 2%. After that, the increase is quite flat for all 4 curves. Just after the 2-year mark, the 75 and older curve becomes closer to the others, and it overlaps with the first 2 younger groups after the 3-year mark, while the 65 to 74 curve starts to separate, becoming considerably lower. None of the curves reach the 5-year mark. The table below the figure includes the related statistics.

Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 2: Cumulative percentage revision for primary total hip replacement by bearing surface, 2012–2013 to 2016–2017

The cumulative percentage revision for each bearing surface (ceramic-on-XLPE, ceramic-on-ceramic, metal-on-XLPE and metal-on-non-XLPE) is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 3.0%. The 4 curves have a similar shape: a steep increase, to around 1%, quite close to the baseline (year 0). After that, the increase is quite flat. The curve for metal-on-non-XLPE is higher than the curves for the other 3, with a more profound steep increase, to about 1.5% close to year 0. Ceramic-on-ceramic and ceramic-on-XLPE curves are lower than the metal ones; however, close to the 5-year mark they all seem to overlap. The table below the figure includes the related statistics.

Note
XLPE: Cross-linked polyethylene.
Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.
International Consortium of Orthopaedic Registries–International Society of Arthroplasty Registries (ICOR-ISAR). Global Arthroplasty Product Library. November 9, 2017, version.

Figure 3: Cumulative percentage revision for primary hip replacement by type of procedure (primary diagnosis of acute hip fracture), 2012–2013 to 2016–2017

The cumulative percentage revision for each replacement type (total, and monopolar monoblock, monopolar modular and bipolar hemiarthroplasty) is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 6.0%. All 3 partial curves, up to about 2 years, look very similar with a steep increase, to about 2%, quite close to the baseline (year 0). Around the 2-year mark, the total hip replacement curve separates slightly from the other curves. The curve representing monoblock monopolar hemiarthroplasties does not reach much further than the 3-year mark. None of the curves reach the 5-year mark. The table below the figure includes the related statistics.

Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 4, age 75+: Cumulative percentage revision for primary partial hip replacement by type of procedure (primary diagnosis of acute hip fracture, patients age 75 and older), 2012–2013 to 2016–2017

The cumulative percentage revision for each hemiarthroplasty type (modular monopolar, monoblock monopolar and bipolar) is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 5.0%. The bipolar and modular monopolar curves look very similar with a steep increase, to just under 2%, quite close to the baseline (year 0); after that, the increase is quite flat. The curve representing the monoblock monopolar hemiarthroplasties does not reach the 3-year mark and is higher than the other 2 curves. None of the curves reach the 5-year mark. The table below the figure includes the related statistics.

Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 5a, age <65: Cumulative percentage revision for primary partial hip replacement by femoral fixation and age (primary diagnosis of acute hip fracture, patients younger than 65), 2012–2013 to 2016–2017

The cumulative percentage revision for each of the 2 femoral fixation approaches, cemented and cementless, is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 9.0%. The 2 curves have a similar shape with a steep increase to around the 2-year mark for cemented and the 3-year mark for cementless. None of the curves reach much further than the 2- and 3-year marks, respectively. The table below the figure includes the related statistics.

Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 5b, age 65 to 74: Cumulative percentage revision for primary partial hip replacement by femoral fixation and age (primary diagnosis of acute hip fracture, patients age 65 to 74), 2012–2013 to 2016–2017

The cumulative percentage revision for each of the 2 femoral fixation approaches, cemented and cementless, is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 9.0%. The curve for the cementless femoral fixation is much higher and increases in a steeper manner shortly after the baseline (year 0).

The curve for cemented femoral fixation is lower, and although it shows a sharp increase at the beginning, it stays below the other curve, diverging slightly from it over time. None of the curves reach the 5-year mark. The table below the figure includes the related statistics.

Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 5c, age 75+: Cumulative percentage revision for primary partial hip replacement by femoral fixation and age (primary diagnosis of acute hip fracture, patients age 75 and older), 2012–2013 to 2016–2017

The cumulative percentage revision for each of the 2 femoral fixation approaches, cemented and cementless, is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 9.0%. The curve for the cementless femoral fixation is slightly higher and increases in a steeper manner shortly after the baseline (year 0). After that, the increase is quite flat for both curves. None of the curves reach the 5-year mark. The table below the figure includes the related statistics.

Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 6: Cumulative percentage revision for primary partial hip replacement by femoral fixation and surgeon volume (primary diagnosis of acute hip fracture), 2012–2013 to 2016–2017

The cumulative percentage revision for each of the 4 groups studied (cemented and high volume, cemented and low volume, cementless and high volume, cementless and low volume) is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 5.0%. The cemented curves (both low volume and high volume) have a similar shape. They are both considerably lower than the cementless curves. All 4 curves have a steep increase shortly after the baseline (year 0); cemented curves reach just higher than 1% while cementless ones are close to 2.5%. When comparing the cementless curves, the low-volume one is considerably higher than the high-volume ones. None of the curves reach the 5-year mark. The table below the figure includes the related statistics.

Note
Surgeon volume refers to the number of arthroplasties performed by the surgeon in the year of primary procedure.
Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 7: Cumulative percentage revision for primary total and partial knee replacement by type of procedure (all diagnoses), 2012–2013 to 2016–2017

The cumulative percentage revision for each knee replacement type (medial, lateral and patellofemoral partials and total knee arthroplasties including and excluding patella) is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 10.0%. The total knee replacement curves are lower than the partial ones, with the total knee replacement including patella being the lowest. Up until the 3-year mark the lateral unicompartmental curve is the highest. The patellofemoral curve has the steepest increase and after the 3-year mark becomes the highest after overlapping the lateral curve. The table below the figure includes the related statistics.

Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 8a, men: Cumulative percentage revision for primary total knee replacement for men by age (primary diagnosis of degenerative arthritis), 2012–2013 to 2016–2017

The cumulative percentage revision for each age group is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 7.0%. The highest curve and the curve with the steepest increase is for the age group younger than 55. The other 3 curves almost overlap up until the 1-year mark, after which they start diverging, with the 75+ group being the lowest, then 65 to 74, then 55 to 64. The increase is steady over time, and the gap increases among them. None of the curves reach the 5-year mark. The table below the figure includes the related statistics.

Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

Figure 8b, women: Cumulative percentage revision for primary total knee replacement for women by age (primary diagnosis of degenerative arthritis), 2012–2013 to 2016–2017

The cumulative percentage revision for each age group is plotted as a separate curve. The x-axis represents the number of years after primary replacement and ranges from 0 to 5 years. The y-axis represents the cumulative percentage revision and ranges from 0.0% to 7.0%. The 4 curves have a very similar shape, although they diverge shortly after year 1, with the exception of the age groups 65 to 74 and 75 and older, which almost overlap. The increase is steady over time, and the gap increases among the age groups younger than 55, 55 to 64 and the 2 older groups. The highest curve is for the age group younger than 55, then 55 to 64, followed by 65 to 74, then 75+. None of the curves reach the 5-year mark. The table below the figure includes the related statistics.

Sources
Canadian Joint Replacement Registry (Ontario, Manitoba and British Columbia only), Discharge Abstract Database and National Ambulatory Care Reporting System, 2012–2013 to 2016–2017, Canadian Institute for Health Information.

References

1. Canadian Institute for Health Information. Patient Cost Estimator. Accessed February 12, 2018.

2. Patil S, Garbuz DS, Greidanus NV, Masri BA, Duncan CP. Quality of life outcomes in revision vs primary total hip arthroplasty: A prospective cohort study. *The Journal of Arthroplasty. 2008.*

3. Lenguerrand E, Whitehouse MR, Wylde V, Gooberman-Hill R, Blom AW. Pain and function recovery trajectories following revision hip arthroplasty: Short-term changes and comparison with primary hip arthroplasty in the ADAPT Cohort Study. *PLOS ONE. 2016.*

4. American Academy of Orthopaedic Surgeons. Osteoarthritis of the hip: Treatment. Accessed February 12, 2018.

5. American Academy of Orthopaedic Surgeons. Hip fractures: Treatment. *Accessed February 12, 2018.*

6. Canadian Institute for Health Information. *The Effect of Bearing Surface on Early Revisions Following Total Hip Arthroplasty*. 2013.

7. Vancouver Coastal Health Research Institute Centre for Clinical Epidemiology and Evaluation. *Health Technology Assessment Report: Alternative Primary Hip Implants and Budget Impact for British Columbia*. 2016.

8. International Consortium of Orthopaedic Registries–International Society of Arthroplasty Registries (ICOR-ISAR). Global Arthroplasty Product Library. November 9, 2017, version. Accessed December 2017.

9. Ravi B, Jenkinson R, Austin PC, Croxford R, Wasserstein D, Escott B, Paterson JM, Kreder H, Hawker GA. Relation between surgeon volume and risk of complications after total hip arthroplasty: Propensity score matched cohort study. *British Medical Journal*. 2014.

10. Labek G, Thaler M, Janda W, Agreiter M, Stockl B. Revision rates after total joint replacement: Cumulative results from worldwide joint register datasets. *Journal of Bone and Joint Surgery. 2011.*

11. Australian Orthopaedic Association, National Joint Replacement Registry. *Hip and Knee Arthroplasty: Annual Report 2016. 2017.*

12. National Joint Registry for England, Wales, Northern Ireland and the Isle of Man. *14th Annual Report 2017. 2017.*

13. Swedish Knee Arthroplasty Register. *Annual Report 2017. 2017.*

14. Sedrakyan A, Paxton E, Graves S, Love R, Marinac-Dabic D. National and international postmarket research and surveillance implementation. *The Journal of Bone and Joint Surgery (American volume). 2014.*


media@cihi.ca

CIHI Ottawa
495 Richmond Road
Suite 600
Ottawa, Ont.
K2A 4H6
613-241-7860

CIHI Toronto
4110 Yonge Street
Suite 300
Toronto, Ont.
M2P 2B7
416-481-2002

CIHI Victoria
880 Douglas Street
Suite 600
Victoria, B.C.
V8W 2B7
250-220-4100

CIHI Montréal
1010 Sherbrooke Street West
Suite 602
Montréal, Que.
H3A 2R7
514-842-2226

cihi.ca

17589-0418