



Hip and Knee Replacements in Canada:  
Canadian Joint Replacement Registry  
2015 Annual Report

September 2015



## Our Vision

Better data. Better decisions.  
Healthier Canadians.

## Our Mandate

To lead the development and maintenance of comprehensive and integrated health information that enables sound policy and effective health system management that improve health and health care.

## Our Values

Respect, Integrity, Collaboration,  
Excellence, Innovation

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## Key findings

Hip and knee joint replacements are one of the most effective ways to reduce joint pain and improve functioning for patients with advanced hip and knee problems, most commonly resulting from osteoarthritis. In Canada, as in many other countries, a high volume of these procedures are performed annually, resulting in significant health care costs and, for some patients, longer-than-desired wait times for their surgeries. Analysis shows that the **volume of these procedures has grown steadily over several years** (49,503 hip replacements in 2013–2014, a 19.1% increase since 2009–2010; and 60,136 knee replacements in 2013–2014, a 22.9% increase since 2009–2010). The volume of hip and knee surgeries increased most rapidly in Saskatchewan (31.5% and 36.1% increase, respectively). The rise in procedures is in part due to population aging and growth; however, age-adjusted rates per 100,000 persons still showed increases of 6.9% and 9.4% for hip and knee replacements, respectively.

Reducing acute care length of stay (LOS) can potentially decrease costs within the health system and allow patients to return home to their families more quickly. In 2013–2014, **length of hospital stays decreased**: the median LOS for knee replacement decreased from 4 to 3 days over the previous year, and the median LOS for hip replacement decreased from 5 to 4 days over the previous 3 years.

Reducing revisions can drive down costs significantly and save patients from having to repeat a difficult surgery and recovery. In Canada, in 2013–2014 alone, 8.9% of hip and 6.7% of knee replacements performed were revision procedures, which represents a **small decrease in revisions over the last 5 years** for hip replacements (from 10.8%). Knee replacement revisions have been stable.

As part of efforts at the Canadian Institute for Health Information (CIHI) to maximize the comprehensiveness, timeliness, quality and use of hip and knee replacement data, we have **successfully achieved mandatory submission** to the Canadian Joint Replacement Registry (CJRR) in 3 provinces: Ontario, Manitoba and British Columbia. CJRR coverage has significantly increased, from 42% (2011–2012) to 67% (2013–2014) of all hip and knee replacements completed in Canada.

## Report objectives

Hip and knee replacement volumes, costs, wait times and patient outcomes continue to be a key area of focus for provincial and territorial governments, and efforts toward improvement garner media attention year after year. CJRR exists to provide a comprehensive cross-Canada view of how hip and knee replacement procedures, patients and outcomes are changing over time and among jurisdictions.

Given the importance of hip and knee replacements in Canada, the objectives of the CJRR annual report are to

- Provide a comprehensive picture of hip and knee replacements in Canada;
- Report on outcomes important to ministries, clinicians and patients; and
- Identify trends over time at the national and provincial/territorial levels.

This report focuses on patients undergoing total hip or knee replacements in Canada in 2013–2014. The analysis was based on data in the Hospital Morbidity Database (HMDB), National Ambulatory Care Reporting System (NACRS) and CJRR.



# Chapter 1: Introduction







The purpose of this report is to characterize hip and knee replacement procedures performed in Canada according to their epidemiology (including volumes and trends over time) and by selected clinical and surgical parameters. Data for this report was obtained from 3 CIHI data sources: the Hospital Morbidity Database (HMDB), the National Ambulatory Care Reporting System (NACRS) and the Canadian Joint Replacement Registry (CJRR).

## About the Canadian Joint Replacement Registry

CJRR is a pan-Canadian source of information about hip and knee replacements. It was established to record and analyze clinical parameters and outcomes of primary and revision hip and knee replacements over time. The registry was developed through a joint effort between CIHI and orthopedic surgeons in Canada. Several key partners have contributed greatly to the successful development and implementation of CJRR, including the Canadian Orthopaedic Association, the Canadian Arthroplasty Society, orthopedic patients, the Arthritis Society of Canada and federal and provincial ministries of health. The goal of CJRR is to provide information to help improve the quality of care and clinical outcomes of joint replacement recipients. More information on CJRR can be found at [www.cihi.ca/cjrr](http://www.cihi.ca/cjrr).

HMDB and NACRS data was used to produce the hospitalization and discharge statistics, and CJRR data was used for the clinical and surgical statistics. The HMDB captures administrative information (including diagnoses and procedure codes) and demographic information on all discharges from acute care facilities in Canada, including all hip and knee joint replacements and revisions. NACRS captures administrative and demographic information on all hospital-based and community-based ambulatory care (day surgeries, outpatient clinics and emergency departments). CJRR was developed to provide additional patient and prosthesis information to complement what is captured in the HMDB to enable more in-depth analysis of hip and knee replacements, including revisions and other outcomes. For more information, refer to Appendix A: Methodological Notes, HMDB and NACRS, and Appendix B: Methodological Notes, CJRR.

CJRR began as a voluntary registry. As of 2012–2013, the governments of Ontario and British Columbia mandated reporting to CJRR, which contributed to an increase in CJRR's coverage from 42% (for 2011–2012) to 67% (for 2013–2014). The government of Manitoba mandated electronic province-wide submission via Manitoba Health as of 2013–2014. The mandating of submission has transformed CJRR from a completely voluntary to a primarily mandated registry. Achieving mandatory submissions from all jurisdictions is a priority for CJRR, as this is the most effective way to ensure comprehensive capture of outcome information for all hip and knee replacement patients.

Table 1 presents CJRR coverage estimates compared with the HMDB and NACRS for 2012–2013 and 2013–2014. Note the following considerations:

- CJRR data is based on date of surgery, whereas HMDB and NACRS data is based on discharge date. However, for comparative purposes, the impact is estimated to be minimal.
- CJRR accepts data from any participating facility, including ambulatory and privately funded institutions. Data from private facilities was excluded from the analysis. The HMDB reports on procedures from public acute care facilities only.

For more information, please see *Data Quality Documentation for Users: Canadian Joint Replacement Registry, 2013–2014* on CJRR’s web page, at [www.cihi.ca/cjrr](http://www.cihi.ca/cjrr).

**Table 1: Hip and knee replacement coverage in CJRR, compared with HMDB and NACRS, by jurisdiction of treatment**

Jurisdiction	Number of procedures submitted to CJRR* in 2013–2014	Number of procedures expected in CJRR† in 2013–2014	2013–2014 coverage	2012–2013 coverage
Newfoundland and Labrador	155	1,755	8.8%	44.5%
Prince Edward Island	0	621	0.0%	0.0%
Nova Scotia	2,050	3,614	56.7%	64.1%
New Brunswick	1,548	2,709	57.7%	81.9%
Quebec	5,062	21,141	23.9%	43.2%
Ontario‡	42,708	46,150	92.5%	90.2%
Manitoba‡	3,994	4,136	96.6%	85.5%
Saskatchewan	3,094	5,283	58.6%	77.6%
Alberta	2,461	11,574	21.6%	64.9%
British Columbia‡	13,168	13,593	94.9%	72.7%
Territories§	0	70	0.0%	41.7%
<b>Canada</b>	<b>74,240</b>	<b>111,006</b>	<b>66.6%</b>	<b>73.5%</b>

**Notes**

\* Excludes procedures done in private facilities.

† Sourced from the HMDB and NACRS (for knee replacements), reporting number of hospitalizations/discharges rather than procedures. Hospitalizations for bilateral procedures were counted as 2 separate procedures to be consistent with CJRR.

‡ As of 2012–2013, Ontario and B.C. mandated CJRR data submission. Manitoba mandated CJRR submission as of 2013–2014.

§ Territories include Yukon and the Northwest Territories.

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

**Sources**

Hospital Morbidity Database, National Ambulatory Care Reporting System and Canadian Joint Replacement Registry, 2012–2013 and 2013–2014, Canadian Institute for Health Information.

## Privacy and confidentiality

As the custodian of numerous registries and databases, CIHI has stringent policies for ensuring that the privacy, confidentiality and security of its data are protected. Information on CIHI’s privacy and confidentiality policies and procedures is available on CIHI’s website at [www.cihi.ca](http://www.cihi.ca).



## Chapter 2: Hip replacements





## Methodological highlights

- Analyses for this chapter are based on the HMDB and CJRR.
- Counts reported are based on the number of hip replacement hospitalizations, not the number of joints replaced, unless otherwise stated. Total and partial replacements as well as elective and urgent cases are included in the analyses.
- For age-standardized rates, the number of hospitalizations includes both total and partial replacements for patients age 20 and older.

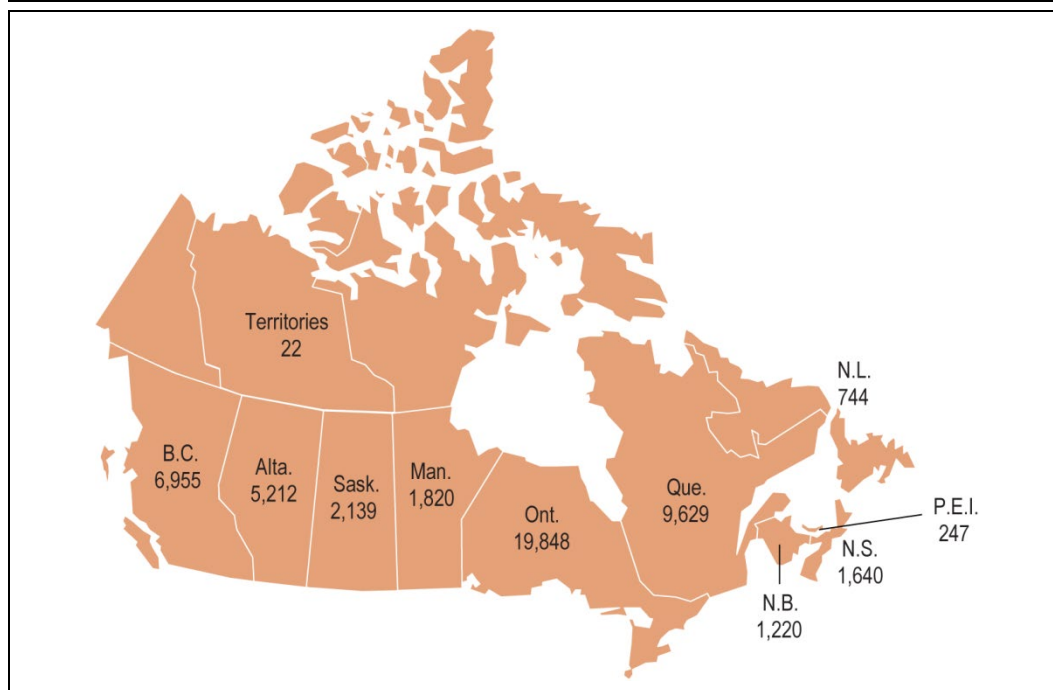
This chapter provides information on hip replacements performed in Canada in 2013–2014, as well as historical trends at the provincial/territorial and pan-Canadian levels.

## Pan-Canadian overview of hip replacements

In 2013–2014, there were 49,503 hospitalizations for hip replacements in Canada, representing a 5-year increase of 19.1% (from 41,573 in 2009–2010) and a 1-year increase of 5.0%.

Figure 1 shows the number of hospitalizations for hip replacements in Canada in 2013–2014.

**Figure 1: Number of hip replacements in Canada, by jurisdiction of treatment, 2013–2014**



### Notes

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

Jurisdictional analysis is based on the location of the facility where the procedure was performed.

### Source

Hospital Morbidity Database, 2013–2014, Canadian Institute for Health Information.

## Type of joint replacement

Of all hip replacements performed in Canada, 91.1% were primary procedures and 8.9% were revisions (data for revisions can be for first or subsequent revisions).

Primary procedures can be further divided into total hip replacements and partial hip replacements (see Appendix B, Table B-1, for detailed definitions):

- Total hip replacement: The entire hip joint (both the femoral and acetabular articulating surfaces) is replaced with artificial implants: 34,424 (76.7%).
- Partial hip replacement: Only parts of the hip joint (femoral component) are replaced with an artificial implant. Typically, this surgical intervention is performed following an acute hip fracture: 10,052 (22.4%).

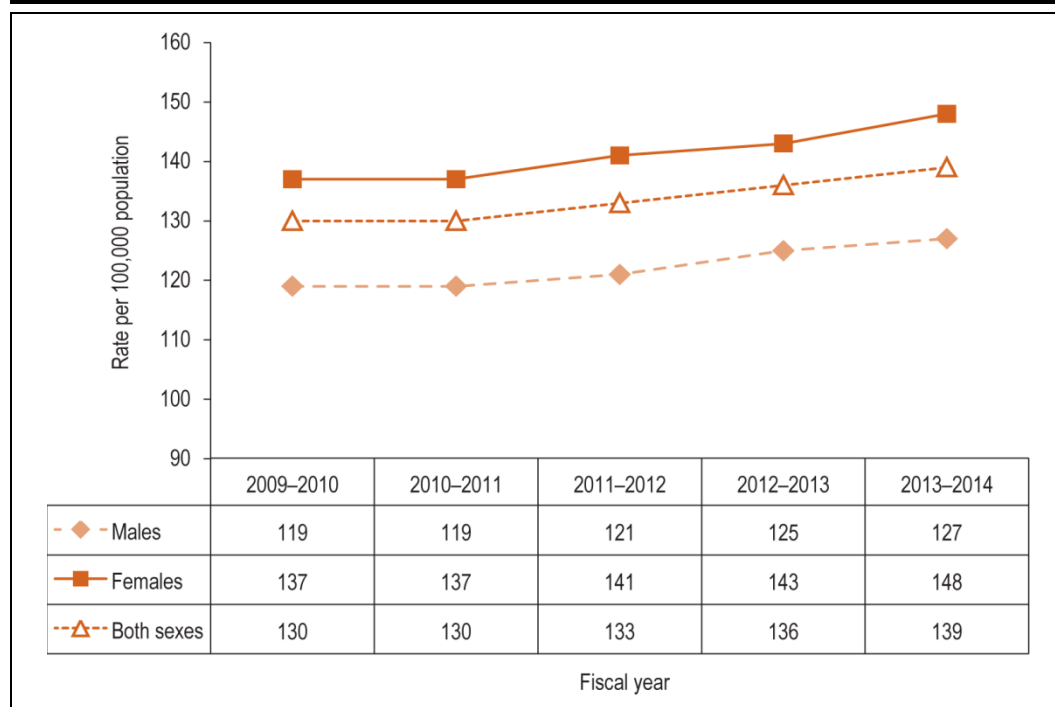
In 2013–2014, there were also 434 hip resurfacing procedures; this is a bone-conserving alternative to conventional total hip replacement. In 2009–2010, there were 383 hip resurfacing procedures; this represents a 5-year increase of 11.8%.

## Age-standardized hospitalization rates

Age standardization takes into account differences in age structures across populations and time by calculating rates against a standard population. The age-standardized rates shown throughout this report are reported per 100,000 population age 20 and older.

The pan-Canadian age-standardized hospitalization rate for all types of hip replacements for patients age 20 and older in 2013–2014 was 139 per 100,000, up 6.9% from 130 in 2009–2010 (Figure 2). The 2013–2014 age-standardized rate for males age 20 and older was 127, while the rate for females was 148, a difference of 21. The age-standardized rate for all hip replacements was consistently higher for females than for males over the entire reporting period. The rate for males had a lower 5-year increase than the rate for females did (6.7% versus 8.0%).

**Figure 2: Age-standardized hospitalization rates (per 100,000 population age 20 and older) for all hip replacements, by sex, Canada, 2009–2010 to 2013–2014**



**Note**

The 1991 Canadian population was used as the standard for rate calculation.

**Source**

Hospital Morbidity Database, 2009–2010 to 2013–2014, Canadian Institute for Health Information.

## Jurisdictional variations

Table 2 presents the number of hip replacement hospitalizations by jurisdiction of treatment for the 5 years from 2009–2010 to 2013–2014.

Of the 49,503 hip replacements done in 2013–2014, the majority (40.1%) involved patients from Ontario.

All jurisdictions had increases in hip replacement procedures over the last 5 years, except for the territories. From 2009–2010 to 2013–2014, Prince Edward Island and Saskatchewan showed the highest percentage increases in terms of volume (35.0% and 31.5%, respectively).

**Table 2: Number of hip replacements, by jurisdiction of treatment, 2009–2010 to 2013–2014**

Jurisdiction	All hip replacements					5-year percentage change
	2009–2010	2010–2011	2011–2012	2012–2013	2013–2014	
<b>Newfoundland and Labrador</b>	599	582	687	704	744	24.2%
<b>Prince Edward Island</b>	203	178	224	241	274	35.0%
<b>Nova Scotia</b>	1,386	1,429	1,415	1,520	1,640	18.3%
<b>New Brunswick</b>	1,022	1,127	1,194	1,156	1,220	19.4%
<b>Quebec</b>	7,704	7,968	8,493	8,930	9,629	25.0%
<b>Ontario</b>	16,655	17,032	17,685	18,729	19,848	19.2%
<b>Manitoba</b>	1,603	1,893	1,836	1,865	1,820	13.5%
<b>Saskatchewan</b>	1,627	1,615	1,644	1,830	2,139	31.5%
<b>Alberta</b>	4,478	4,467	4,868	5,189	5,212	16.4%
<b>British Columbia</b>	6,267	6,397	6,712	6,947	6,955	11.0%
<b>Territories*</b>	29	25	7	26	22	-24.1%
<b>Canada</b>	<b>41,573</b>	<b>42,713</b>	<b>44,765</b>	<b>47,137</b>	<b>49,503</b>	<b>19.1%</b>

**Notes**

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

Jurisdictional analysis is based on the location of the facility where the procedure was performed.

**Source**

Hospital Morbidity Database, 2009–2010 to 2013–2014, Canadian Institute for Health Information.



Table 3 shows the distribution of primary and revision hip procedures by jurisdiction of treatment. Most hospitalizations for hip replacements in Canada were for primary procedures (91.1%). Saskatchewan and P.E.I. had the highest ratio of primary to revision procedures (15:1), followed by Newfoundland and Labrador at 13:1. Nova Scotia and B.C. had the lowest ratio of primary to revision hip procedures (9:1). The ratios provide an indication of the relative volumes of primary and revision procedures. These measures can be influenced by factors such as patient demographics.

**Table 3: Number of hip replacements, by type of replacement and jurisdiction of treatment, 2013–2014**

Jurisdiction	All hip replacements		
	Primary	Revision	Ratio — primary:revision
Newfoundland and Labrador	687	54	13:1
Prince Edward Island	257	17	15:1
Nova Scotia	1,473	162	9:1
New Brunswick	1,113	97	11:1
Quebec	8,685	822	11:1
Ontario	18,020	1,808	10:1
Manitoba	1,668	152	11:1
Saskatchewan	2,003	136	15:1
Alberta	4,718	481	10:1
British Columbia	6,264	679	9:1
Territories*	22	0	—
<b>Canada</b>	<b>44,910</b>	<b>4,408</b>	<b>10:1</b>

#### Notes

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

Jurisdictional analysis is based on the location of the facility where the procedure was performed.

Less than 1% (N = 185) of hip replacements were excluded due to unknown type.

#### Source

Hospital Morbidity Database, 2013–2014, Canadian Institute for Health Information.

## Age-standardized rates by jurisdiction

Table 4, which presents age-standardized rates by jurisdiction of residence, shows variations across Canada for all hip replacement procedures. Saskatchewan and P.E.I. had the highest rates of hospitalization for hip replacements (204 and 185 per 100,000, respectively) in 2013–2014. Quebec had the lowest rate of hospitalization for all hip replacements (109), followed by Newfoundland and Labrador (129). From 2009–2010 to 2013–2014, the age-standardized rate for hip replacements increased in all of the provinces; the greatest rate increases were in P.E.I. (28.5%) and Saskatchewan (20.8%). The national age-standardized rate of hospitalization for all hip replacement procedures increased from 130 in 2009–2010 to 139 in 2013–2014.

**Table 4: Age-standardized hospitalization rate (per 100,000 population age 20 and older) for all hip replacements, by jurisdiction of residence, 2009–2010 to 2013–2014**

Jurisdiction	Age-standardized rate					5-year percentage change
	2009–2010	2010–2011	2011–2012	2012–2013	2013–2014	
<b>Newfoundland and Labrador</b>	116	111	127	131	129	11.4%
<b>Prince Edward Island</b>	144	123	156	161	185	28.5%
<b>Nova Scotia</b>	141	142	137	146	151	7.1%
<b>New Brunswick</b>	126	135	140	132	138	9.4%
<b>Quebec</b>	98	99	102	104	109	11.2%
<b>Ontario</b>	137	136	138	141	145	5.8%
<b>Manitoba</b>	137	158	151	153	150	9.2%
<b>Saskatchewan</b>	169	164	165	181	204	20.8%
<b>Alberta</b>	157	152	160	164	161	2.5%
<b>British Columbia</b>	140	139	143	143	141	0.7%
<b>Canada*</b>	<b>130</b>	<b>130</b>	<b>133</b>	<b>136</b>	<b>139</b>	<b>6.9%</b>

### Notes

\* Totals exclude cases with unknown jurisdiction of residence (N = 51). The territories (Yukon, the Northwest Territories and Nunavut) were also excluded due to small counts (N = 100).

Results are presented by patients' jurisdiction of residence, rather than by the province of the facility where treatment occurred. The 1991 Canadian population was used as the standard for rate calculations.

### Source

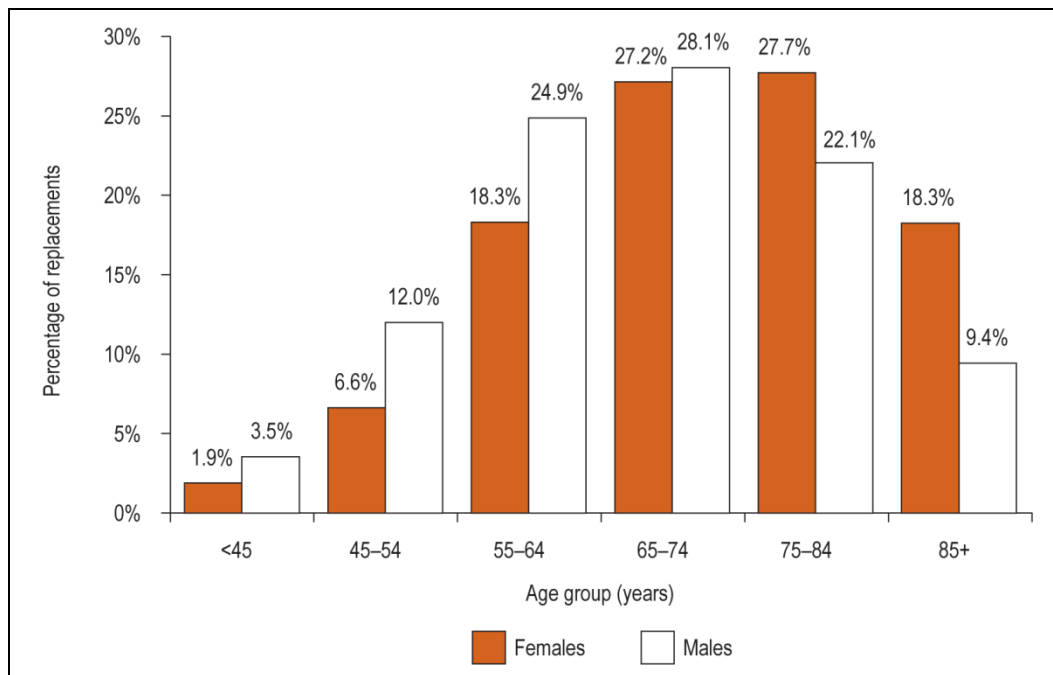
Hospital Morbidity Database, 2009–2010 to 2013–2014, Canadian Institute for Health Information.

## Patient demographics

### Age and gender

The age distribution of hip replacement recipients differed between the sexes (Figure 3). Males tended to be younger at the time of hip replacement (average age of 67.6) than females (average age of 72.3). Most male hip replacement recipients (53%) were age 55 to 74, whereas most female hip replacement recipients (54.9%) were age 65 to 84 at the time of surgery. Women were far more likely to have hip replacement surgery after age 75.

**Figure 3: Age distribution of all hip replacement recipients, by sex, Canada, 2013–2014**



**Note**

N = 20,572 males; N = 28,930 females.

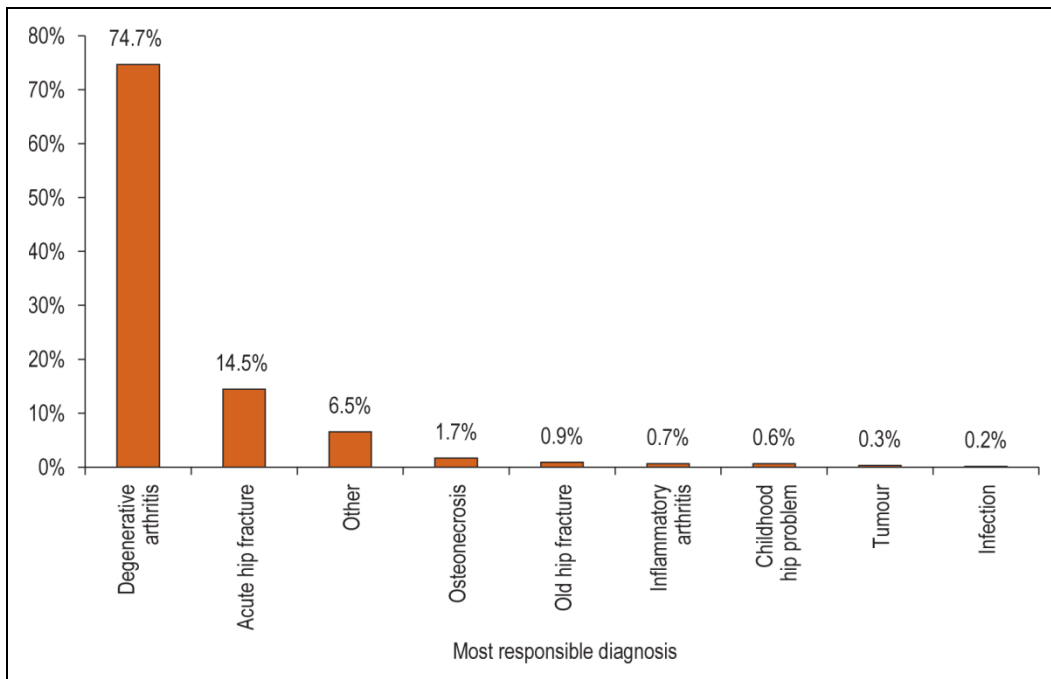
**Source**

Hospital Morbidity Database, 2013–2014, Canadian Institute for Health Information.

## Most responsible diagnosis

For primary hip replacements, CJRR data providers were asked to record the most responsible diagnosis grouping applicable to each procedure. Figure 4 shows that in 2013–2014, degenerative arthritis was the most common diagnosis grouping indicated by surgeons (74.7%), followed by acute hip fracture (14.5%).

Figure 4: Most responsible diagnosis for primary hip replacements, 2013–2014



**Note**

N = 29,340 primary hip replacements.

**Source**

Canadian Joint Replacement Registry, 2013–2014, Canadian Institute for Health Information.

## Length of stay for hip replacements in Canada

This section presents acute inpatient length of stay (LOS) using the median, interquartile range (IQR) and 90th percentile.<sup>i</sup>

The median LOS was 4 days for male and female hip replacement recipients in 2013–2014 (Table 5). For women, this was 1 day less than in 2012–2013. 1 in 10 male patients stayed in acute care for longer than 12 days, whereas 1 in 10 female patients stayed for longer than 14 days. Comparing LOS figures with those for the previous year, female patients in the top 10% (or 90th percentile) stayed 1 day less. Overall, the median LOS for both sexes did not change from the previous year.

i. The median is a measure of central tendency, the middle of a data distribution. The median is less sensitive to extreme scores than the mean, which makes it a better measure for highly skewed distributions. The IQR is a corresponding measure of variability, being equal to the difference between the third and the first quartiles. 50% of cases have an LOS within the IQR. Median, IQR and 90th percentile are reported throughout this section.

**Table 5: Length of stay (days) for all hip replacements, by sex, Canada, 2009–2010 to 2013–2014**

Fiscal year	Males			Females			Both sexes		
	Median	IQR	90th percentile	Median	IQR	90th percentile	Median	IQR	90th percentile
2009–2010	5	4	13	6	5	17	5	4	16
2010–2011	4	4	13	5	4	16	5	5	15
2011–2012	4	4	13	5	4	16	5	4	15
2012–2013	4	3	12	5	5	15	4	4	14
2013–2014	4	3	12	4	4	14	4	4	13

**Note**

IQR: Interquartile range.

**Source**

Hospital Morbidity Database, 2009–2010 to 2013–2014, Canadian Institute for Health Information.

Overall, the median and 90th percentile LOS in hospital for hip replacements varied across jurisdictions (Table 6). Nova Scotia, Ontario, Saskatchewan, Alberta and B.C. had the shortest median LOS for hip replacements (4 days). In contrast, P.E.I. had the longest median LOS (7 days). The national average median LOS for hip procedures was 4 days.

**Table 6: Length of stay (days) for all hip replacements, by jurisdiction of treatment, Canada, 2013–2014**

Jurisdiction	All hip replacements		
	Median	IQR	90th percentile
Newfoundland and Labrador	5	4	15
Prince Edward Island	7	6	21
Nova Scotia	4	4	16
New Brunswick	5	5	15
Quebec	5	5	20
Ontario	4	3	10
Manitoba	5	4	14
Saskatchewan	4	3	11
Alberta	4	4	14
British Columbia	4	4	16
Northwest Territories	5	4	11
Canada	4	4	13

**Notes**

IQR: Interquartile range.

Jurisdictional analysis is based on the location of the facility where the procedure was performed.

**Source**

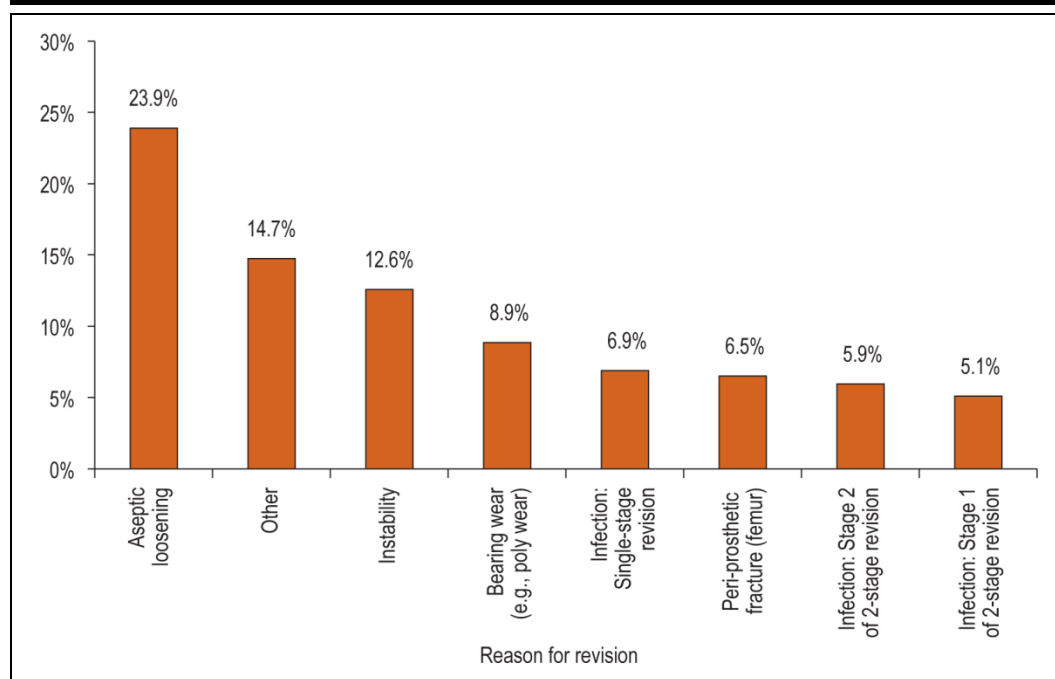
Hospital Morbidity Database, 2013–2014, Canadian Institute for Health Information.

## Revisions

### Reason for revision

Among the hip replacement revisions reported to CJRR in 2013–2014, the most common reason for revision was aseptic loosening, at 23.9% (Figure 5). This is consistent with findings from other national joint replacement registries.<sup>1, 2</sup>

Figure 5: Reasons for hip revisions, 2013–2014



#### Notes

N = 2,674 revision hip replacements.

Less common reasons for hip revisions, such as osteolysis, pain of unknown origin, implant dissociation, implant fracture acetabular erosion (e.g., hemiarthroplasty), peri-prosthetic fracture (acetabulum) and leg length discrepancy, were each less than 5%.

#### Source

Canadian Joint Replacement Registry, 2013–2014, Canadian Institute for Health Information.

### Risk of revision

Risk of hip revision was calculated by determining the number of hip replacements that had a subsequent revision on the same side of the hip within 1, 2 and 3 years of the primary procedure. For this analysis, counts are based on the number of primary (and associated first revision) procedures, not hospitalizations. 5 years of data were used for this analysis, from 2009–2010 to 2013–2014. Only those primary procedures that had sufficient follow-up were included in each calculation, irrespective of whether they had a revision.

The 1-, 2- and 3-year risk of revision by sex and age group can be seen in tables 7 and 8, respectively. Of primary hip replacements that occurred between 2009–2010 and 2012–2013, 1.6% were revised within the first year. Similarly, 2.0% of primary hip replacements that occurred between 2009–2010 and 2011–2012 were revised within 2 years; and 2.4% of primary hip replacements that occurred between 2009–2010 and 2010–2011 were revised within 3 years.

The overall risk of hip revision was low but increased over time: the risk of revision increased by about 0.4% each year.

Women and men had comparable risk of revision of hip replacement. The lowest revision rate was found among the youngest (and the smallest) group, those younger than age 45. Within all age groups, the risk increased over time. The smallest increase in the risk of revision from one year to another was found in the oldest group, which includes patients 85 and older.

**Table 7: Risk of revision of hip replacements by gender, 2009–2010 to 2012–2013**

Gender	1-year risk of revision	2-year risk of revision	3-year risk of revision
<b>Males</b>	1.62%	1.96%	2.31%
<b>Females</b>	1.53%	2.00%	2.48%
<b>All</b>	1.58%	1.97%	2.38%

**Source**

Hospital Morbidity Database, 2009–2010 to 2013–2014, Canadian Institute for Health Information.

**Table 8: Risk of revision of hip replacements by age group, 2009–2010 to 2012–2013**

Age group	1-year risk of revision	2-year risk of revision	3-year risk of revision
<b>&lt;45</b>	1.23%	1.87%	2.27%
<b>45–54</b>	1.44%	2.15%	2.72%
<b>55–64</b>	1.5%	2.02%	2.55%
<b>65–74</b>	1.54%	1.98%	2.46%
<b>75–84</b>	1.90%	2.19%	2.55%
<b>85+</b>	1.37%	1.43%	1.52%
<b>All</b>	1.58%	1.97%	2.38%

**Source**

Hospital Morbidity Database, 2009–2010 to 2013–2014, Canadian Institute for Health Information.

## Joint replacement prosthesis characteristics

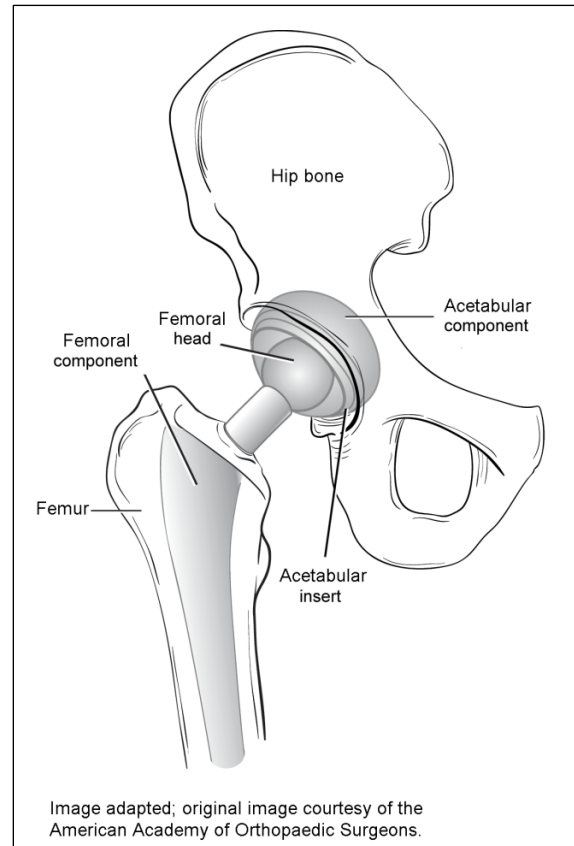
### Components replaced in revision procedures

Throughout this report, the term “component replaced” refers to components replacing existing artificial implants, as in the case of revision procedures.

4 basic components (or implant parts) are used for hip replacements: the acetabular component, acetabular insert/liner, femoral component and femoral head.

For hip revisions reported in CJRR in 2013–2014, the femoral head was by far the most common component replaced (90.2%), while the femoral component was the least common (48.4% of revision procedures). Acetabular components were replaced in 56.9% of reported revisions, while 75.2% of revisions required the acetabular liners to be changed.

To obtain information on implant product characteristics (such as material and size), barcodes submitted in 2013–2014 were linked to barcodes in data previously submitted to CJRR (before the minimum data set [MDS] was introduced, data contained more detailed product information). This information may be used to study implant characteristics that influence surgical outcome, utilization trends, etc.



### Femoral head size in hip replacements

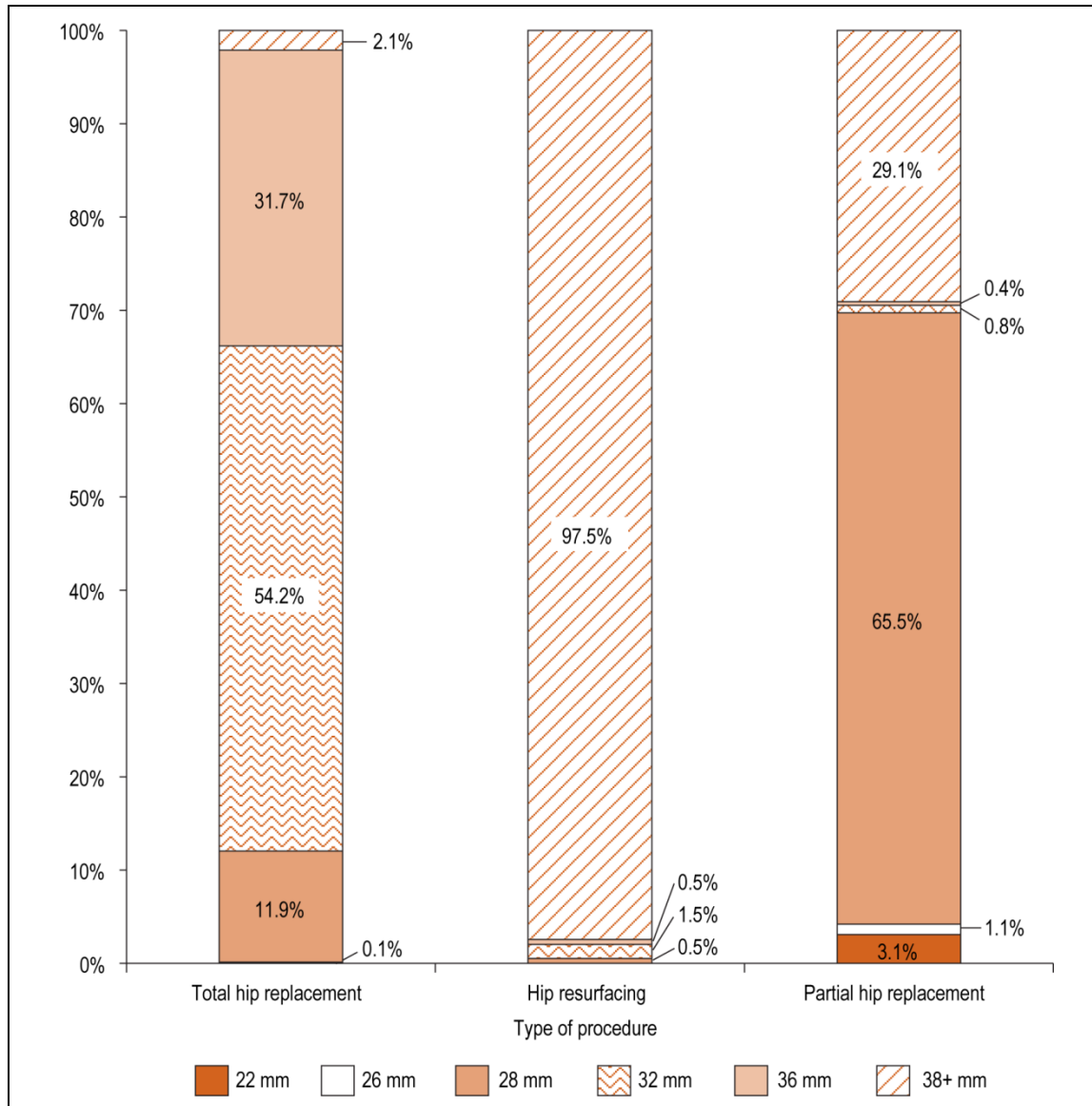
The durability and stability of a hip implant depends on many factors, such as the design and type of prosthetic used. An aspect of particular interest is the size of the femoral head implanted. In recent years, a preference for larger-diameter heads to improve stability has been evident.<sup>3</sup>

Figure 6 shows the size of femoral heads used for primary hip replacements in 2013–2014. Femoral head sizes were identifiable for 80% of primary hip replacements submitted to CJRR, thanks to the availability of product numbers for implant identification previously submitted by data providers.



The use of various sizes differed among the types of primary hip replacement procedures (Figure 6). As expected, hip resurfacing procedures used large femoral heads. 97.5% of all hip resurfacing procedures in 2013–2014 reported femoral head sizes of 38+ mm. Most total hip replacements were performed using 32 mm femoral heads (54.2%), followed by 36 mm heads (31.7%). Among partial hip replacements, there was more variation in femoral head size, but the majority of the replacements were performed using 28 mm or larger femoral heads (28 mm: 65.5%; 36+ mm: 29.5%).

**Figure 6: Femoral head size by type of primary hip replacement procedure, 2013–2014**



**Note**

N = 22,788 femoral heads for primary hip replacements.

**Source**

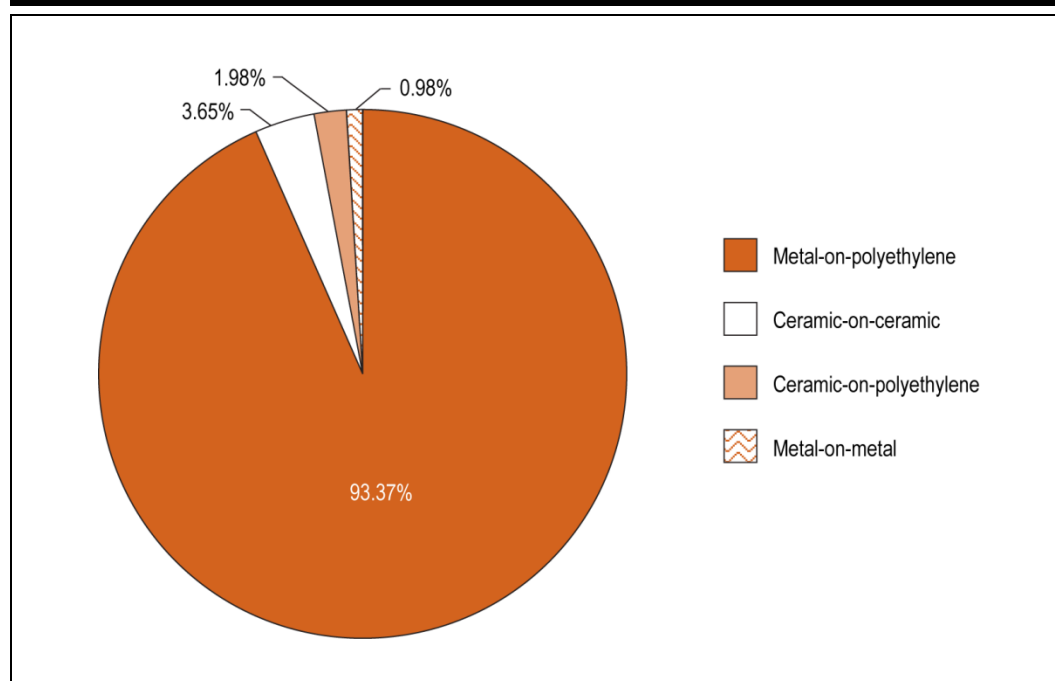
Canadian Joint Replacement Registry, 2013–2014, Canadian Institute for Health Information.

## Bearing surfaces for hip replacements

Another important characteristic of hip replacements is the combination of materials that make up the bearing (or articulating) surface of the implanted hip joint, namely the material used for the articulating femoral head and the acetabular components.

As seen in Figure 7, the most common bearing surface among the primary total hip replacements in 2013–2014 was metal-on-polyethylene (or plastic) (93.4%), followed by ceramic-on-ceramic (3.7%). A metal-on-metal bearing surface combination was used in approximately 1% of all hip replacements.<sup>ii</sup> The strong preference for metal-on-polyethylene is consistent with findings from the past 10 years.<sup>4</sup>

Figure 7: Bearing surfaces for hip replacements, 2013–2014



### Notes

N = 12,599 bearing surfaces for primary total hip replacements.

Fewer than 5 cases of ceramic-on-metal were excluded from analysis. In accordance with CIHI's privacy policy, cells with counts of 1 to 4 are suppressed.

### Source

Canadian Joint Replacement Registry, 2013–2014, Canadian Institute for Health Information.

ii. Information on bearing surfaces was available for 54% of primary total hip replacements submitted to CJRR in 2013–2014; these numbers should therefore be interpreted with careful consideration. Information on implant product characteristics presented in this report is influenced by both CJRR coverage in 2013–2014 (see Table 1) and the completeness of information available for each implant type. Availability of this information is expected to increase as the CJRR product library continues to improve.

## Fixation method

Surgeons employ 3 different fixation methods to secure orthopedic implants:

1. Cemented: Using bone cement to adhere the implant to the patient's remaining natural bone stock;
2. Cementless: For example, where the implants are secured using bone screws or are press fit into position; and
3. Hybrid: A combination of cemented and cementless implant parts.

For all types of hip replacements, the cementless approach was the most common fixation method (86.8%) in 2013–2014. Among primary procedures, 92.6% of total hip replacements, 69.3% of partial hip replacements and 56.5% of hip resurfacings used the cementless approach; the remainder used either a hybrid or cemented approach. These preferences are in keeping with findings from other national joint replacement registries.<sup>3</sup> Among revision procedures, 77.7% used cementless fixation.

## Summary of hip findings

In 2013–2014, there were 49,503 hospitalizations for all hip replacements, an increase of 19.1% since 2009–2010. Most hip replacements in Canada were primary procedures (91.1%).

The overall pan-Canadian age-standardized rate for all hip replacements increased from 130 per 100,000 population in 2009–2010 to 139 in 2013–2014. In general, age-standardized rates for females were higher than for males.

Substantial jurisdictional variation in the age-standardized rates of hip and knee replacement was seen in 2013–2014. Saskatchewan had the highest rate of hip replacements (204 per 100,000). Quebec had the lowest age-standardized rate of hip replacements in the country, at 109 per 100,000.

The median LOS in acute care for hip replacements decreased in the 5 years since 2009–2010. In 2013–2014, the median LOS for both sexes combined was 4 days for all hip replacements. However, 10% of patients stayed longer than 13 days for hip replacements.

In 2013–2014, degenerative arthritis was indicated as the most common diagnosis grouping for primary hip replacements (74.7%). The most common reason for hip revision was aseptic loosening, which accounted for 23.9% of hip revisions.

The information on implant characteristics was obtained through a linkage with available product numbers previously submitted to CJRR (pre-MDS data contained detailed product information). In 2013–2014, the use of various sizes of femoral heads differed among the types of primary hip replacements. The majority of total hip replacements were performed using 32 mm femoral heads (54.2%), followed by 36 mm (31.7%). Sizes 38 mm and larger were used in 97.5% of resurfacing procedures and in 29.1% of partial procedures.

More than 90% of hip replacements used a metal-on-polyethylene bearing surface combination, while metal-on-metal hip replacements made up only 1% of all hip replacements in CJRR in 2013–2014.

Data from 2013–2014 shows that more than 85% of all hip replacements used a cementless fixation method.





## Chapter 3: Knee replacements





## Methodological highlights

- Analyses for this chapter are based on the HMDB, NACRS and CJRR.
- Counts reported are based on the number of knee replacement discharges, not the number of joints replaced, unless otherwise stated. The term “discharges” in this report includes inpatient and day procedure discharges.
- Total and partial replacements and elective and urgent cases are included in the analyses. Both admissions and day surgeries (from the HMDB and NACRS) are included.
- For age-standardized rates, the number of discharges includes both total and partial replacements for patients age 20 and older.

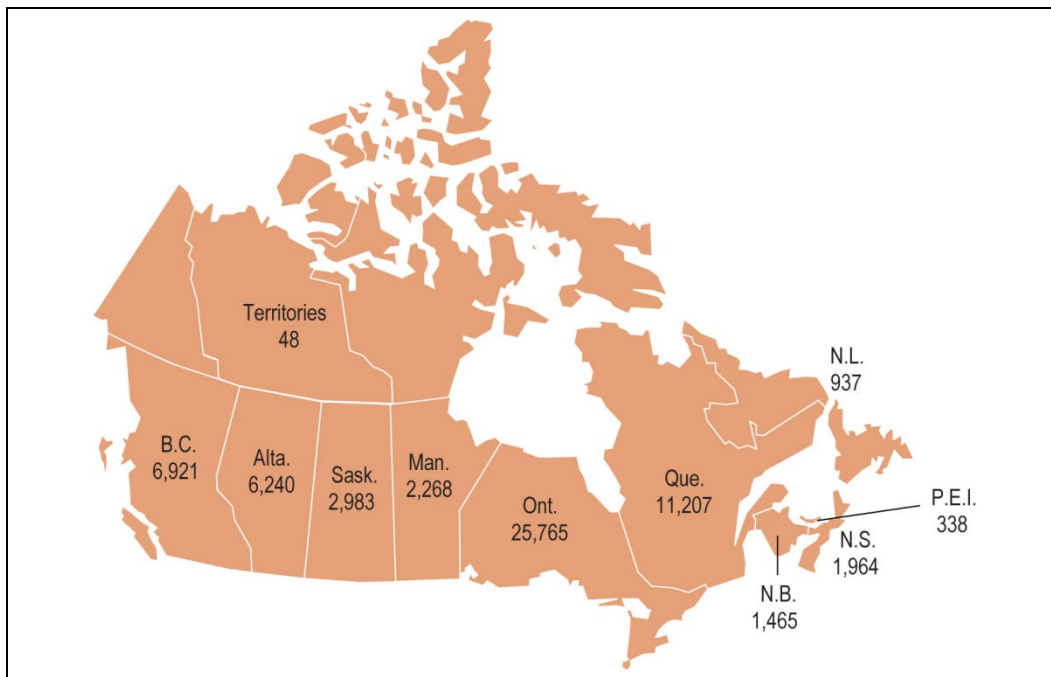
This chapter provides information on knee replacements performed in Canada in 2013–2014, as well as historical trends at the provincial/territorial and pan-Canadian levels.

## Pan-Canadian overview of knee replacements

In 2013–2014, there were 60,136 knee replacements performed in Canada, representing a 5-year increase of 22.9% from 48,946 in 2009–2010 and a 1-year increase of 3.6%.

Figure 8 shows the number of discharges for knee replacements in Canada in 2013–2014.

**Figure 8: Number of knee replacements in Canada, by jurisdiction of treatment, 2013–2014**



### Notes

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

Jurisdictional analysis is based on the location of the facility where the procedure was performed.

### Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, 2013–2014, Canadian Institute for Health Information.

## Type of joint replacement

Of the knee replacement discharges, 93.3% were primary procedures and 6.7% were revisions (data for revisions can be for first or subsequent revisions).

Primary procedures can be further divided into total knee replacements and partial knee replacements (see Appendix B for detailed definitions):

- Total knee replacement: The entire knee joint (both the femoral and tibial articulating surfaces) is replaced with artificial implants: 55,393 (99.1%).
- Partial knee replacement: Only 1 part of the knee joint is replaced with an artificial implant: 333 (0.6%).

In 2013–2014, there were also 181 patella and patellofemoral replacement procedures.

## Day surgeries

This year, day surgeries from both the HMDB and NACRS are included in the analyses. In 2013–2014, there were 190 day surgeries for knee replacements reported to the HMDB and NACRS. Newfoundland and Labrador, Quebec and B.C. submitted day surgeries through the HMDB, and Nova Scotia, Ontario and Alberta submitted day surgeries through NACRS. Day surgeries made up less than 1% of all knee replacement surgeries performed in Canada in 2013–2014.

**Table 9: Hospitalizations and day surgeries for knee replacements, 2009–2010 to 2013–2014**

	2009–2010	2010–2011	2011–2012	2012–2013	2013–2014	Total
<b>Hospitalizations</b>	48,667	50,734	54,993	57,718	59,946	<b>272,058</b>
<b>Day surgeries</b>	279	332	285	304	190	<b>1,390</b>
<b>Total</b>	<b>48,946</b>	<b>51,066</b>	<b>55,278</b>	<b>58,022</b>	<b>60,136</b>	<b>273,448</b>

### Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, 2009–2010 to 2013–2014, Canadian Institute for Health Information.

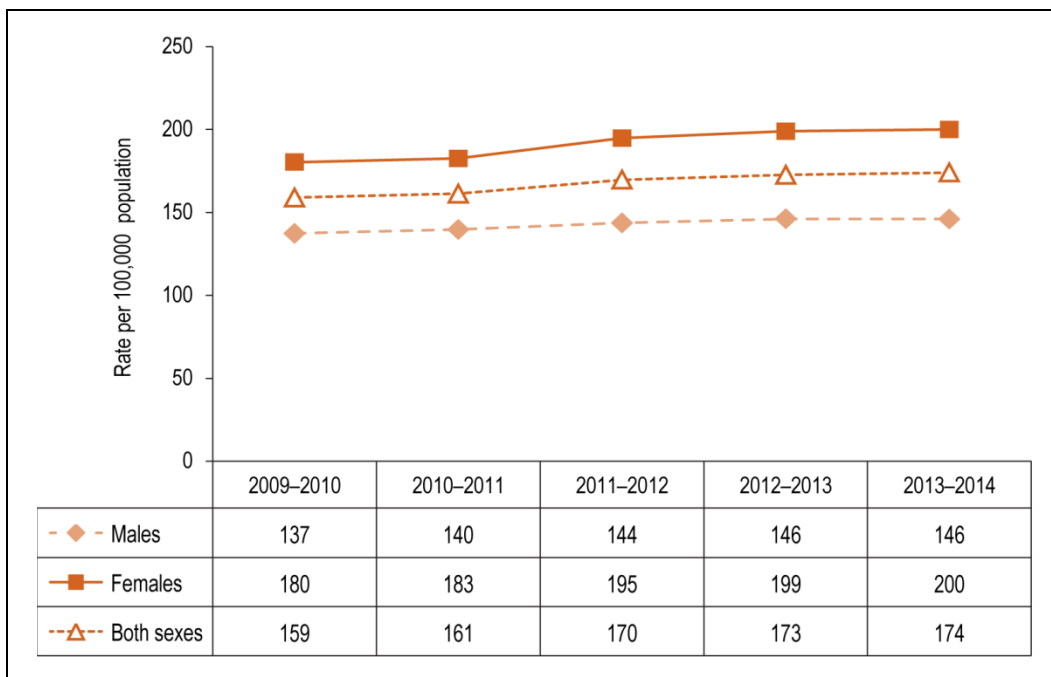
## Age-standardized discharge rates

Age standardization takes into account differences in age structures across populations and time by calculating rates against a standard population. The age-standardized rates shown throughout this report are reported per 100,000 population age 20 and older.

The pan-Canadian age-standardized discharge rate for all types of knee replacements for patients age 20 and older in 2013–2014 was 174 per 100,000, up 9.4% from 159 in 2009–2010 (Figure 9). In 2013–2014, the age-standardized rate for males age 20 and older was 146, while that for females was 200, a difference of 54. The age-standardized rate for all knee replacements was consistently higher for females than for males over the entire reporting period. The rate for males had a lower 5-year increase than the rate for females did (6.3% versus 10.9%).



**Figure 9: Age-standardized discharge rates (per 100,000 population age 20 and older) for all knee replacements, by sex, Canada, 2009–2010 to 2013–2014**



**Note**

The 1991 Canadian population was used as the standard for rate calculation.

**Sources**

Hospital Morbidity Database and National Ambulatory Care Reporting System, 2009–2010 to 2013–2014, Canadian Institute for Health Information.

## Jurisdictional variations

Table 10 presents the number of knee replacement discharges by jurisdiction of treatment between 2009–2010 and 2013–2014.

Of the 60,136 knee replacements performed in 2013–2014, 25,765 (42.8%) were performed on patients residing in Ontario.

All jurisdictions experienced increases in knee replacement procedures over the last 5 years, except for the territories. P.E.I. and Quebec had the largest 5-year increases at 43.8% and 42.4%, respectively, followed by Newfoundland and Labrador and Saskatchewan.

**Table 10: Number of knee replacements, by jurisdiction of treatment, 2009–2010 to 2013–2014**

Jurisdiction	All knee replacements					5-year percentage change
	2009–2010	2010–2011	2011–2012	2012–2013	2013–2014	
<b>Newfoundland and Labrador</b>	676	728	913	925	937	38.6%
<b>Prince Edward Island</b>	235	202	255	316	338	43.8%
<b>Nova Scotia</b>	1,645	1,762	1,825	1,898	1,964	19.4%
<b>New Brunswick</b>	1,175	1,224	1,438	1,454	1,465	24.7%
<b>Quebec</b>	7,870	9,132	9,867	10,289	11,207	42.4%
<b>Ontario</b>	21,768	22,026	23,766	24,964	25,765	18.4%
<b>Manitoba</b>	1,980	2,058	2,179	2,139	2,268	14.5%
<b>Saskatchewan</b>	2,192	1,889	1,981	2,465	2,983	36.1%
<b>Alberta</b>	4,813	5,054	5,870	6,163	6,240	29.6%
<b>British Columbia</b>	6,532	6,928	7,155	7,351	6,921	6.0%
<b>Territories*</b>	60	63	29	58	48	-20.0%
<b>Canada</b>	<b>48,946</b>	<b>51,066</b>	<b>55,278</b>	<b>58,022</b>	<b>60,136</b>	<b>22.9%</b>

### Notes

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

Jurisdictional analysis is based on the location of the facility where the procedure was performed.

### Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, 2009–2010 to 2013–2014, Canadian Institute for Health Information.

Table 11 shows the distribution of primary and revision knee procedures by jurisdiction of treatment. Most discharges for knee replacements in Canada were for primary procedures (93.3%). Newfoundland and Labrador had the highest ratio of primary to revision procedures (26:1), followed by Saskatchewan (18:1) and New Brunswick (17:1). Nova Scotia and P.E.I. had the lowest ratios of primary to revision knee procedures, at 10:1 and 11:1, respectively. The ratios provide an indication of the relative volumes of primary and revision procedures. These measures can be influenced by factors such as patient demographics.

**Table 11: Number of knee replacements, by type of replacement and jurisdiction of treatment, 2013–2014**

Jurisdiction	All knee replacements		
	Primary	Revision	Ratio — primary:revision
Newfoundland and Labrador	898	35	26:1
Prince Edward Island	310	28	11:1
Nova Scotia	1,782	178	10:1
New Brunswick	1,382	81	17:1
Quebec	10,323	737	14:1
Ontario	24,010	1,745	14:1
Manitoba	2,126	141	15:1
Saskatchewan	2,828	155	18:1
Alberta	5,782	449	13:1
British Columbia	6,418	478	13:1
Territories*	48	0	—
<b>Canada</b>	<b>55,907</b>	<b>4,027</b>	<b>14:1</b>

#### Notes

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

Jurisdictional analysis is based on the location of the facility where the procedure was performed.

Less than 1% (N = 202) of knee replacements were excluded due to unknown type.

#### Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, 2013–2014, Canadian Institute for Health Information.

## Age-standardized rates by jurisdiction

Table 12, which presents age-standardized rates by jurisdiction of residence, shows variations across Canada for all knee replacement procedures. In 2013–2014, P.E.I. and Saskatchewan had the highest rates of knee replacement at 220 and 299 per 100,000, respectively; Quebec had the lowest rate (131), followed by B.C. (145). Over the 5-year period, all provinces had an increased age-standardized rate for knee replacements, with the exception of B.C., whose rate decreased by 6%. The greatest increases were seen in P.E.I. (28%) and Quebec (27%). The national age-standardized rate of discharge for knee replacement procedures increased by 9.4%, from 159 to 174 over the 5-year period from 2009–2010 to 2013–2014.

**Table 12: Age-standardized discharge rate (per 100,000 population age 20 and older) for all knee replacements, by jurisdiction of residence, 2009–2010 to 2013–2014**

Jurisdiction	Age-standardized rate					5-year percentage change
	2009–2010	2010–2011	2011–2012	2012–2013	2013–2014	
<b>Newfoundland and Labrador</b>	127	134	162	157	156	23.2%
<b>Prince Edward Island</b>	172	144	180	214	220	28.2%
<b>Nova Scotia</b>	175	182	186	188	190	8.5%
<b>New Brunswick</b>	148	152	169	167	167	12.8%
<b>Quebec</b>	103	116	122	123	131	27.0%
<b>Ontario</b>	184	181	190	193	196	6.4%
<b>Manitoba</b>	183	184	191	183	191	4.2%
<b>Saskatchewan</b>	244	212	213	258	299	22.5%
<b>Alberta</b>	175	176	200	202	197	12.8%
<b>British Columbia</b>	155	159	159	158	145	-6.2%
<b>Canada*</b>	<b>159</b>	<b>161</b>	<b>170</b>	<b>173</b>	<b>174</b>	<b>9.4%</b>

### Notes

\* Total counts exclude cases with unknown jurisdiction of residence (N = 10). The territories (Yukon, the Northwest Territories and Nunavut) were also excluded due to small numbers (N = 116).

Results are presented by patients' province of residence, rather than by the province of the facility where the procedure occurred. The 1991 Canadian population was used as the standard for rate calculations.

### Sources

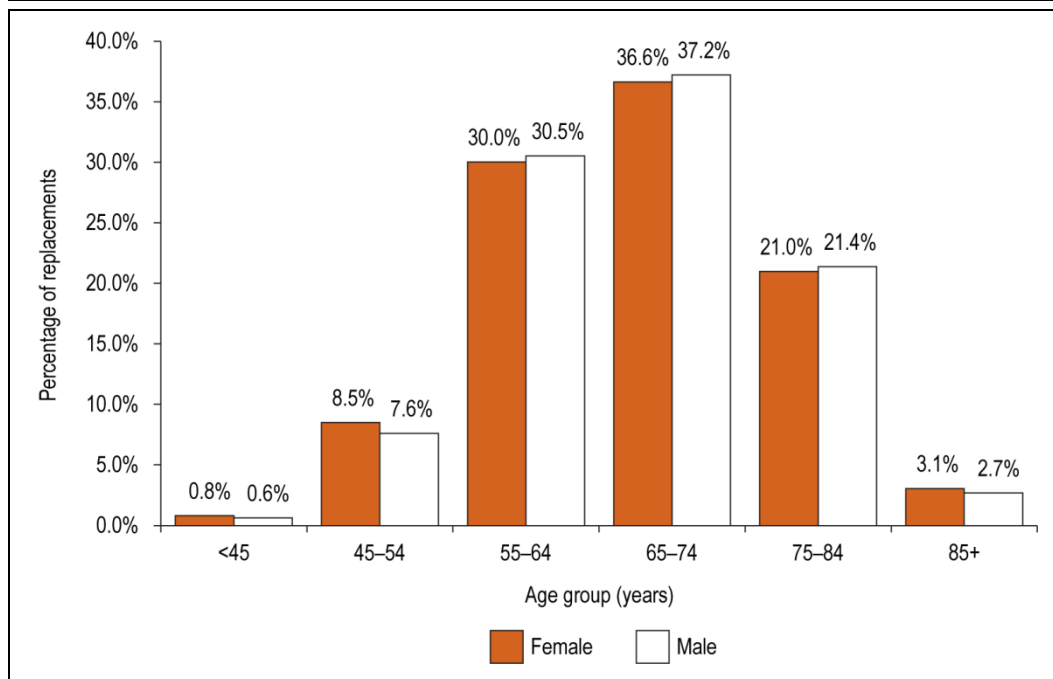
Hospital Morbidity Database and National Ambulatory Care Reporting System, 2009–2010 to 2013–2014, Canadian Institute for Health Information.

## Patient demographics

### Age and gender

Figure 10 shows the age distribution of knee replacement recipients by sex. Unlike those for hip replacements, these trends were very similar by sex: the average ages for males and females at the time of knee replacement were 67.4 and 67.3, respectively. For both sexes, most patients were age 65 to 74 (36.6% and 37.2% for females and males, respectively).

**Figure 10: Age distribution of all knee replacement recipients, by sex, Canada, 2013–2014**



**Note**

N = 23,926 males; N = 36,210 females.

**Sources**

Hospital Morbidity Database and National Ambulatory Care Reporting System, 2013–2014, Canadian Institute for Health Information.

### Most responsible diagnosis

For primary knee replacements performed in 2013–2014, degenerative arthritis was the most common diagnosis grouping indicated by surgeons (98.1%).

### Length of stay for knee replacements in Canada

This section presents acute inpatient LOS using the median, IQR and 90th percentile.

The median LOS for males, females and both sexes combined was 3 days in 2013–2014, which was 1 day less than in 2012–2013. 1 in 10 patients remained in acute care longer than 7 days.

**Table 13: Length of stay (days) for all knee replacements, by sex, Canada, 2009–2010 to 2013–2014**

Fiscal year	Males			Females			Both sexes		
	Median	IQR	90th percentile	Median	IQR	90th percentile	Median	IQR	90th percentile
2009–2010	4	3	8	4	3	8	4	3	8
2010–2011	4	2	8	4	3	8	4	3	8
2011–2012	4	2	7	4	2	8	4	2	8
2012–2013	4	2	7	4	2	7	4	2	7
2013–2014	3	1	7	3	2	7	3	2	7

**Note**

IQR: Interquartile range.

**Sources**

Hospital Morbidity Database and National Ambulatory Care Reporting System, 2009–2010 to 2013–2014, Canadian Institute for Health Information.

The median and 90th percentile LOS in hospital for knee replacements varied across jurisdictions (Table 14). Nova Scotia, Ontario, Alberta and B.C. had the shortest median LOS, at 3 days. In contrast, P.E.I. and Quebec had the longest median LOS (5 days). The national average median LOS for knee procedures was 3 days (for both males and females).

**Table 14: Length of stay (days) for all knee replacements, by jurisdiction of treatment, Canada, 2013–2014**

Jurisdiction	All knee replacements		
	Median	IQR	90th percentile
Newfoundland and Labrador	4	2	7
Prince Edward Island	5	3	10
Nova Scotia	3	1	6
New Brunswick	4	2	7
Quebec	5	2	9
Ontario	3	1	5
Manitoba	4	3	8
Saskatchewan	4	1	7
Alberta	3	1	6
British Columbia	3	1	6
Yukon	3	1	5
Northwest Territories	4	3	6
Canada	3	2	7

**Notes**

IQR: Interquartile range.

Jurisdictional analysis is based on the location of the facility where the procedure was performed.

**Sources**

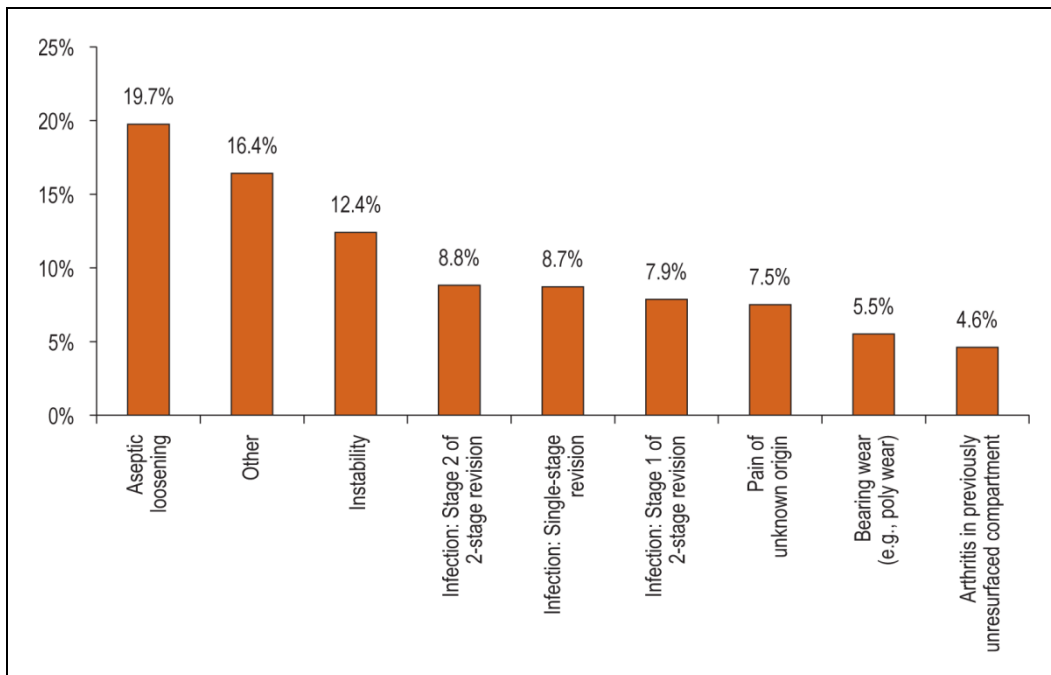
Hospital Morbidity Database and National Ambulatory Care Reporting System, 2013–2014, Canadian Institute for Health Information.

## Revisions

### Reason for revision

Among the knee replacement revisions reported to CJRR in 2013–2014, the most common reason for revision was aseptic loosening, at 19.7% (Figure 11). This is consistent with findings from other national joint replacement registries.<sup>5</sup>

Figure 11: Reasons for knee revisions, 2013–2014



#### Notes

N = 2,304 revision knee replacements in CJRR. 1 case was excluded from analysis due to unknown reason for revision. Less common reasons for knee revisions, such as patella maltracking or instability, peri-prosthetic fracture, implant dissociation, implant fracture and osteolysis, were each less than 3%.

#### Source

Canadian Joint Replacement Registry, 2013–2014, Canadian Institute for Health Information.

### Risk of revision

Risk of knee revision was calculated by determining the number of knee replacements that had a subsequent revision within 1, 2 and 3 years of the primary procedure. For this analysis, counts are based on the number of primary (and associated first revision) procedures, not hospitalizations. 5 years of data were used for this analysis, from 2009–2010 to 2013–2014. Only those primary procedures that had sufficient follow-up were included in each calculation, irrespective of whether they had a revision.

The 1-, 2- and 3-year risk of revision by sex and age group can be seen in tables 15 and 16, respectively. Of primary knee replacements that occurred between 2009–2010 and 2012–2013, 1.05% were revised within the first year. Similarly, 1.8% of primary knee replacements that occurred between 2009–2010 and 2011–2012 were revised within 2 years; and 2.29% of primary knee replacements that occurred between 2009–2010 and 2010–2011 were revised within 3 years.

The overall risk of knee revision was low and lower than that for hip replacements. However, the risk increased over time at a somewhat higher rate than that for hip replacements.

Women were more likely to have had a revision after the primary knee replacement than men (statistically significant difference). The rates show that over time the gap between the genders increased. The risk of revision decreased with the patient's age. Individuals who were 64 and younger at the time of their primary knee replacement had a higher risk of revision than those who were 65 and older. The highest rate of revision for knee replacement was found among the youngest and smallest group, those younger than 45.

**Table 15: Risk of revision of knee replacements by gender, 2009–2010 to 2013–2014**

Gender	1-year risk of revision	2-year risk of revision	3-year risk of revision
<b>Males</b>	0.87%	1.52%	2.00%
<b>Females</b>	1.34%	2.21%	2.74%
<b>All</b>	<b>1.05%</b>	<b>1.80%</b>	<b>2.29%</b>

**Sources**

Hospital Morbidity Database and National Ambulatory Care Reporting System, 2009–2010 to 2013–2014, Canadian Institute for Health Information.

**Table 16: Risk of revision of knee replacements by age group, 2009–2010 to 2013–2014**

Age group	1-year risk of revision	2-year risk of revision	3-year risk of revision
<b>&lt;45</b>	2.04%	4.64%	5.44%
<b>45–54</b>	1.70%	3.23%	4.41%
<b>55–64</b>	1.12%	2.04%	2.63%
<b>65–74</b>	0.90%	1.47%	1.95%
<b>75–84</b>	0.89%	1.35%	1.50%
<b>85+</b>	1.20%	1.42%	1.72%
<b>All</b>	<b>1.05%</b>	<b>1.80%</b>	<b>2.29%</b>

**Sources**

Hospital Morbidity Database and National Ambulatory Care Reporting System, 2009–2010 to 2013–2014, Canadian Institute for Health Information.



## Joint replacement prosthesis characteristics

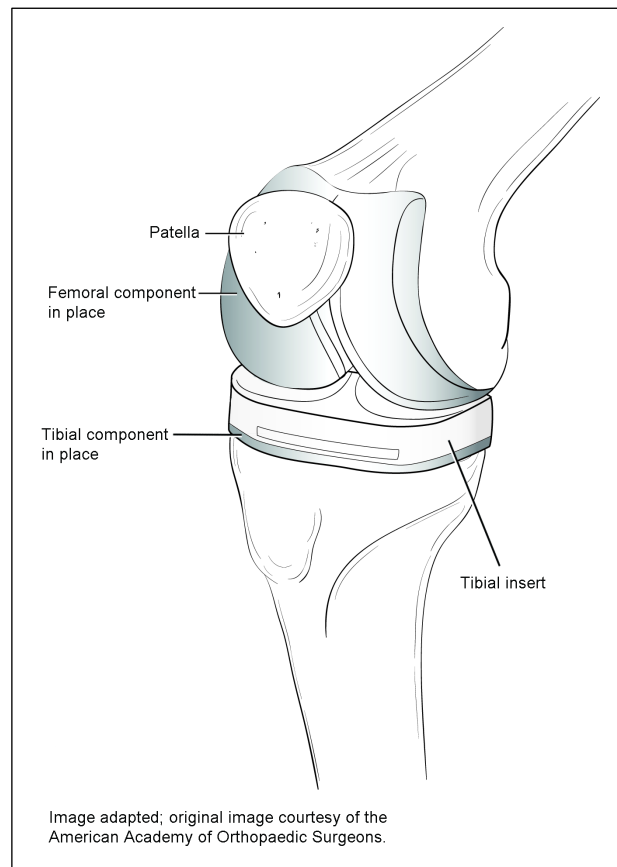
### Components replaced in revision procedures

Throughout this report, the term “component replaced” refers to components replacing existing artificial implants, as in the case of revision procedures.

4 basic components (or implant parts) are used for knee replacements: the femoral component, tibial component, tibial insert/liner and patellar component.

To obtain information on implant product characteristics, barcodes submitted in 2013–2014 were linked to barcodes in data previously submitted to CJRR (pre-MDS data contained more detailed product information).

For knee revisions reported to CJRR in 2013–2014, the tibial insert was the most common component replaced (86.7%) and the patellar component was the least common (28.6%). 67.0% of femoral components and 63.0% of tibial components were replaced.



### Fixation method

Surgeons employ 3 different fixation methods to secure orthopedic implants:

1. Cemented: Using bone cement to adhere the implant to the patient’s remaining natural bone stock;
2. Cementless: For example, where the implants are secured using bone screws or are press fit into position; and
3. Hybrid: A combination of cemented and cementless implant parts.

For knee replacements, the cemented and hybrid approaches were by far the most common fixation methods used, representing 78.3% of all procedures in 2013–2014. Among primary procedures, 80.0% of total knee replacements and 60.4% of partial knee replacements used either the cemented approach or a hybrid approach; the remainder used a cementless approach. Among revision procedures, 65.3% used either the cemented or hybrid fixation method. This strong preference for cemented knee replacements over cementless options is consistent with findings from other national joint replacement registries.<sup>1, 3</sup>

## Summary of knee findings

In 2013–2014, there were 60,136 discharges for all knee replacements, an increase of 22.9% since 2009–2010. Most knee replacements in Canada were primary procedures (93.3%).

The overall pan-Canadian age-standardized rate for all knee replacements increased, from 159 per 100,000 population in 2009–2010 to 174 in 2013–2014. In general, age-standardized rates for females were higher than that for males.

Substantial jurisdictional variation in the age-standardized rates of knee replacement was seen in 2013–2014. Saskatchewan had the highest rate of knee replacements (299 per 100,000). Quebec had the lowest age-standardized rate of knee replacements in the country, at 131 per 100,000.

The median LOS in acute care for knee replacements decreased in the 5 years since 2009–2010. In 2013–2014, the median LOS for both sexes combined was 3 days for all knee replacements. However, 10% of patients stayed longer than 7 days for knee replacements.

In 2013–2014, degenerative arthritis was indicated as the most common diagnosis grouping for primary knee replacements (98.1%). The most common reason for knee replacement revision was aseptic loosening, which accounted for 19.9% of knee revisions.

Data from 2013–2014 shows that close to 80% of knee replacements were performed using the cemented or hybrid fixation method.



## Chapter 4: Future directions





CJRR continues work to improve its ability to contribute to quality and outcome improvements for Canadians who have hip or knee replacements and to support health system goals. Maximizing the comprehensiveness, timeliness, quality and use of hip and knee replacement data will help achieve this. Priority areas for focus are outlined below.

CJRR aims to achieve **greater than 90% coverage** for hip and knee replacements. Only those jurisdictions that mandate submission to CJRR currently achieve this goal. The CJRR team will actively collaborate with key policy-makers and orthopedic surgeons in voluntary jurisdictions to increase mandated reporting to CJRR and maximize CJRR coverage. The CJRR Advisory Committee has launched a new participation working group to support this goal.

CIHI's information about joint replacements, including that in CJRR, needs to be **more accessible and widely used** by orthopedic surgeons, clinicians, health system managers and policy-makers. The CJRR Advisory Committee has launched a new analytical working group to provide advice on enhancing the annual report, producing academic papers and promoting the value and use of CJRR data.

CIHI is working with health system leaders across Canada to advance a common approach to **patient-reported outcome measures (PROMs) data collection and reporting**. As part of this program, the CJRR team and a small number of advisory committee members are participating in an exploratory PROMs demonstration project focused on hip and knee replacement patients.

The CJRR team will continue to identify options to **increase data quality** while also **reducing the burden of data collection** for data suppliers and CIHI. As of 2013–2014, the registry is able to receive scanned implant barcodes. Barcode scanning reduces possible data entry errors as well as the effort needed to capture the medical device information.

The CJRR team will continue **to enhance the CJRR implant product library** to support analysis. We will collaborate with the International Consortium of Orthopedic Registries (ICOR), manufacturers, orthopedic surgeons and others to achieve this essential objective. With product characteristics no longer being captured in the MDS, the CJRR team is continuously improving its internal product information library to enable efficient identification of implant characteristics from product number information collected based on product catalogue numbers. Accurate and timely product information from manufacturers is required to support this goal.

As the number of hip and knee replacement procedures continues to rise and the implants and surgical techniques used continue to evolve, CJRR data will be even more important for understanding related health outcomes from clinical, administrative and policy perspectives. In addition to clinical data from CJRR and the Discharge Abstract Database–Hospital Morbidity Database (DAD-HMDB), incorporating costs (e.g., from physician billings, drugs claims data), follow-up data (e.g., from rehabilitation), etc., would help create a more comprehensive picture of hip and knee replacements in Canada.





# Appendices







## Appendix A: Methodological notes, HMDB and NACRS

### Day surgeries for knee replacements

This report includes knee replacement day surgeries submitted to the HMDB and NACRS. Including day surgeries for knee replacements is a methodological change from previously published CJRR reports. Counts and rates will differ from those included in previous CJRR reports. The new methodology was consistently applied across all data years included in this report.

### Hospitalization information

Chapters 2 and 3 of this report present data from the HMDB. The figures and tables provide data on hospitalizations and discharges for hip and knee replacements (primary and revision, elective and urgent procedures) performed in acute care hospitals in Canada, based on discharges from April 1, 2009, to March 31, 2014.

Counts reported were based on the number of hospitalizations/discharges, not the number of procedures, unless otherwise stated. A hospitalization/discharge may include more than 1 joint replacement procedure. Procedures coded as “abandoned” were excluded from the analyses.

Provincial analyses in these chapters were based on where the procedure was performed, with the exception of age-standardized rates, which are based on a patient’s province or territory of residence.

For the calculation of age-standardized rates, national and provincial fiscal population estimates were used based on July 1 estimates of the given fiscal year, as provided by Statistics Canada. The 1991 Canadian population was used as the standard population. The number of hospitalizations/discharges used for rate calculations includes both total and partial replacements for patients age 20 and older.

All analyses were conducted using the SAS (version 9.2, Cary, North Carolina) statistical software package.

### Hip and knee replacement coding in the HMDB and NACRS

Canadian Classification of Health Interventions (CCI) codes were used to identify hip and knee replacements from 2009–2010 to 2013–2014.

As of 2006–2007, all provinces and territories have adopted the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada* (ICD-10-CA) and CCI as the coding standard for diagnoses and interventions. Data from 2009–2010 to 2011–2012 used version 2009 of ICD-10-CA/CCI, and data from 2012–2013 onward uses version 2012.

### Hip replacements

Table A-1 outlines the CCI codes used to identify hip replacements in the HMDB in this report. The specific rubrics of interest were 1.SQ.53 *Implantation of internal device, pelvis* and 1.VA.53 *Implantation of internal device, hip joint*. Revisions were identified using a supplementary code called a Status Attribute, where Status Attribute = R identified that the procedure was a revision.

Starting with version 2009, CCI codes allowed hip resurfacing procedures to be identified using the Extent Attribute code (Extent Attribute = 02 in version 2009 and Extent Attribute = RE in version 2012). Partial and total hip replacements were as defined in Table A-1.

**Table A-1: CCI codes for hip replacements**

Rubric*		CCI codes				
Type	1.SQ.53.^ <sup>^^</sup> Implantation of internal device, pelvis	Uncemented	Using bone autograft (uncemented)	Using bone homograft (uncemented)	Using combined sources of tissue (e.g., bone graft, cement/paste)	Using synthetic tissue (e.g., bone cement or paste)
P	Prosthetic device, dual component (e.g., cup with protrusion ring or additional screw, plate fixation)	1.SQ.53.LA-PN	1.SQ.53.LA-PN-A	1.SQ.53.LA-PN-K	1.SQ.53.LA-PN-Q	1.SQ.53.LA-PN-N
P	Prosthetic device, single component (e.g., cup)	1.SQ.53.LA-PM	1.SQ.53.LA-PM-A	1.SQ.53.LA-PM-K	1.SQ.53.LA-PM-Q	1.SQ.53.LA-PM-N
Type	1.VA.53.^ <sup>^^</sup> Implantation of internal device, hip joint	Bone homograft (uncemented)	Uncemented	Bone autograft (uncemented)	With synthetic material (e.g., bone paste, cement, Dynagraft, Osteoset)	Using combined sources of tissue (e.g., bone graft, cement, paste)
<b>Open approach</b>						
T	Dual component prosthetic device (femoral and acetabular)	1.VA.53.LA-PN-K	1.VA.53.LA-PN	1.VA.53.LA-PN-A	1.VA.53.LA-PN-N	1.VA.53.LA-PN-Q
P	Single component prosthetic device (femoral)	1.VA.53.LA-PM-K	1.VA.53.LA-PM	1.VA.53.LA-PM-A	1.VA.53.LA-PM-N	1.VA.53.LA-PM-Q
—	Cement spacer (temporary, impregnated with antibiotics)	—	—	—	1.VA.53.LA-SL-N	—
<b>Robotics-assisted approach (e.g., telemanipulation of tools) [discontinued as of version 2012]</b>						
T	Dual component prosthetic device (femoral and acetabular)	1.VA.53.PN-PN-K	1.VA.53.PN-PN	1.VA.53.PN-PN-A	1.VA.53.PN-PN-N	1.VA.53.PN-PN-Q
P	Single component prosthetic device (femoral)	1.VA.53.PN-PM-K	1.VA.53.PN-PM	1.VA.53.PN-PM-A	1.VA.53.PN-PM-N	1.VA.53.PN-PM-Q

**Notes**

\* P = partial hip replacement; T = total hip replacement.

1.SQ.53.^<sup>^^</sup> *Implantation of internal device, pelvis* includes the following:

- Arthroplasty (cup), acetabulum alone
- Hemiarthroplasty, acetabulum
- Implantation, acp 54etabulum alone
- Replacement, acetabulum alone, using prosthetic device

1.VA.53.^<sup>^^</sup> *Implantation of internal device, hip joint* includes the following:

- Arthroplasty with implantation prosthetic device, hip
- Resurfacing arthroplasty (no resection of femoral head)
- Hemiarthroplasty with implantation prosthetic device, hip
- Replacement, hip, using prosthetic device
- Reduction with fixation and implantation of prosthetic device, hip

## Knee replacements

Table A-2 outlines the CCI codes used to identify knee replacements in the HMDB and NACRS in this report. The specific rubrics of interest were 1.VG.53 *Implantation of internal device, knee joint* and 1.VP.53 *Implantation of internal device, patella*. Revisions were identified using a supplementary code called a Status Attribute, where Status Attribute = R identified that the procedure was a revision.

**Table A-2: CCI codes for knee replacements**

Rubric	CCI codes				
	With synthetic material (e.g., bone paste, cement, Dynagraft, Osteoset)	Uncemented	With bone autograft	With bone homograft	With combined sources of tissue (e.g., bone graft, cement, paste)
1.VG.53.^ <sup>^</sup> Implantation of internal device, knee joint					
<b>Single component prosthetic device</b>	1.VG.53.LA-PM-N	1.VG.53.LA-PM	1.VG.53.LA-PM-A	1.VG.53.LA-PM-K	1.VG.53.LA-PM-Q
<b>Dual component prosthetic device</b>	1.VG.53.LA-PN-N	1.VG.53.LA-PN	1.VG.53.LA-PN-A	1.VG.53.LA-PN-K	1.VG.53.LA-PN-Q
<b>Tri component prosthetic device</b>	1.VG.53.LA-PP-N	1.VG.53.LA-PP	1.VG.53.LA-PP-A	1.VG.53.LA-PP-K	1.VG.53.LA-PP-Q
<b>Cement spacer (temporary) (impregnated with antibiotics)</b>	1.VG.53.LA-SL-N	—	—	—	—

1.VP.53.^ <sup>^</sup> Implantation of internal device, patella	Cemented	Uncemented
<b>Single component [patella only]</b>	1.VP.53.LA-PM-N	1.VP.53.LA-PM
<b>[New as of version 2012] Dual component [patellofemoral]</b>	1.VP.53.LA-PN-N	1.VP.53.LA-PN

### Notes

1.VG.53.^<sup>^</sup> *Implantation of internal device, knee joint* includes the following:

- Replacement with implantation of prosthetic device, knee
- Hemiarthroplasty with implantation of prosthetic device, knee
- Replacement, knee, using prosthetic device

1.VP.53.^<sup>^</sup> *Implantation of internal device, patella* includes the following:

- Patellaplasty, using prosthetic implant device
- Replacement, patella (only), using prosthetic device
- Replacement, patellofemoral (only), using prosthetic device

## Appendix B: Methodological notes, CJRR

### Clinical and surgical information

Data from surgeons, hospitals or regions is submitted electronically to CIHI in 1 of 2 ways: electronic file submissions or web-based data submissions. This data is processed and is loaded into the CJRR database.

Additional joint replacement data is obtained from the HMDB and NACRS for annual reports, Analysis in Brief reports and ad hoc requests.

CJRR coverage for 2013–2014 was 67%, based on comparison with hip and knee replacement procedures submitted to the HMDB and NACRS. Participation in CJRR is mandated in Ontario, Manitoba and B.C. Refer to Table 1 for specific coverage by province.

### Hip and knee replacement coding in CJRR

Throughout this report, the type of joint replacement procedure was determined based on information provided by the data supplier and on whether specific components were used during the procedure. The coding methodology for each type of joint replacement is described in Table B-1.

**Table B-1: CJRR coding methodology for primary hip and knee replacements**

Joint type	Procedure type	CJRR data standard	
		Pre-MDS (until 2011–2012)	MDS (2012–2013 onward)
<b>Hip</b>	Partial hip replacement	Identified as hemiarthroplasty by the data submitter	Identified as such by the data submitter
	Hip resurfacing	Identified through femoral head and acetabular component catalogue numbers	Identified as such by the data submitter
	Total hip replacement	Not otherwise identified as partial or resurfacing hip replacement  AND  At least 1 of the femoral components or femoral heads <b>and</b> at least 1 of the acetabular components or acetabular liner are used	Identified as such by the data submitter
<b>Knee</b>	Partial knee replacement	Identified as unicompartmental arthroplasty by the data submitter	Identified as such by the data submitter
	Total knee replacement	Not otherwise identified as partial replacement  AND  A femoral component, a tibial component and a patellar component are used	Identified as such by the data submitter

## Appendix C: 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-specific rate*

An age-specific rate is the rate measured in a particular age group. The numerator and the denominator for this rate refer to the same age group, that is, both have the same age distribution.

### *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.

### *bearing surfaces*

Bearing surfaces refer to the type of material used for the hip prostheses (i.e., femoral and acetabular components). Surface types include cobalt chrome, stainless steel, metal, ceramic alumina, standard polyethylene and cross-linked polyethylene.

### *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 replaced, they are fixed to securely position the joint and allow for natural bone growth. 3 major categories of fixation methods were analyzed in this report for both hip and knee replacements:

- **Cemented:** The components involved (femoral and acetabular for hip; femoral, tibial and patellar for knee) are fixed by bone cement.
- **Cementless:** None of the components are cemented (e.g., screws are used).
- **Hybrid:** 1 component is cemented and the other is not.

### *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.

*hip resurfacing (surface replacement)*

Hip resurfacing is a type of hip replacement. It is a bone-conserving alternative to conventional total hip replacement in which the femoral head is resurfaced with a metal cap (a conventional replacement removes the femoral head and replaces it with a metal prosthesis) and the neck, stem and acetabulum (socket) are relined with a metal cup-shaped implant.

*interquartile range (IQR)*

The interquartile range is a measure of variability, being equal to the difference between the third and first quartiles.

*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 (knee cap) 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 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.

*most responsible diagnosis*

The principal or primary diagnosis relating to the patient's admission to the hospital is reported on the discharge abstract that is submitted to CIHI. The most responsible diagnosis captures the key reason for the patient's admission to the hospital. This helps define the exact cause or reason for a patient's hip or knee replacement procedure.

*osteolysis*

Osteolysis is an active process of bone breaking down and dissolving.

*osteonecrosis*

In Greek, osteonecrosis means "death of bone," often as a result of obstruction of its blood supply.

*partial hip replacement (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.

*poly wear*

"Poly wear" is short for polyethylene wear. The patterns of poly wear include deformation, delamination, breakage, pitting, abrasion and third-body wear.

*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 1 or more hip or knee components as necessary.





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