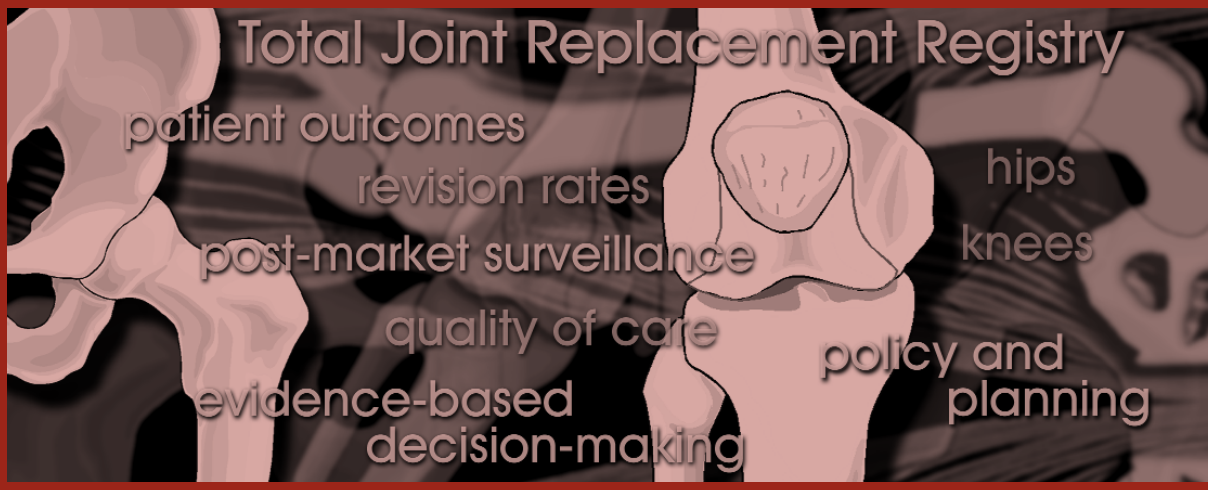
(CJRR) CANADIAN JOINT REPLACEMENT REGISTRY



2004 REPORT

TOTAL HIP AND TOTAL KNEE REPLACEMENTS IN CANADA

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

Canadian Joint Replacement Registry (CJRR)
2004 Report

Total Hip and Total Knee Replacements in Canada

Canadian Institute for Health Information
377 Dalhousie Street
Suite 200
Ottawa, Ontario
K1N 9N8

Telephone: (613) 241-7860
Fax: (613) 241-8120
www.cihi.ca

ISBN 1-55392-368-5 (PDF)

Cette publication est disponible en français sous le titre : « Registre canadien des remplacements articulaires (RCRA) — Rapport de 2004, Arthroplasties totales de la hanche et du genou » ISBN 1-55392-369-3 (PDF)

Acknowledgements

The CJRR team at CIHI would like to acknowledge the orthopaedic surgeons across Canada who contributed to the successful implementation of the CJRR through their diligent submission of surgical data to the registry. In particular, we wish to express our sincere thanks and appreciation to the members of the CJRR Advisory Committee and the CJRR Research and Development Subcommittee for providing invaluable expert advice on the development of the registry and this report.

Dr. William K. Beveridge
Provincial Representative
Valley Regional Hospital
Nova Scotia

Dr. Eric R. Bohm
Provincial Representative
St. Boniface General Hospital
Manitoba

Dr. Robert Bourne
Chair—CJRR Advisory Committee
London Health Sciences Centre
Ontario

Dr. Calab Emerson Brooks
Provincial Representative
Prince Edward Island

Dr. Ken L. Brown
Provincial Representative
British Columbia's Children's Hospital

Dr. Dalton Dickinson
Provincial Representative
Fredericton Medical Clinic
New Brunswick

Dr. Michael Dunbar
Director of Orthopaedic Research
Queen Elizabeth II Health Sciences Centre
Nova Scotia

Dr. Nicolas Duval
Le Pavillon des Charmilles
Quebec

Dr. Olga L. Huk
Provincial Representative
Sir Mortimer B. Davis—
The Jewish General Hospital
Quebec

Dr. Hans Kreder
Sunnybrook and Women's College Health
Sciences Centre
Ontario

Dr. Andreas Laupacis
President and Chief Executive Officer
Institute for Clinical Evaluative Sciences

Dr. Brendan Lewis
Western Memorial Hospital
Newfoundland and Labrador

Dr. Barry Ling
Polyclinic
Prince Edward Island

Dr. James MacKenzie
Rockyview Hospital
Canadian Orthopaedic Foundation
Representative
Alberta

Dr. Yang Mao
Health Canada Population and Public Health
Branch

Dr. Rod Martin
Provincial Representative
Health Care Corporation of St. John's
Newfoundland

Dr. Bas Masri
Vancouver General Hospital
British Columbia

Mr. Denis Morrice
President and Chief Executive Officer
Arthritis Society of Canada

Dr. Timothy J. Pearce
Provincial Representative
Red Deer Regional Hospital
Alberta

Dr. David Petrie
Regional Representative—Atlantic Provinces
Queen Elizabeth II Health Sciences Centre
Nova Scotia

Mr. John Pipe
Patient Representative
Ontario

Dr. Cecil Rorabeck
Chair, CJRR Research and Development Subcommittee
London Health Sciences Centre
Ontario

Dr. Robert Russell
James Paton Memorial Hospital
Newfoundland and Labrador

Dr. William A. Silver
Provincial Representative
Saskatchewan

Dr. Sandra Taylor
Director of Bioethics
Queen's University
Ontario

Dr. James Waddell
Canadian leader, Bone and Joint Decade
St. Michael's Hospital
Ontario

Ms. Susan Warner
Managing Director
The Ontario Joint Replacement Registry

The 2004 CJRR report was developed at CIHI under the direction of Nizar Ladak, Director of Health Services Information, by:

Nicole de Guia, Consultant, Joint Replacement and Trauma Registries
Dereck Cyrus, Senior Analyst, CJRR
Sukanya Gopinath, Senior Analyst, CJRR
Greg Webster, Director, Research and Indicator Development

Data entry of CJRR surgical forms and follow-up on quality-related issues were provided by Ann Baker, CJRR Quality Assurance Assistant and CJRR Data Entry Clerks Sharon Meade and Margaret Tom-Kun. The CJRR data entry application and database were developed by a CIHI team led by Herbet Brasileiro, Consultant, Applications Development, Health Services under the direction of Manager, Isabel Tsui.

The CJRR also thanks the CIHI Publication and Translation teams for assisting with formatting, layout and translation.

All questions regarding this report should be directed to:

Canadian Joint Replacement Registry
90 Eglinton Avenue East, Suite 300
Toronto, Ontario
M4P 2Y3
Telephone: (416) 481-2002
Fax: (416) 481-2950
e-mail: cjrr@cihi.ca

Canadian Joint Replacement Registry (CJRR)
2004 Report
Total Hip and Total Knee Replacements in Canada

Table of Contents

Executive Summary i

Introduction 1

Background 2

Canadian Joint Replacement Registry 2

- Description 2
- Why a National Joint Replacement Registry? 4
- Benefits of the CJRR 5
- Participation in the CJRR 6

Methodology 9

- Concepts and Definitions 9
- Data Sources 11
- Major Methodological Changes From Previous Years 16
- Revision History 17
- External Comparability 17
- Summary of Methodological Notes 18

Results 19

- Overall Trends 19
- Provincial/Territorial Variations 23
- Patient Demographics 30
- Inter-Provincial/Territorial Movements 35
- Length of Hospital Stay 38
- Inhospital Mortality 40
- Surgical and Clinical Characteristics 41

Discussion 55

Future Directions 56

References 59

Apendix A—Glossary A–1

Appendix B—Additional Tables and Figures B–1

Executive Summary

The purpose of the CJRR 2004 annual report is to characterize the basic epidemiology of total hip and total knee replacement surgeries performed in Canada according to person (patient demographics), place (provincial and national level data) and time, as well as selected surgical and clinical parameters.

Hip and knee replacement surgery can provide significant pain and disability relief and considerable improvement in a patient's functional status and quality of life. These benefits extend to all age groups, including patients over the age of 80 years. An aging population contributes to an increase in total hip and total knee replacement procedures. In addition, new technologies are emerging in the surgical treatment of arthritis and arthritis-related disorders. These factors will likely increase the demand for surgery.

Canadian Joint Replacement Registry (CJRR)

The CJRR is a national registry that collects information on total hip and total knee replacement surgeries performed in Canada and follows joint replacement recipients over time to monitor their outcomes, including revision rates. The ultimate goal of the CJRR is to improve the quality of care and clinical outcomes of joint replacement recipients through post-market surveillance of orthopaedic implants, improving the quality of surgical practices and the study of risk factors affecting outcomes.

Participation in the CJRR has been steadily increasing since orthopaedic surgeons began submitting operative data in May 2001. As of September 2003, 63% of orthopaedic surgeons performing total hip and total knee replacement surgery in Canada were participating in the registry. Surgeons from outside Ontario submit their data directly to the CJRR. Orthopaedic surgeons in Ontario submit their data to the Ontario Joint Replacement Registry (OJRR), an initiative funded by the Ontario Ministry of Health and Long-Term Care (MOHLTC) that is based at London Health Sciences Centre. Data from the OJRR is forwarded to CJRR.

Methodology

Joint replacement data for this report are obtained from four sources, namely non-Ontario orthopaedic surgeons participating in the CJRR, Ontario surgeons participating in the OJRR, and two hospital separation databases managed by the Canadian Institute for Health Information (CIHI), the Hospital Morbidity Database and the Discharge Abstract Database (DAD).

Surgical and orthopaedic implant data presented in this report are based on the 16,819 submissions by surgeons participating in the CJRR for patients admitted for surgical procedures between April 1, 2002 and March 31, 2003 (2002–2003). This dataset is three times larger than the data source for last year's CJRR report, reflecting the increase in CJRR participation and the addition of Ontario data via the OJRR.

Results

Overall Trends

There were 44,856 total hip and total knee replacements performed in Canada in 2001–2002, of which 44,792 were performed on Canadian residents. The latter number represents a seven-year increase of 39.3% from 32,147 procedures in 1994–1995 and a one-year increase of 4.4% from 42,917 procedures in 2000–2001.

In 2001–2002, among Canadian residents, 24,815 total knee replacements were performed compared to 19,977 total hip replacements. Since 1996–1997, the number of total knee replacements has annually surpassed the number of total hip replacements, and the gap has been increasing over time. Compared to 1994–1995 numbers, the number of total knee replacements in 2001–2002 increased by 61.6%, with a 7.3% increase compared to the previous year. In contrast, the number of total hip replacements increased by 19.0% compared to 1994–1995, with a 1.0% increase compared to the previous year.

Provincial/Territorial Variations

Provincial variations in joint replacement rates were observed across the country. Alberta and Saskatchewan residents had the highest age-standardized total hip replacement rates (72.2 and 69.0 per 100,000 population, respectively), whereas Quebec and Newfoundland and Labrador residents had the lowest rates (39.3 and 38.6 per 100,000 for each). For total knee replacement rates, Manitoba and Ontario had the highest rates (96.0 and 90.5 per 100,000 population), while Newfoundland and Labrador and Quebec had the lowest (44.5 and 39.2 per 100,000 population). Rates from the Territories are not reported due to small numbers.

Patient Demographics

Women were more likely to have a total hip replacement procedure compared to men in 2001–2002 (the age-standardized rate for women was 60.1 per 100,000 compared to 53.8 for men). Women (80.4) also had a higher rate of knee replacement compared to men (63.5). In 2001–2002, among total hip replacement recipients, 57.7% were female, and 42.3% were male. Among total knee replacement recipients, 60.5% were female, and 39.5% were male.

The majority of total hip and total knee replacements were performed on patients aged 65 years of age and older (66.2% and 70.7%, respectively). The mean age of a patient who underwent a total hip replacement in Canada was 67.9 years (69.3 years for females and 65.9 years for males) in 2001–2002. In contrast, only 5.2% of patients who underwent a hip replacement were younger than 45 years of age. For total knee replacement patients, the mean age was 69.0 years (69.2 years for females and 68.7 years for males) in 2001–2002. Only 1.4% of patients who underwent a knee replacement were younger than 45 years of age.

Since 1994–1995, significant increases in age-sex specific rates have occurred for total knee replacement procedures, ranging from 28.8% to 108.4%. Although the highest age-sex specific rate was in the 75 to 84 age group (483.3 per 100,000 among men and 540.7 per 100,000 among women), the rate among persons aged 45 to 54 had increased by 78.9% among men and more than doubled among women (a 108.4% increase). The number of total knee replacements performed on people aged less than 55 years rose by 119.3% (up from 938 to 2,057) between 1994–1995 and 2001–2002.

For total hip replacement procedures, the highest age-sex specific rate was in the 75–84 age group (373.2 per 100,000 among men and 443.8 per 100,000 among women). Compared to 1994–1995 levels, the highest rate increase occurred in the 85+ age group (18.4% and 18.7% for men and women, respectively).

Length of Stay

There has been a decrease in average length of stay for these procedures since 1994–1995. For total hip replacements, the average length of stay decreased by 28.7% from 13.6 days in 1994–1995 to 9.7 days in 2001–2002. For total knee replacements, the average length of stay decreased by 36.9% from 12.2 to 7.7 days for the same period. Between 2000–2001 and 2001–2002, the average length of stay fell by 4.0% from 10.1 to 9.7 days for total hip replacements and fell by 7.2% from 8.3 days to 7.7 days for total knee replacements.

Inter-Provincial/Territorial Movements

With the exception of Yukon Territory and Nunavut, the majority of patients had their surgeries done in their home province. Residents of the Northwest Territories and Prince Edward Island were next most likely to have their hip replacements performed in another province. Next to Yukon Territory and Nunavut residents, residents of the Northwest Territories were most likely to have their knee replacements performed in another province.

Inhospital Mortality

Post-operative inhospital mortality is a relatively rare event among recipients of a total hip or total knee replacement. Overall, the mortality rate of total hip and total knee replacement patients was 0.8% and 0.2%, respectively.

Surgical and Clinical Characteristics

Degenerative osteoarthritis was the most common diagnosis resulting in the need for a primary total hip replacement (81%) and a primary total knee replacement (93%). Other common diagnoses were osteonecrosis, inflammatory arthritis and post-traumatic osteoarthritis.

The most common reasons for requiring a revision to a total hip replacement were aseptic loosening (55%), osteolysis (33%), poly wear (30%) and instability (17%). Among knee replacement revisions, the top four reasons were the same: aseptic loosening (39%), poly wear (36%), instability (26%) and osteolysis (20%).

The most common surgical approach among total hip replacement surgeries was the direct lateral approach. Approximately half (51%) of procedures involved the use of this technique. Other common approaches were the anterolateral (27%), and the posterolateral (22%) surgical approaches. Among total knee replacement surgeries, the most common approach was by far the medial approach (86% of surgeries).

Discussion

The CJRR 2004 Annual Report makes use of multiple data sources to highlight important trends and regional variations for total hip and knee replacements across Canada. This information will be useful to decision-makers involved in managing health care systems and for orthopaedic surgeons and related care providers. The surgical data also provides surgeons with a valuable tool to use in improving their practices and related patient outcomes. The CJRR's success to-date is in large part due to the collaborative work of the many partners involved.

Participation in the CJRR has increased significantly, primarily due to the addition of Ontario Joint Replacement Registry (OJRR) data to the CJRR. Ontario is estimated to have one third (34%) of orthopaedic surgeons in Canada who conduct hip and knee replacements. With over 7,500 additional procedures from the OJRR, Ontario data now comprises almost half (45%) of the CJRR's 2002–2003 dataset. Participation has also increased among orthopaedic surgeons outside of Ontario, with a 20% increase in numbers since 2002. In total, 454 orthopaedic surgeons performing total hip and total knee replacement surgeries now participate in the CJRR.

Significant increases were evident in both the number and rate of total knee replacement surgeries. Compared to 1994–1995, the number of total knee replacements in 2001–2002 was 61.6% higher, and the rate was 43.4% higher. In comparison, the number of total hip replacement surgeries increased by 19.0% and the rate by 4.4%.

The CJRR data presented in this report highlight several important variations in the rates and lengths of stay for total hip and knee replacements across Canada. The CJRR can be used to dig deeper into these issues to gain a better understanding of the reasons for these variations. Furthermore, the CJRR can be used inform decisions and policies intended to improve access to these services and to promote better long-term outcomes for the patients who need these services.

Although it will take several years before the CJRR can calculate long-term revision rates, the registry in the near future will be able to measure and monitor short-term revision rates by following patients over time and conducting post-market surveillance of orthopaedic implants. Also in the future, the CJRR will be exploring ways to measure wait times for these surgeries and determining what is required to report on these wait times across Canada, currently a significant information gap. Wait times for hip and knee replacement surgeries are already available publicly in some provinces. Data on prioritization, illness severity, and patient follow-up and satisfaction may also be explored as additional components for inclusion in the CJRR.

Copies of the 2004 report can be purchased through the CIHI Order Desk at www.cihi.ca. Copies of the Executive Summary, media release and recent bulletins can be downloaded free of charge from the CJRR Web site (www.cihi.ca/cjrr). Queries regarding this report may be addressed to cjrr@cihi.ca.

Introduction

This is the third annual report produced by the Canadian Joint Replacement Registry (CJRR). The first annual report was published in January 2002 and the second in January 2003. A supplementary report was released in October 2002.[1, 2] The aim of this report is to characterize the basic epidemiology of total hip and total knee replacements performed in Canada according to person (patient demographics), place (provincial and national level data) and time, as well as selected surgical and clinical parameters. Joint replacement data for this report are obtained from four sources: orthopaedic surgeons from outside Ontario who submit data directly to the CJRR; Ontario Joint Replacement Registry (OJRR) data; and two hospital separation databases managed by the Canadian Institute for Health Information (CIHI)—the Hospital Morbidity Database and the Discharge Abstract Database (DAD).

The CJRR is a national registry that collects information on total hip and total knee replacement surgeries performed in Canada and follows joint replacement recipients over time to monitor their outcomes (including revision rates). The ultimate goal of the CJRR is to improve the quality of care and clinical outcomes of joint replacement recipients through post-market surveillance of orthopaedic implants, improvement in the quality of surgical practices and the study of risk factors affecting outcomes.

The CJRR is a joint effort between CIHI and the orthopaedic surgeons of Canada. This initiative was championed by CIHI and orthopaedic surgeons from each province who were working under the auspices of the Canadian Orthopaedic Association and the Canadian Orthopaedic Foundation. A number of other key partners contributed to the successful development and implementation of the CJRR including the federal, provincial and territorial ministries of health, the Arthritis Society, the Canadian Arthritis Network and the OJRR.

Background

Total joint replacement surgery has evolved substantially since 1938, when the notion of total hip arthroplasty was first introduced. Replacement of a diseased hip can provide significant pain relief and considerable improvement in a patient's functional status and quality of life.[3] Following a total knee replacement, patients can expect significant improvements in mobility, well-being and emotional status, a relief from severe pain and disability associated with knee arthritis.[4] These benefits extend to all age groups, including patients over the age of 80 years.[4] New technologies are emerging in the surgical treatment of arthritis and arthritis-related disorders.[5] These factors will likely increase the demand for surgery. However, access to these procedures may be influenced by the availability of human resources, as well as operating room space and restrictions on procedure volumes by hospital administrations.[5]

Among Canadian residents, 44,792 total hip and total knee replacements were performed in 2001–2002, compared to 32,147 procedures in 1994–1995, representing a 39% increase over this period. This upward trend in the absolute number of surgeries is paralleled by an increase in the age-standardized rates for total hip and total knee replacements, which increased by 4.4% and 43.4%, respectively, during the same time period. The consistent upward trend in age-adjusted rates over time indicates that an aging population is not the only factor leading to an increase in the number of procedures performed annually.

Canadian Joint Replacement Registry

Description

The CJRR is a national registry that collects information on patient outcomes and revisions following total hip and total knee replacement procedures performed in Canada. The registry was officially launched at the Canadian Orthopaedic Association annual meeting in June 2000 and has been receiving data since May 2001. The CJRR, which is managed by CIHI, was modelled after the Swedish hip and knee replacement registries, which have been operational since 1975 and 1979, respectively. A brief history of the development of the CJRR is outlined in Table 1.

Table 1. Development of the CJRR

Milestones	Date
1. Proposal and planning	1995
2. Feasibility study and report (Phase 1)	May 1996
3. Pilot study and report (Phase 2)	August 1997
4. Launch of the CJRR at the COA 2000 annual meeting	June 2000
5. Start of data submission	May 2001
6. First annual CJRR report	January 2002
7. CJRR surgeon participation rate exceeds 50%	July 2002
8. Supplementary CJRR report	October 2002
9. Second annual CJRR report	January 2003
10. OJRR data submitted for first time to the CJRR	July 2003
11. Third annual CJRR report	March 2004

Prior to surgery, patients are asked to provide consent to have their surgical information included in the CJRR. Once written patient consent is obtained, a two-page data collection form is filled out by the surgeon and/or operating room staff. It captures information on patient demographics, the type of replacement, reason for replacement, surgical approach, fixation mode, implant types, antibiotic use, deep vein thrombosis prophylaxis and operating room environment. The data collection forms are mailed directly to CIHI (in a confidential and secure manner), where data verification and data entry are completed. Joint replacement data are then analyzed in conjunction with administrative hospital data held at CIHI from the Hospital Morbidity Database and the Discharge Abstract Database (DAD).

At publication time, only the province of Ontario had an operational provincial joint replacement registry, the Ontario Joint Replacement Registry (OJRR). Orthopaedic surgeons in Ontario participate in the CJRR through the OJRR. Surgeons in all other provinces submit operative data directly to CIHI. Surgical information in Ontario is collected via hand-held computers in the operating room. The flow of data collection in the CJRR is shown in Figure 1.

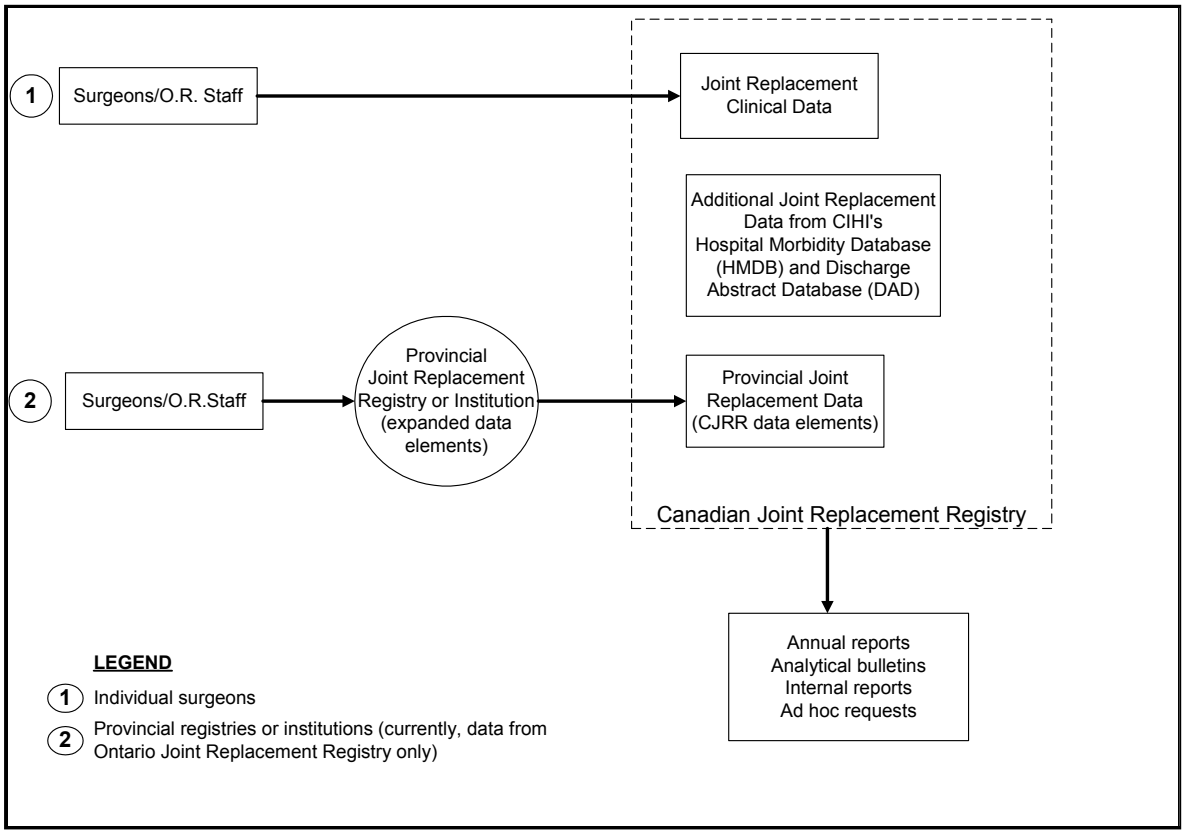


Figure 1. Canadian Joint Replacement Registry (CJRR) Data Flow Diagram

Privacy and confidentiality of patients and surgeons are assured. As custodian of numerous registries and databases, CIHI has stringent policies for ensuring that the privacy, confidentiality and security of its data holdings are protected. For more information on CIHI's privacy and confidentiality policies and procedures, visit the CIHI Web site at www.cihi.ca.

Why a National Joint Replacement Registry?

Before the CJRR, detailed surgical data on total hip and total knee replacements were not routinely collected nationally. Therefore, the relative effectiveness of various surgical techniques, operating room environments, practices around antibiotic use and prevention of deep vein thrombosis—as well as fixation methods on clinical outcomes and implant survival—could not be determined. Similarly, the relative effectiveness of currently available hip and knee implants is largely unknown. Although there has been a proliferation of orthopaedic implants in the last two decades, post-market surveillance of these devices has not previously been carried out on an ongoing, systematic basis in Canada.

The CJRR captures revision operations and reasons for revisions and follows joint replacement recipients over time to monitor their outcomes. This information will enable CIHI to calculate revision rates and determine the most common identified reasons for revisions. Through focused analyses of revisions, reasons for revisions and other factors related to the patient, to the implant and to the surgical technique, risk factors that predict revisions can be identified, which in turn, may contribute to decreasing the number of revisions.

Although Health Canada has a process in place for the evaluation and approval of medical devices prior to their release in the field, post-market surveillance of medical implants and new technologies is largely lacking in Canada. Longitudinal follow-up of joint replacement recipients registered in the CJRR will help delineate the reasons for and variables affecting implant survival, thus providing an effective mechanism for post-market surveillance of orthopaedic implants. A 1996 editorial in the *British Medical Journal* called for the development of a national arthroplasty registry in the UK and identified it as the best method for assessing orthopaedic implants.[6] The author argued that a minimum follow-up of 10 years is usually required to ascertain the effectiveness of an implant. With the exception of the Charnley low-friction arthroplasty, no other prosthesis has had a long-term follow-up in the UK. The UK National Joint Replacement Registry is now in the consultative stages of development. The CJRR will provide valuable information on implant performance to surgeons in Canada and internationally.

Benefits of the CJRR

With almost 45,000 total joint replacements performed annually in Canada, the CJRR will be one of the largest arthroplasty registries in the world, with great potential to follow a significant number of joint replacement recipients over time. Large numbers are often needed to detect changes in trends, as well as provincial variations in procedure rates and lengths of stay. Additionally, a large sample size is necessary to carry out meaningful analyses of association and prediction.

Demographic information on patients is limited in existing data holdings collected from hospital discharge abstracts in Canada. The CJRR captures detailed patient demographics, allowing us to characterize the profile of joint replacement recipients and link this to clinical outcomes.

CJRR data can be linked with other CIHI holdings, such as the Hospital Morbidity Database and the DAD, to determine average lengths of stay, re-admissions (including reasons for re-admission), inhospital mortality and other clinical interventions while in hospital, such as blood transfusion.

Patient Benefits

The ultimate goal of the CJRR is to improve the quality of care and clinical outcomes of joint replacement recipients in Canada. Lowering the risk for revisions through optimal surgical techniques and effective orthopaedic implants can result in better patient care, better surgical outcomes and better health system efficiency. The CJRR will also be measuring patient wait times, functional status following surgery and patient satisfaction in future years.

Surgeon Benefits

Over time, the CJRR will provide information to surgeons for evidence-based decision-making with respect to patient prioritization, surgical technique and implant selection—all of which may improve the quality of total hip and total knee replacement surgery. Surgeons and institutions participating in the registry will receive regular feedback and comparative reports and analyses. The CJRR will also provide a credible source of information for use in policy and planning decisions.

Participating surgeons can earn Continuing Professional Development (CPD) credits by submitting operative data to the CJRR and reviewing regular CJRR feedback reports. Submission of six completed data collection forms to CIHI will earn each surgeon one credit under activities outlined in Section 6 (Educational Development, Teaching and Research) of the CPD Framework of the Maintenance of Certification Program. The CJRR team at CIHI provides surgeons with regular updates on the number of CPD credits earned through their participation in the CJRR.

Benefits for the Health-Care System

Information from the CJRR will aid in the development of evidence-based practice and/or guidelines for total hip and total knee replacement surgeries in Canada. The application of these evidence-based practices will improve the outcomes of these surgeries through a decrease in subsequent morbidity among joint replacement patients and will provide system-wide cost savings.

Participation in the CJRR

CJRR participation is tracked and reported as the percent of eligible surgeons who have agreed to submit data to the CJRR and as the estimated percent of surgeries for which data have been submitted (see Table 3, later in this report). Surgeons performing total hip and knee replacement during the reporting period are considered eligible to participate in the CJRR. The CJRR project team works with orthopaedic surgeons across the country to identify all eligible surgeons and records their agreement to participate.

Surgeons in Ontario participate in the CJRR through the Ontario Joint Replacement Registry (OJRR), which is separately funded by the Ontario Ministry of Health and Long-Term Care (MOHLTC) and hosted by the London Health Sciences Centre.

Surgeon Participation Trends

Data collection from surgeons began in May 2001. As shown in Figure 2, between December 2001 and October 2002, the number of participating surgeons increased from 139 to 250 surgeons, an increase of 80%. In September 2003, the number of non-Ontario participating surgeons increased to 285, an increase of 20% compared to 2002.

In July 2003, OJRR data were transferred to the CJRR for the first time, resulting in a dramatic increase in CJRR participation with the addition of 169 OJRR surgeons, who now contribute data to the CJRR. At the time of publication, there were 454 surgeons enrolled in the CJRR, of whom 37% were from Ontario.

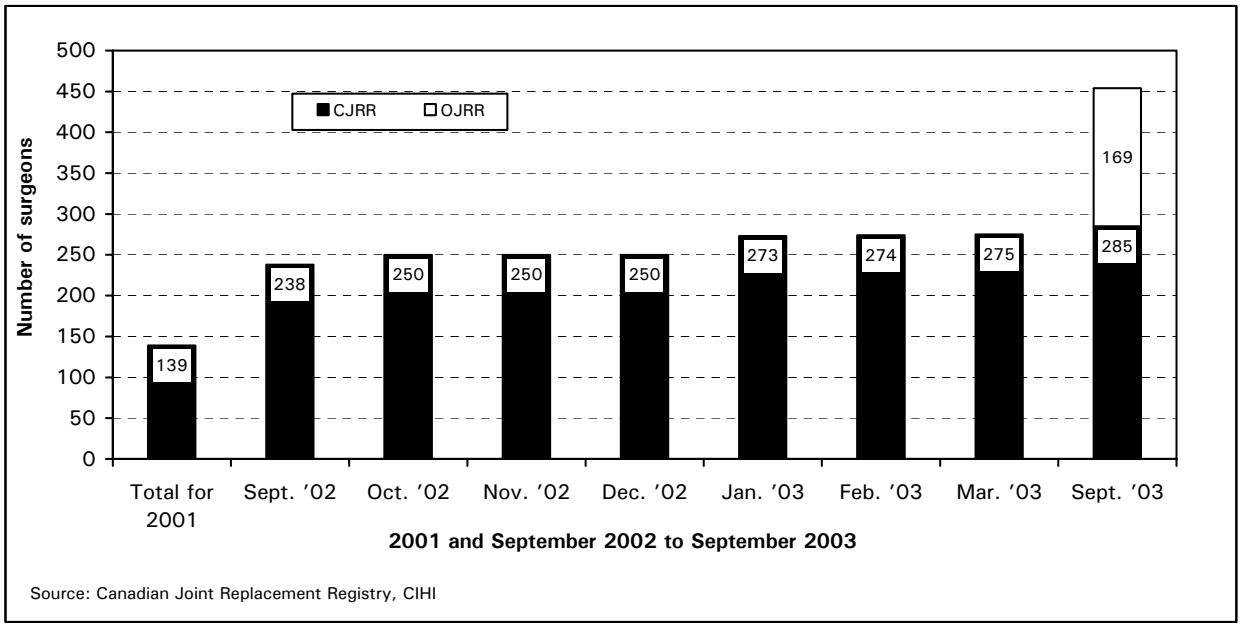


Figure 2. Number of CJRR Participating Surgeons for 2001 and from September 2002 to September 2003

Surgeon Participation by Province

Table 2 shows participation statistics by province, compared to the estimated number of surgeons performing total hip and knee replacement procedures at the end of September 2003. The CJRR's overall participation rate is estimated at 63%, and is heavily weighted by the provinces that have the largest number of surgeons (Ontario, Quebec, British Columbia and Alberta, respectively). Together, these provinces account for approximately 83% of orthopaedic surgeons performing total hip and knee replacements in Canada and 78% of all CJRR participating surgeons. Participation rates by province and territory range from 44% in Quebec to 100% in New Brunswick, Nova Scotia and the Northwest Territories.

CJRR provincial representatives and numerous site leaders have been instrumental in promoting the benefits of the registry and, by extension, increasing surgeon participation and commitment for submitting operative data to the CJRR in their respective provinces.

Table 2. CJRR Surgeon Participation by Province as of September 2003

Hospital province	Surgeons signed up to participate	Estimated number of surgeons[1]	% participation
British Columbia	63	109	58%
Alberta	39	51	77%
Saskatchewan	17	29	59%
Manitoba	19	27	70%
Ontario	169	245	69%
Quebec	82	185	44%
New Brunswick	26	26	100%
Nova Scotia	23	23	100%
Prince Edward Island	3	4	75%
Newfoundland and Labrador	12	15	80%
Yukon Territory	N/A	0	N/A
Nunavut Territory	N/A	0	N/A
Northwest Territories	1	1	100%
Total	**454**	**715**	**63%**

[1] Estimates based on information provided by CJRR provincial representatives.
N/A—Not applicable (no practicing orthopaedic surgeons)

Methodology

Concepts and Definitions

The purpose of the CJRR is to collect national information on total hip and total knee replacement surgeries in Canada. The definitions of total hip and total knee replacements and revisions are provided in Appendix A—Glossary.

To permit comparisons over time, primary and revision surgeries, as well as elective and emergency surgeries, are included in the analyses for all years of data. In 2001–2002, the proportion of total hip replacements and total knee replacements that were revisions is estimated at 11.3% and 7.9%, respectively (excluding Quebec). The estimated proportion of total hip replacements and total knee replacements that are performed on an emergency basis is 6% and 1%, respectively.

Population Reference Period

Surgical and clinical data presented in this report are based on total hip and total knee replacement surgeries and revisions performed in Canada on patients admitted between April 1, 2002 and March 31, 2003 (2002–2003).

Hospital morbidity data reported in this document are for total hip and knee replacement surgeries and revisions performed in Canada on patients discharged between April 1, 2001 and March 31, 2002 (2001–2002). Additional years of data are also reported for trending purposes. Analyses presented in this report are based on Canadian residents only, with the exception of length of stay and inhospital mortality analyses, which report on all procedures regardless of residence.

Geographical Reporting

For most of the Hospital Morbidity Database analyses in this report, the reported province is based on where the patient resides, not where the procedure was performed. Patient geography was assigned based on postal code using the July 2003 Postal Code Conversion File, which is updated semi-annually by Statistics Canada. Patients with incomplete postal codes were included in the provincial and national count and rate calculations, whereas out-of-Canada residents, or those with unknown or invalid residence codes, were excluded.

For the clinical and surgical data presented in this report, the reported province is based on where the procedure was performed, not where the patient resides.

Rate Reporting

Unless otherwise indicated, rates presented in this report are age-standardized; that is, they are adjusted for variations in age structure over populations differing by geography or over time. Sex-specific rates are reported because there are considerable differences in rates of total hip and total knee replacements between males and females.

For the calculation of rates, national and provincial fiscal population estimates (October 1) are used. These are special order tabulations provided by the Demography Division of Statistics Canada.

For age-standardized rates, the 1991 Canadian population was used as the standard.

Procedure Codes for Hip and Knee Replacement

To identify a hip or knee replacement procedure in the Hospital Morbidity Database and the Discharge Abstract Database (DAD), specific procedure codes were extracted based on the relevant coding classification system. In fiscal year 2001–2002, data were collected in one of three coding classification systems: ICD-10-CA/CCI,* ICD-9-CM, and ICD-9/CCP. ICD-10-CA/CCI is a new coding classification system that is replacing ICD-9-CM and ICD-9/CCP across Canada. It is much more detailed compared to its predecessors and is being implemented in a staggered fashion across Canada. ICD-9-CM coded data are converted to ICD-9/CCP for the purposes of reporting. See Major Methodological Changes From Previous Years for more information on these important coding changes.

For total hip replacement procedures coded in the CCI classification, the rubric code of interest is 1.VA.53 *Implantation of internal device, hip joint*. This rubric code is broken down into more detailed subcategories: cement spacer, single component and dual component, and for each, whether the procedure was cemented or uncemented (even more detailed components in the latter). Only the dual component prosthetic device codes are of interest to this report, as these capture total (as opposed to partial) hip replacements: 1.VA.53.LA-PN (open approach) and 1.VA.53.PN-PN (robotics-assisted approach). In CCI, revisions are identified using a supplementary code called a Status Attribute, in which Status Attribute = R identifies that the procedure is a revision. It must be noted that for fiscal year 2001–2002, the coding of this attribute was optional and therefore the number of revision procedures may be underestimated. Coding of revisions will be mandatory beginning in fiscal year 2003–2004.

For total hip replacement procedures coded in the CCP classification, codes of interest are 93.51 *Total hip replacement with methyl methacrylate* and 93.59 O*ther total hip replacement.* Prior to fiscal year 2000–2001, these codes also included revisions. However, after April 1, 2000, revisions of a total hip replacement *cemented with methyl methacrylate* were assigned the CCP code of 93.52 and revision of a total hip replacement *uncemented* was coded 93.53. Therefore, when reporting total hip replacement procedures in this report, any of these four codes are identified. It must be noted that partial hip replacement procedures were captured in the code 93.69 *Other repair of hip*, which is not included in this report's analyses.

For total knee replacement procedures coded in CCI, the rubric 1.VG.53 for knee replacements refers to *Implantation of internal device, knee joint* and is broken down into cement spacer, single, dual, and tri-component prosthetic device categories, and each can be broken down into cemented or uncemented subcategories. For the first time, this classification permits the separation of "true" total knee replacements (dual and tri-component prosthetic device codes) from partial knee replacements (single component prosthetic devices and cement spacers). However, in order to maintain comparability with provinces using the older classification systems, all codes in rubric 1.VG.53 will be used to

* International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada and Canadian Classification of Health Interventions; ICD-9-CM 9th Revision—Clinical Modification; and ICD-9-CCP 9th Revision—Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures.

define total knee replacement procedures. As with hip replacement procedures coded in CCI, revisions are identified using the supplementary code Status Attribute = R. As mentioned earlier, it was optional to report this in fiscal year 2001–2002.

For total knee replacement procedures coded in CCP, the relevant codes are 93.41 *geomedic and polycentric total knee replacement* (until April 2000, these codes captured both primary and revision procedures) and 93.40 (after April 2000, this code was added to capture revision of a total knee replacement, cemented or uncemented).

Appendix Tables B.1 and B.2 provide all codes for hip and total knee replacement procedures, respectively, in the CCI and CCP classification system. Appendix Table B.3 shows the split between true partial versus total knee replacements using the CCI coding system.

Data Sources

Surgical and implant data presented in this report are submitted to the CJRR by orthopaedic surgeons participating in the CJRR (including Ontario surgeons participating via the OJRR). National and provincial numbers and rates of total hip and total knee replacements presented in this report are extracted from CIHI's Hospital Morbidity Database and DAD. All analyses were conducted using the SAS (version 8) statistical package.

Orthopaedic Surgeons

The surgical and clinical analyses presented in this report are based on 16,819 procedures on patients admitted between April 1, 2002 and March 31, 2003 and performed by orthopaedic surgeons participating in the CJRR. This dataset is three times larger than the data source for last year's CJRR report, reflecting the increase in CJRR participation and the addition of Ontario data via the OJRR. It is possible that surgeons participating in the CJRR differ from non-participating surgeons; therefore, results should not be generalized to all joint replacements performed in Canada.

Orthopaedic surgeons participating in the CJRR complete a two-page data collection form following a total hip or a total knee replacement surgery. Data collection forms and a list of data elements are available for download on the CIHI Web site at (www.cihi.ca/cjrr). Completed forms are couriered directly to CIHI in a confidential and secure manner. Data entry staff examine the data collection forms to ensure that patient consent is obtained and the form is adequately completed. If patient consent is not completed correctly or is missing other critical information, the data collection form is returned to the orthopaedic surgeon for completion or confirmation of patient consent. Once the data collection forms have been checked for patient consent and deemed complete, they are entered into the CJRR system (Oracle database). Currently, approximately 1,400 forms are submitted to the CJRR on a monthly basis. Ontario surgeons participate in the CJRR via the Ontario Joint Replacement Registry (see following section).

Standardized edit checks are applied to submitted forms upon entry into the CJRR database and are also applied to data received electronically (i.e. OJRR). These checks flag data elements which do not meet criteria for logic, value range and completeness. Error comments and reports are automatically generated and records are then classified as draft, incomplete or complete according to which edit checks were passed or failed. A record is classified as complete only if it successfully passes all edit checks. For electronic data submissions, erroneous cases are referred back to their source for review and correction. For paper data submissions, all records (regardless of classification) are included in order to maximize the information available for this report.

Beginning with the fiscal year 2002–2003 data, the CJRR team will conduct an annual comprehensive data quality evaluation of the data submitted from orthopaedic surgeons based on CIHI's Data Quality Framework.[7] The framework considers data quality from a user's perspective whereby quality is defined as "fitness-for-use." Fifty-eight questions are asked of the database that encompass five data quality dimensions of timeliness, usability, relevance, accuracy and comparability. Findings from this evaluation will be posted on the CJRR Web site.

Data Submission by Province

Figure 3 shows the distribution of submissions by province for total hip and knee replacement procedures received from orthopaedic surgeons for the 2002–2003 fiscal year. By far, orthopaedic surgeons from Ontario accounted for the greatest proportion of submissions (45%), followed by surgeons from Quebec (12%), British Columbia (10%) and Nova Scotia (9%).

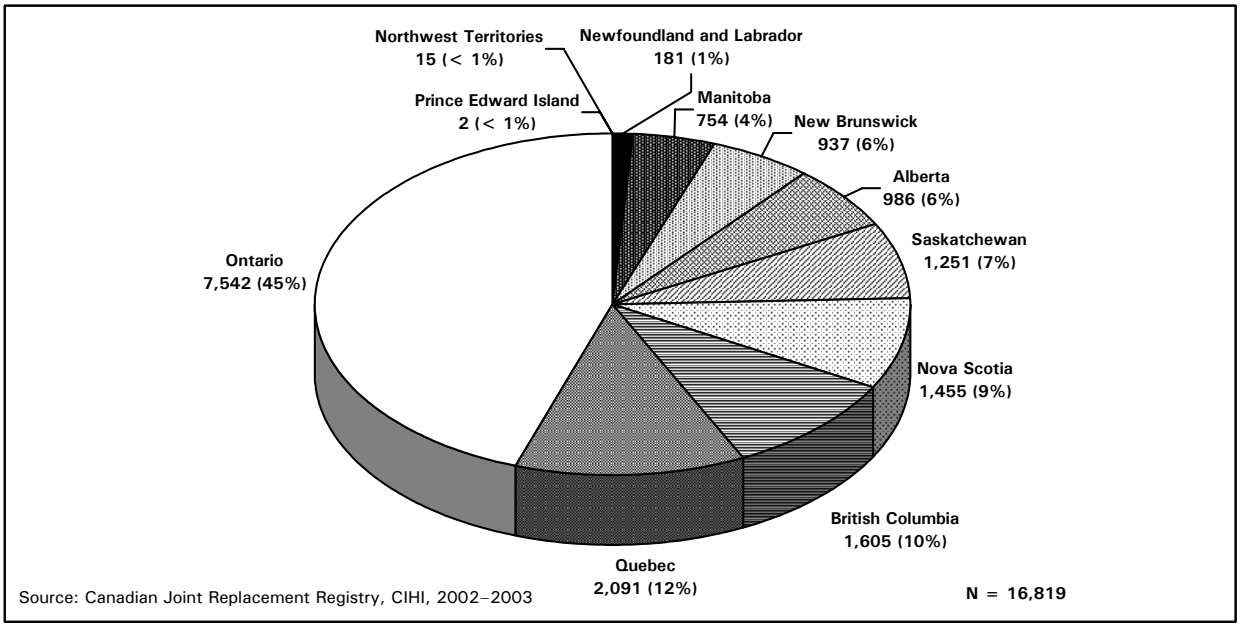


Figure 3. Number of Total Hip and Total Knee Replacement Procedures Submitted to CJRR by Province, 2002–2003

Ontario Joint Replacement Registry (OJRR)

The Ontario Joint Replacement Registry (OJRR) collects data from Ontario orthopaedic surgeons on hip and knee joint replacements at the time of surgery. The OJRR is funded by the Ontario Ministry of Health and Long-Term Care (MOHLTC)and made possible by the support of the orthopaedic surgeons of Ontario under the Ontario Orthopaedic Association and Ontario Ministry of Health Long-Term Care. The Registry is housed at the London Health Sciences Centre. The OJRR is being implemented on a region-by-region basis, beginning in Southwestern Ontario in May 2001. The OJRR is releasing its second data report, based on data collected between May 14, 2001 and March 31, 2003.[8]

For the first time in July 2003, the CJRR received a subset of OJRR data via the Ontario Ministry of Health and Long-Term Care for inclusion in the CJRR. Surgical and clinical data elements collected by the OJRR are greater in both scope and specificity compared to those of the CJRR. For instance, the OJRR collects data related to wait time and post-operative functional status scores.

Before a subset of the OJRR data could be provided, a mapping was conducted between the OJRR and the CJRR database elements. During this mapping exercise, there were several instances in which there was a higher level of detail in the OJRR data elements compared to those of the CJRR. When this occurred, the information was captured in the "Other" category or retained in the CJRR database as additional data elements for reference purposes. The number of CJRR data elements which could not be mapped constituted less than 2%. Analyses in this report do not include the latter data elements.

OJRR data were also subjected to CIHI's edit checks intended to identify potential errors such as out-of-range values and problems with data logic. These are standard edits performed on all raw data after entry into the CJRR database.

Ontario data incorporated in the CJRR are subject to revision as data from this report's fiscal year are still being corrected and submitted by orthopaedic surgeons to the OJRR. In the future, the OJRR will provide updated data to the CJRR from historical years in order to ensure that the Ontario data housed in both registries are up-to-date and consistent.

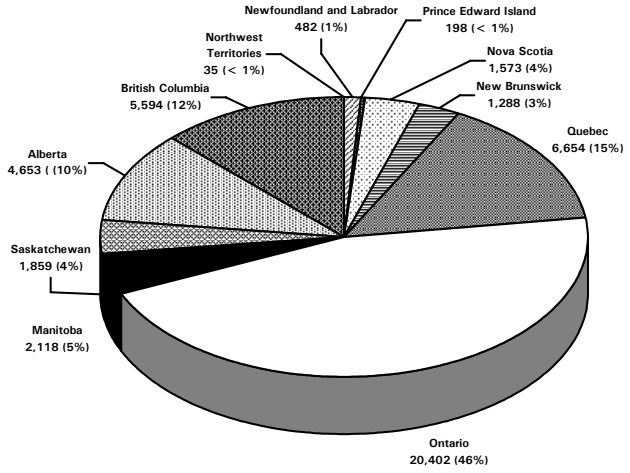
Hospital Morbidity Database

The Hospital Morbidity Database is managed by CIHI and provides the number of discharges (including deaths) from a hospital by primary diagnosis and contains all acute care discharges in Canada. This database contains a number of different clinical and demographic data, such as primary diagnosis, operation, admission date, discharge condition, total days stay and age and sex of the patient.

Data are received from general and allied special hospitals, including acute care, convalescence and chronic facilities (with the exception of Ontario) and are downloaded from the DAD for those provinces participating in DAD. Data for the remaining hospitals are submitted separately by the corresponding provinces and territories. The Hospital Morbidity Database captures 100% of acute care discharges in Canada.

The Hospital Morbidity Database has recently merged with the DAD. Beginning with fiscal year 2001–2002 data, the two databases share a common structure resembling that of the DAD. As a result, there have been changes to the way in which hip and knee replacements are reported (see Major Methodological Changes From Previous Years).

Figure 4 shows the number of total hip and total knee replacement procedures performed by hospital province.



Source: Hospital Morbidity Database, CIHI, 2001–2002

N = 44,856

Figure 4. Number of Total Hip and Total Knee Replacement Procedures Performed in Canada, by Province, 2001–2002

Table 3 compares the number and distribution of procedures captured in fiscal year 2002–2003 by orthopaedic surgeons compared to the total number and distribution of all procedures conducted in 2001–2002 according to the Hospital Morbidity Database. For provinces with large surgical volumes (Ontario, Quebec and British Columbia), the proportional representation is similar between the two data sources.

In terms of overall coverage, procedures captured by CJRR in 2002–2003 represent 38% of the volume of all procedures conducted in 2001–2002. Nova Scotia had the highest comparative captures (93%) while Prince Edward Island had the lowest (1%).

Table 3. Number of Total Hip and Total Knee Replacements Submitted to the CJRR (2002–2003 data) Relative to Data from the Hospital Morbidity Database (HMDB) (2001–2002 data)[1]

Hospital province	No. of CJRR replacements submitted in 2002–2003	Distribution of CJRR submissions in 2002–2003	No. of HMDB replacements performed in 2001–2002	Distribution of HMDB replacements performed in 2001–2002	2002–2003 CJRR submissions as % of HMDB replacements performed in 2001–2002
Newfoundland and Labrador	181	1%	482	1%	38%
Prince Edward Island	2	<1%	198	<1%	1%
Nova Scotia	1,455	9%	1,573	4%	93%
New Brunswick	937	6%	1,288	3%	73%
Quebec	2,091	12%	6,654	15%	32%
Ontario[2]	7,542	45%	20,402	46%	37%
Manitoba	754	4%	2,118	5%	36%
Saskatchewan	1,251	7%	1,859	4%	67%
Alberta	986	6%	4,653	10%	21%
British Columbia	1,605	10%	5,594	12%	29%
Northwest Territories	15	<1%	35	<1%	43%
Total	**16,819**	**100%**	**44,856**	**100%**	**38%**

[1] Counts are based on the locations of submitting acute care institutions conducting total hip and knee replacement procedures in Canada and include procedures performed on non-Canadian residents.
[2] Ontario surgeons participate in the CJRR via the OJRR.

Source: Hospital Morbidity Database 2001–2002, Canadian Joint Replacement Registry 2002–2003, CIHI

Discharge Abstract Database

This database contains demographic, administrative and clinical data for hospital discharges, including inpatient acute, chronic, rehabilitation and day surgeries. CIHI receives data directly from participating hospitals, which represent about 85% of all hospital inpatient discharges in Canada. The DAD is one of the primary data sources for the Hospital Morbidity Database.

Major Methodological Changes From Previous Years

Data from Orthopaedic Surgeons Presented for Latest Fiscal Year Only

In the previous CJRR annual report, analyses presented were based on all surgical and clinical data submitted from May 1, 2001 to September 30, 2002. Beginning with this annual report, data will be presented according to fiscal years. For this report, date of admission was chosen as a reference period over date of surgery because date of admission was provided more often than date of surgery. Although it is known that in Ontario the date of admission is generally the same as the date of surgery, it is not yet known what the pattern is for other provinces and territories.

Hospital Morbidity Database Adopts Discharge Abstract Database Structure

Beginning with the fiscal year 2001–2002 reporting period, which is presented in this report, the Hospital Morbidity Database has adopted the DAD structure. Although the two databases shared some common data elements, the DAD contained many more. As a result, some Hospital Morbidity Database elements and processes have been dropped or modified that impact on reporting in this annual report compared to that of previous years. One example is the analysis on length of stay, which previously was based on the tabulating procedure. In this report, the length of stay analysis was based on all hip or knee replacement patients in Canada.

For the purposes of analysis in this report, certain types of surgeries were excluded: surgeries coded as previous or abandoned surgeries and, beginning with 2001–2002 data, surgeries coded as being performed out-of-province were also excluded in order to avoid double-counting of cases.

Staged Adoption of ICD-10-CA/CCI Coding Classification Across Canada

ICD-10, the new international classification and coding system, is replacing ICD-9 and ICD-9-CM in many countries in the world. CIHI developed a Canadian modification of this coding classification (ICD-10-CA) and developed a Canadian Classification for Interventions (CCI) to be implemented among hospital separation data beginning with April 1, 2001 discharges. As the decision to adopt this new classification system rests with the individual provinces and territories, only British Columbia, parts of Saskatchewan, Nova Scotia, Prince Edward Island, Newfoundland and Labrador and Yukon Territory were using the new system for the fiscal year 2001–2002 hospital separation data presented in this report. The remaining provinces were using ICD-9/CCP, ICD-9-CM, or a combination of the two.

CCI provides greater specificity in the classification of hip and knee replacement procedures. In addition to providing separate codes for cemented versus uncemented procedures, it also permits separation of partial versus total replacements. For knee replacements, however, both partial and total replacement procedures are reported together in order to maintain comparability to the older classification systems, which did not permit separation of the two.

The mix of coding classifications and staggered implementation of the new classification across the country presents unique challenges in the interpretation of trends over time and geography. The CJRR will continue to monitor and investigate the impact of these coding changes over the coming years.

Patient Residence Geography

Regional analyses are primarily based on where the patient lives, not where the procedure was performed. Mapping of the province of residence of the patient is accomplished using the Postal Code Conversion File. In previous reports, patients with unknown or invalid postal codes were reported in the "Unknown" category. This year, incomplete or unknown postal codes are mapped to provinces or territories, whenever possible, through the use of the first digit of the postal code, which is unique to a province or territory. The impact is a large reduction of patients in the "Unknown" category and a subsequent increase in the counts for some of the specific provinces and territories.

Quebec Replacement Revision Counts Underestimated

Since the release of the 2002 CJRR annual report, CIHI has learned that a difference in coding of revision knee replacements in Quebec relative to the other provinces has resulted in an underestimation of Quebec knee replacement revision procedures since 1998.

In 1998, Quebec designated code 93.471 to indicate knee replacement revisions, which differs from the CCP code 93.40 that was implemented for knee replacement revisions as of April 1, 2000 for participating DAD provinces and territories (Quebec does not submit to the DAD). Code 93.471 is not part of the universe of codes reported by the CJRR. Also, it is not identifiable in the Hospital Morbidity Database because the fifth digit is truncated during routine Morbidity data processing. As a result, 93.471 is processed as CCP code 93.47 "Other Repair of the Knee." CIHI is working with Quebec to resolve this data issue and anticipates a resolution for the 2003–2004 Hospital Morbidity Database.

In 2001–2002, there were 255 knee replacement revision procedures in Quebec, 240 in 2000–2001, 171 in 1999–2000, and 184 in 1998–1999.[9]

Similarly, Quebec did not implement CCP hip revision codes 93.52 and 93.53. It is anticipated that these codes will be used in the 2003–2004 Hospital Morbidity Database. Therefore, one is currently unable to distinguish between primary and revision procedures conducted in Quebec facilities.

Revision History

Surgical data from orthopaedic surgeons presented in this report are subject to revision in future reports. The CJRR continues to accept data beyond the deadline for the reporting period; therefore, the information presented from this data source may be incomplete.

External Comparability

Some of the clinical and administrative data submitted by orthopaedic surgeons can be compared with data from the Hospital Morbidity Database or the DAD. Examples are admission date, date of surgery, patient health card, patient gender and patient birth date. To date, such a data quality study has not yet been conducted. In the future, CIHI plans to link data from orthopaedic surgeons to these hospital separation databases.

Summary of Methodological Notes

- Results pertaining to surgical and implant information from orthopaedic surgeons are preliminary and have not been validated through an extensive data quality study. Due to undercoverage issues, these results are not considered generalizable to all total hip and total knee arthroplasties performed in Canada.
- Data submission by orthopaedic surgeons to the CJRR is voluntary. Not all participating surgeons have submitted data to the CJRR. Furthermore, it is not known whether all procedures have been submitted by each surgeon. Response bias is possible, but is not quantifiable.
- Hospital separation data presented in this report are collected in a mix of coding classifications (ICD-10-CA/CCI, ICD-9-CM, ICD-9/CCP). The staggered implementation of the new classification across the country presents unique challenges in the interpretation of trends over time and geography. The CJRR will continue to monitor and investigate the impact of these coding changes over the coming years.
- Analyses presented on total knee replacement procedures also include partial knee replacement procedures, as the latter cannot be separated out in the CCP classification system.
- Hospital separation data are based on fiscal year 2001–2002 discharges, whereas clinical and surgical data are based on fiscal year 2002–2003 admissions.
- Quebec counts for hip and knee replacements are underestimated since revision codes are not identifiable in the Hospital Morbidity Database.
- Regional analyses in this report are primarily based on patient's region of residence, not where the procedure occurred. Counts by province of residence may have artificially increased due to a new methodology of assigning patients to a province when possible when the postal code is incomplete (the counts in the "Unknown" region category have decreased).
- Cases are counted by number of procedures. If a person has more than one hip or knee replacement procedure coded for the same hospital visit, each instance is counted.
- Length of stay analyses presented are based on all persons who underwent hip or knee replacement surgery, rather than tabulating procedure, as shown in last year's report.

Results

Important Note: *Analyses on trends, patient demographics, provincial variations and inhospital mortality are based on total hip and total knee replacement data extracted from the Hospital Morbidity Database, primarily on patients discharged between April 1, 2001 and March 31, 2002. Analyses on surgical and clinical characteristics, and component characteristics, are based on data submitted by orthopaedic surgeons participating in the CJRR and the OJRR on patients admitted for total hip and knee replacements and revisions between April 1, 2002 and March 31, 2003.*

Overall Trends

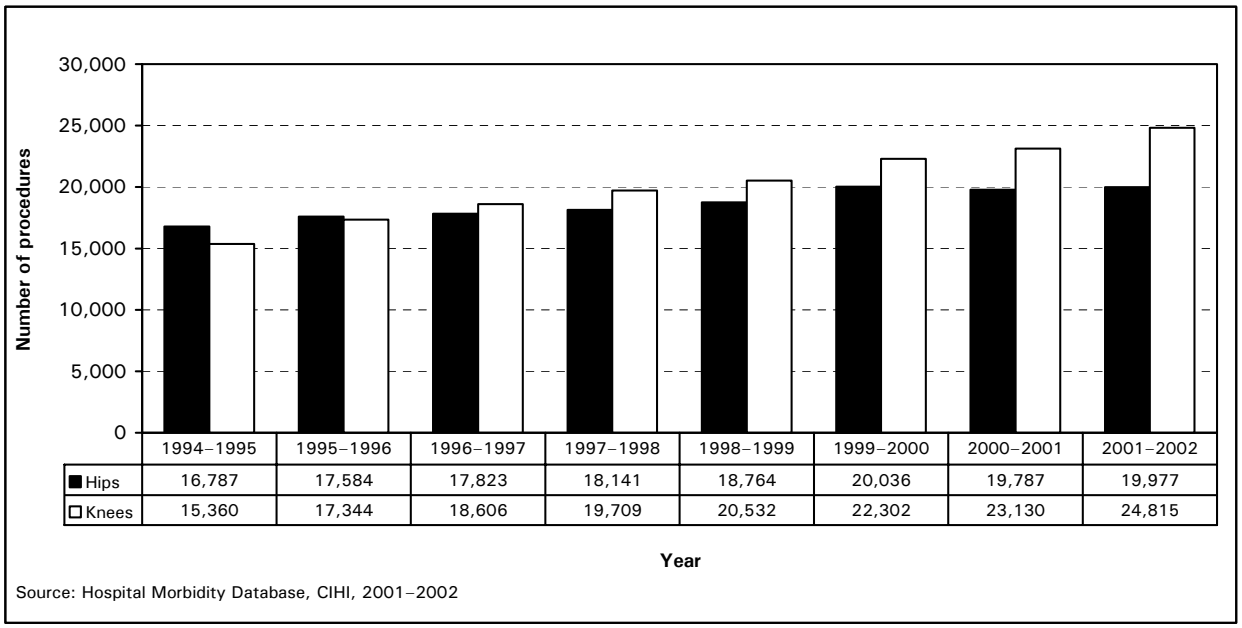
There were 44,792 total hip and total knee replacements performed in Canada among Canadian residents in 2001–2002, representing a seven-year increase of 39% from 32,147 procedures in 1994–1995 and a one-year increase of 4% from 42,917 procedures in 2000–2001.

As shown in Table 4 and Figure 5, in 1994–1995, the number of total hip replacements slightly exceeded the number of total knee replacements in Canada (16,787 versus 15,360 surgeries, respectively). However, beginning in 1996–1997, total knee replacements have annually surpassed the number of total hip replacements, and the gap has been increasing. In 2001–2002, there were 24,815 total knee replacements compared to 19,977 total hip replacements. Compared to 1994–1995 numbers, the number of total knee replacements in 2001–2002 had increased by 62%, with a 7% increase over to the previous year. In contrast, the number of total hip replacements increased by 19% compared to 1994–1995, with a 1% increase over the previous year.

Table 4. Number of Total Hip and Knee Replacement Procedures and Percent Change, 2001–2002 Compared to 1994–1995 and 2000–2001

Type of replacement	Total replacement procedures			7-year % change	1-year % change
	1994–1995	2000–2001	2001–2002		
Hip	16,787	19,787	19,977	19.0%	1.0%
Knee	15,360	23,130	24,815	61.6%	7.3%
Total	**32,147**	**42,917**	**44,792**	**39.3%**	**4.3%**

Source: Hospital Morbidity Database, CIHI



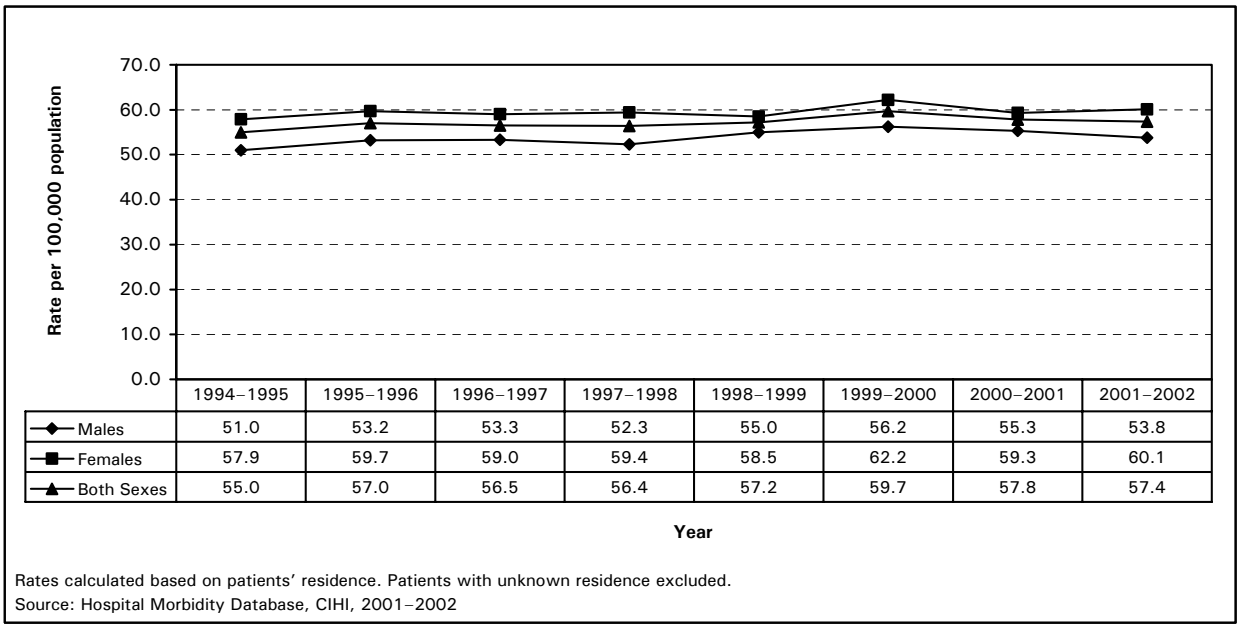
	1994–1995	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	2000–2001	2001–2002
■ Hips	16,787	17,584	17,823	18,141	18,764	20,036	19,787	19,977
□ Knees	15,360	17,344	18,606	19,709	20,532	22,302	23,130	24,815

Source: Hospital Morbidity Database, CIHI, 2001–2002

Figure 5. Number of Total Hip and Total Knee Replacement Procedures Performed in Canada, 1994–1995 to 2001–2002

To compare the rates of surgeries over time, one commonly employed analytical technique is age-standardization, which takes into account changes in age structure in different populations.

Figure 6 shows that the age-standardized rate of total hip replacement procedures among females in Canada was 12% higher than that among males (60.1 versus 53.8 per 100,000). Total hip replacement procedures increased by 4% from 55.0 per 100,000 population in 1994–1995 to 57.4 per 100,000 in 2001–2002. Among males, the seven-year increase was 6% (from 51.0 to 53.8 per 100,000). Among females, the seven-year increase was 4% (57.9 to 60.1 per 100,000).

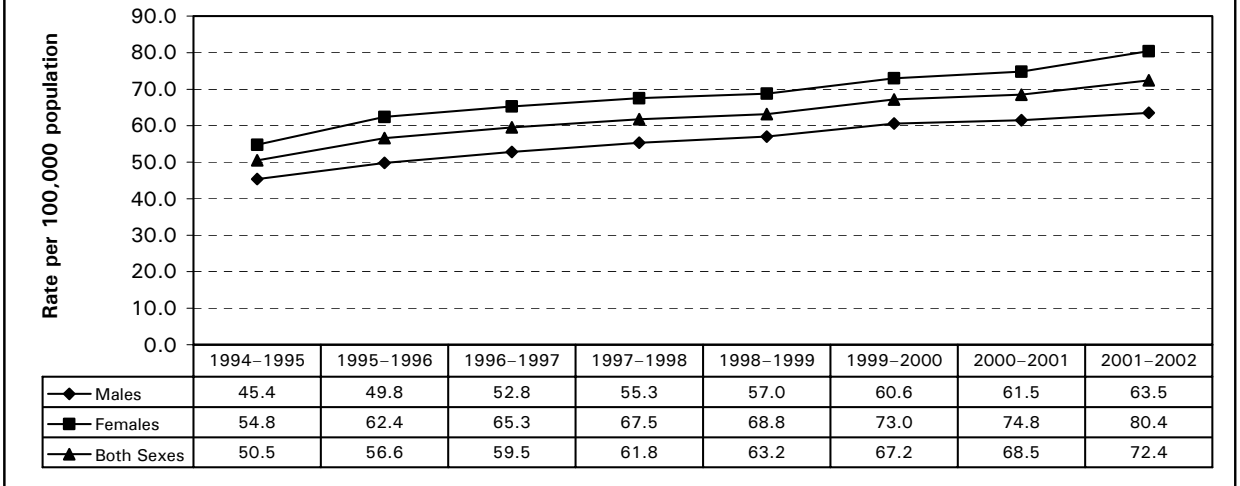


	1994–1995	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	2000–2001	2001–2002
Males	51.0	53.2	53.3	52.3	55.0	56.2	55.3	53.8
Females	57.9	59.7	59.0	59.4	58.5	62.2	59.3	60.1
Both Sexes	55.0	57.0	56.5	56.4	57.2	59.7	57.8	57.4

Rates calculated based on patients' residence. Patients with unknown residence excluded.
Source: Hospital Morbidity Database, CIHI, 2001–2002

Figure 6. Age-Standardized Rates (per 100,000 population) by Sex for Total Hip Replacement Procedures, Canada, 1994–1995 to 2001–2002

For total knee replacement rates, the differences were much larger between the sexes and over time (Figure 7). In 2001–2002, the age-standardized total knee replacement rate was 80.4 per 100,000 among females compared to 63.5 among males, a difference of 27% over males. The overall age-standardized rate increased by 43% in the seven-year period from 50.5 to 72.4 per 100,000. Among males, the increase was 40% (from 45.4 to 63.5 per 100,000). Among females, the corresponding increase was 47% (from 54.8 to 80.4 per 100,000).



	1994–1995	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	2000–2001	2001–2002
Males	45.4	49.8	52.8	55.3	57.0	60.6	61.5	63.5
Females	54.8	62.4	65.3	67.5	68.8	73.0	74.8	80.4
Both Sexes	50.5	56.6	59.5	61.8	63.2	67.2	68.5	72.4

Rates calculated based on patients' residence. Patients with unknown residence excluded.
Source: Hospital Morbidity Database, CIHI, 2001–2002

Figure 7. Age-Standardized Rates (per 100,000 population) by Sex for Total Knee Replacement Procedures, Canada, 1994–1995 to 2001–2002

Crude (i.e. unadjusted) rates of total hip and knee replacement procedures for several countries are presented in Tables 5 and 6. While Canada has one of the lowest rates of total hip replacements, Canada falls in the higher range for knee replacements. For the latter, however, the Canadian rate includes partial knee replacements, which cannot be distinguished from total knee replacements in the ICD-9/CCP coding classification system.

Comparisons of these national crude rates should be done with caution, since the rates are not adjusted for differences in the age and sex structures of each country's population. In addition, with the exception of Sweden, the optimal rates of total hip and total knee replacements have not been determined for most of these countries, which makes comparisons even more difficult. A group of Swedish researchers have recommended a hip replacement rate of 130 per 100,000 population to meet the needs for these procedures and eliminate wait times in Sweden.[10] However, this "optimal" rate cannot be assumed to be applicable to other countries, as there are many factors that influence the population-based need for total hip replacements. The CJRR is a valuable source of information that can be helpful in determining appropriate rate ranges for regions and sub-groups (i.e. age groups) within Canada. Determining optimal rates for total hip and total knee replacement surgeries in regions across Canada will require a better understanding of the many factors including impact of waiting for surgery on outcomes and quality of life.

Table 5. International Comparison of Crude Rates (per 100,000 population) of Primary Total Hip Replacements

Country	Crude rate per 100,000	Year	Reference
Norway	114	1990	Bulletin Hospital Joint Diseases 1999;58(3):139-47
	124	2000	Personal communication, Birgitte Espehaug, Statistician, The Norwegian Arthroplasty Register, December 2001.
New Zealand	119	2000	Personal communication, Toni Hobbs, New Zealand Joint Replacement Register Coordinator, November 2001.
Sweden	100	N/A	Acta Orthop Scand 2000;71(2):111-21
Finland	93	1999	Acta Orthop Scand 2001;72(5):433-41
Australia	74	1999–2000	2001 Annual Report
Canada[1]	**64**	**2001–2002**	**Canadian Institute for Health Information**
United States[2]	52	1996	American Academy of Orthopaedic Surgeons, Musculoskeletal Conditions in the United States. Arthroplasty and Total Joint Procedures, 1999.

[1] Canadian rate includes both primary and revision total hip replacements.
[2] U.S. data is not representative of full population.
N/A—Not available

Table 6. International Comparison of Crude Rates (per 100,000 population) of Primary Total Knee Replacements

Country	Crude rate per 100,000	Year	Reference
United States[1]	92	1996	American Academy of Orthopaedic Surgeons, Musculoskeletal Conditions in the United States. Arthroplasty and Total Joint Procedures, 1999.
Australia	81	1999–2000	2001 Annual Report
Canada[2]	**80**	**2001–2002**	**Canadian Institute for Health Information**
New Zealand	75	2000	Personal communication, Toni Hobbs, New Zealand Joint Replacement Register Coordinator, November 2001.
Sweden[3]	63	1996–1997	Acta Orthop Scand 2000;71(4):378-80
Norway	35	2000	Personal communication, Birgitte Espehaug, Statistician, The Norwegian Arthroplasty Register, December 2001.

[1] U.S. data is not representative of full population.
[2] Canadian rate includes both primary and revision total and partial knee replacements.
[3] The Swedish rate includes all endoprosthetic knee replacements, not just total knee replacements.

Provincial/Territorial Variations

Table 7 shows the number and percent change of total hip replacement procedures by province of patient residence for 2001–2002 compared to 1994–1995 and 2000–2001. For total hip replacements, residents of Prince Edward Island and Nova Scotia showed declines over both the seven-year and one-year periods. All other provinces and territories showed an increase in the number of procedures in the seven-year period. For the one-year period, however, decreases were also seen in Saskatchewan and British Columbia. Among the provinces, the largest percentage increases were observed among residents in Quebec (34%) and Manitoba (31%) in the seven-year period. For the one-year period, the largest percentage increases were observed among residents of Quebec (6%) and Newfoundland and Labrador (6%).

Table 7. Number of Total Hip Replacement Procedures Performed in Canada Based on Patient Residence, 1994–1995, 2000–2001 and 2001–2002

Province	Total hip replacements 1994–1995	Total hip replacements 2000–2001	Total hip replacements 2001–2002	7-year % change	1-year % change
Newfoundland and Labrador[1]	203	218	230	+13.3%	+5.5%
Prince Edward Island	104	110	101	-2.9%	-8.2%
Nova Scotia	734	781	697	-5.0%	-10.8%
New Brunswick	429	514	525	+22.4%	+2.1%
Quebec	2,527	3,188	3,374	+33.5%	+5.8%
Ontario	6,988	8,078	8,469	+21.2%	+4.8%
Manitoba	664	867	870	+31.0%	+0.3%
Saskatchewan	821	885	850	+3.5%	-4.0%
Alberta	1,786	2,036	2,076	+16.2%	+2.0%
British Columbia	2,383	2,892	2,747	+15.3%	-5.0%
Territories[2]	9	29	36	+300.0%[5]	+24.1%[5]
Unknown[1, 3]	199	189	2	N/A	N/A
Canada[4]	**16,787**	**19,787**	**19,977**	**+19.0%**	**+1.0%**

[1] For Newfoundland and Labrador and patients with unknown residence, 1995–1996 numbers are used for 1994–1995, as the latter data were incomplete.
[2] Includes Northwest Territories, Yukon Territory and Nunavut.
[3] Excludes non-Canadian residents.
[4] Total for 1994–1995 does not add up because 1995–1996 numbers were used for Newfoundland and Labrador and patients with unknown residents.
[5] Percentage change should be interpreted with caution as it is based on small numbers.
N/A—Not applicable

Source: Hospital Morbidity Database, CIHI

As shown in Table 8, for total knee replacements, residents in all provinces and territories experienced an increase in the number of procedures in the seven-year period. The greatest increase among provinces was in Manitoba (115%), followed by New Brunswick (78%). For the one-year period, a decline was seen in Nova Scotia (-17%) and British Columbia (-1%).

Table 8. Number of Total Knee Replacement Procedures Performed in Canada Based on Patient Residence, 1994–1995, 2000–2001 and 2001–2002

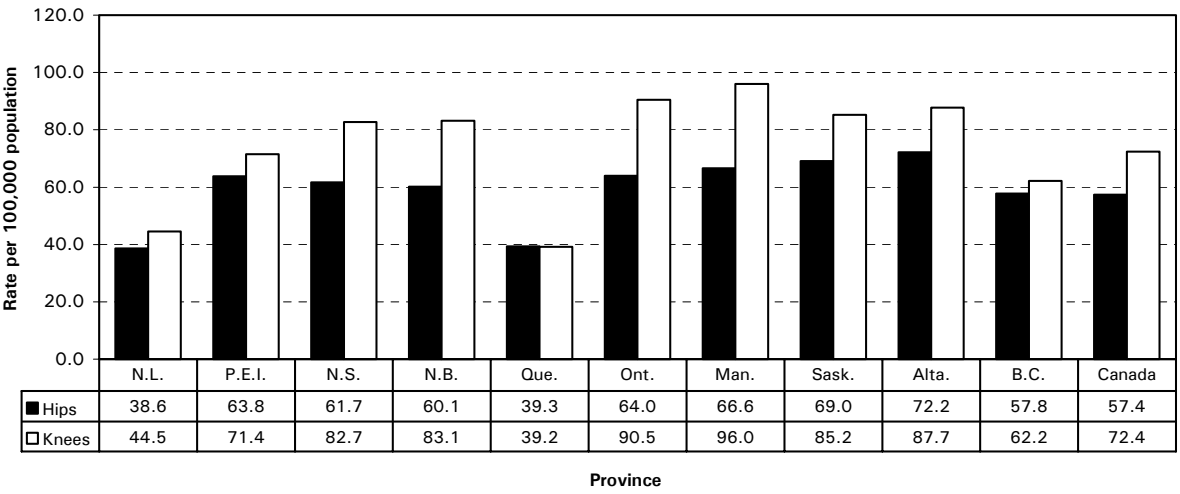
Province	Total knee replacements 1994–1995	Total knee replacements 2000–2001	Total knee replacements 2001–2002	7-year % change	1-year % change
Newfoundland and Labrador[1]	175	226	254	+45.1%	+12.4%
Prince Edward Island	88	101	112	+27.3%	+10.9%
Nova Scotia	679	1,077	896	+32.0%	-16.8%
New Brunswick	402	685	717	+78.4%	+4.7%
Quebec	2,146	3,069	3,325	+54.9%	+8.3%
Ontario	6,839	10,426	11,821	+72.8%	+13.4%
Manitoba	578	1,178	1,244	+115.2%	+5.6%
Saskatchewan	840	975	1,023	+21.8%	+4.9%
Alberta	1,587	2,223	2,443	+53.9%	+9.9%
British Columbia	1,875	2,946	2,920	+55.7%	-0.9%
Territories[2]	6	35	54	+800.0%[5]	+54.3%[5]
Unknown[1, 3]	176	189	6	N/A	N/A
Canada[4]	**15,360**	**23,130**	**24,815**	**+61.6%**	**+7.3%**

[1] For Newfoundland and Labrador and patients with unknown residence, 1995–1996 numbers are used for 1994–1995, as the latter data were incomplete.
[2] Includes Northwest Territories, Yukon Territory and Nunavut.
[3] Excludes non-Canadian residents.
[4] Total for 1994–1995 does not add up because 1995–1996 numbers were used for Newfoundland and Labrador and patients with unknown residents.
[5] Percentage change should be interpreted with caution as it is based on small numbers.
N/A—Not applicable

Source: Hospital Morbidity Database, CIHI

The age-standardized rates of total hip and total knee replacement procedures varied across Canada (Figure 8). Alberta and Saskatchewan residents had the highest total hip replacement rates (72 and 69 per 100,000 population, respectively), whereas Newfoundland and Labrador and Quebec residents had the lowest rates (39 per 100,000 for each).

For total knee replacement rates, Manitoba and Ontario had the highest rates (96 and 91 per 100,000 population), while Newfoundland and Labrador and Quebec had the lowest (45 and 39 per 100,000 population).



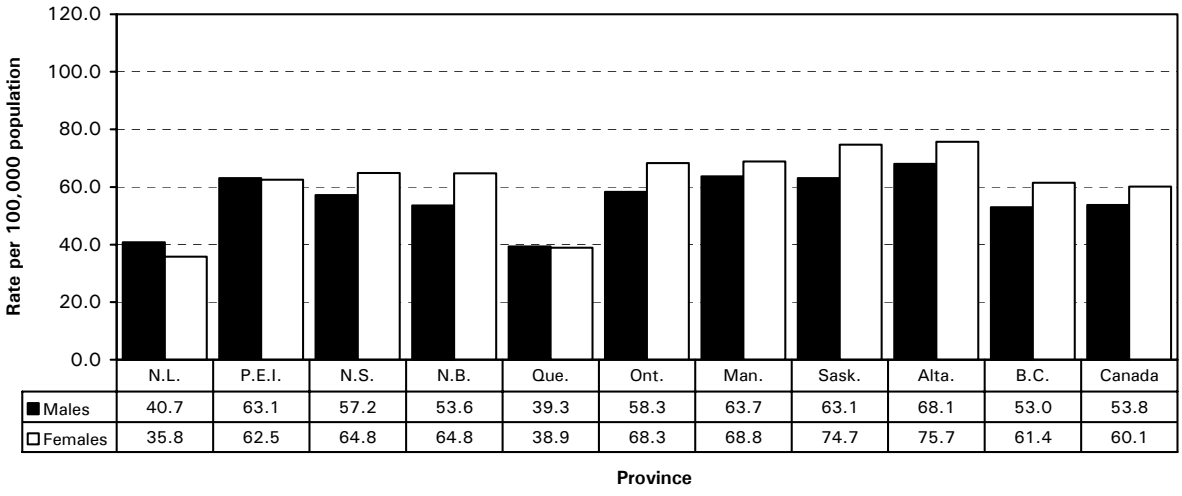
	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
■ Hips	38.6	63.8	61.7	60.1	39.3	64.0	66.6	69.0	72.2	57.8	57.4
□ Knees	44.5	71.4	82.7	83.1	39.2	90.5	96.0	85.2	87.7	62.2	72.4

Rates calculated based on patients' residence. Patients with unknown residence excluded. Yukon Territory, Northwest Territories and Nunavut rates suppressed due to small numbers but included in national average.
Source: Hospital Morbidity Database, CIHI, 2001–2002

Figure 8. Age-Standardized Rates (per 100,000 population) of Total Hip and Total Knee Replacement Procedures by Province, 2001–2002

When age-standardized rates were examined by sex (Figure 9), the provincial trends for total hip replacement rates among males and females were similar to both sexes combined.

For total knee replacement rates (Figure 10), among males, the provincial trend was similar to that of both sexes combined. However, among females, residents from Manitoba, Alberta, and Ontario had the highest rates. The lowest rates were among Quebec and Newfoundland and Labrador residents.

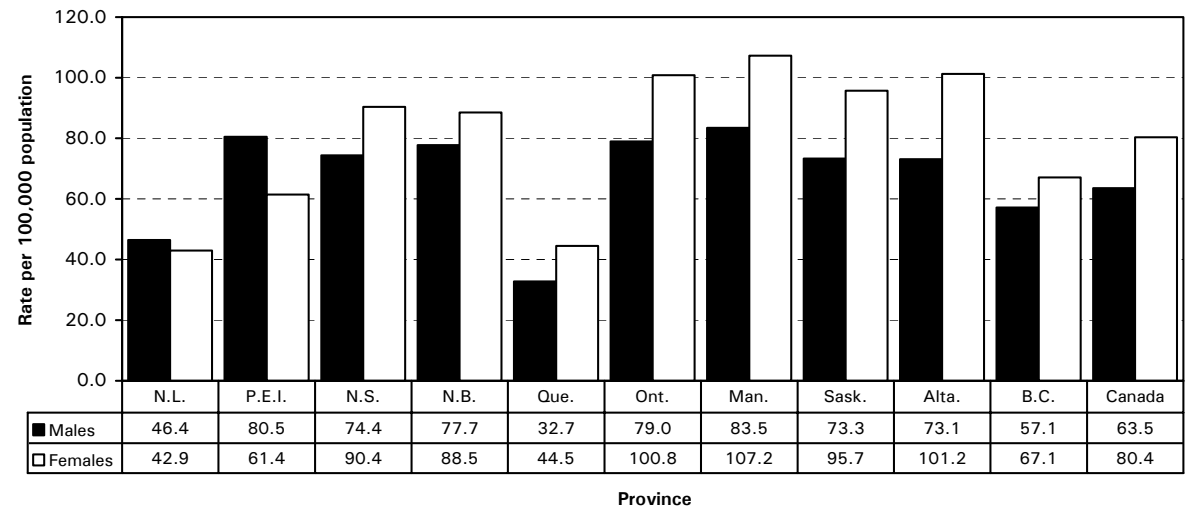


	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
■ Males	40.7	63.1	57.2	53.6	39.3	58.3	63.7	63.1	68.1	53.0	53.8
□ Females	35.8	62.5	64.8	64.8	38.9	68.3	68.8	74.7	75.7	61.4	60.1

Province

Rates calculated based on patients' residence. Patients with unknown residence excluded. Yukon Territory, Northwest Territories and Nunavut rates suppressed due to small numbers but included in national average.
Source: Hospital Morbidity Database, CIHI, 2001–2002

Figure 9. Age-Standardized Rates (per 100,000 population) of Total Hip Replacement Procedures for Males and Females, 2001–2002



	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
■ Males	46.4	80.5	74.4	77.7	32.7	79.0	83.5	73.3	73.1	57.1	63.5
□ Females	42.9	61.4	90.4	88.5	44.5	100.8	107.2	95.7	101.2	67.1	80.4

Province

Rates calculated based on patients' residence. Patients with unknown residence excluded. Yukon Territory, Northwest Territories and Nunavut rates suppressed due to small numbers but included in national average.
Source: Hospital Morbidity Database, CIHI, 2001–2002

Figure 10. Age-Standardized Rates (per 100,000 population) of Total Knee Replacement Procedures for Males and Females, 2001–2002

Table 9 shows the age-standardized total hip replacement rate and percent change by province of patient residence for 2001–2002 compared to 1994–1995 and 2000–2001. Since 1994–1995, the rate increased in New Brunswick, Quebec, Ontario, and Manitoba, with the greatest percent increase in Manitoba (24%), followed by Quebec (16%). Newfoundland and Labrador, New Brunswick, Quebec, and Ontario all had small increases (3% or less) compared to 2000–2001. Provinces with substantial decreases compared to 1994–1995 rates were Nova Scotia (15%), Prince Edward Island (10%), and Alberta (7%).

Table 9. Age-Standardized Rates of Total Hip Replacement Procedures Performed in Canada Based on Patient Residence, 1994–1995, 2000–2001 and 2001–2002

Province	Total hip replacement 1994–1995	Total hip replacement 2000–2001	Total hip replacement 2001–2002	7-year % change	1-year % change
Newfoundland and Labrador[1]	38.5[1]	37.6	38.6	+0.3%	+2.7%
Prince Edward Island	70.9	70.5	63.8	-10.0%	-9.5%
Nova Scotia	72.9	71.7	61.7	-15.4%	-13.9%
New Brunswick	53.7	59.1	60.1	+11.9%	+1.7%
Quebec	34.0	38.1	39.3	+15.6%	+3.1%
Ontario	62.1	62.8	64.0	+3.1%	+1.9%
Manitoba	53.7	66.7	66.6	+24.0%	-0.1%
Saskatchewan	69.6	72.8	69.0	-0.9%	-5.2%
Alberta	77.5	73.5	72.2	-6.8%	-1.8%
British Columbia	59.7	62.1	57.8	-3.2%	-6.9%
Territories	**	**	**	N/A	N/A
Canada[2]	**55.0**	**57.8**	**57.4**	**+4.4%**	**-0.7%**

[1] For Newfoundland and Labrador, 1995–1996 numbers are used, as 1994–1995 data are incomplete.
[2] Patients with unknown residence are excluded.
** Yukon Territory, Northwest Territories and Nunavut rates are suppressed due to small numbers but included in national average.
N/A—Not applicable

Source: Hospital Morbidity Database, CIHI

Table 10 shows the age-standardized total knee replacement rate and percent change by province of patient residence for 2001–2002 compared to 1994–1995 and 2000–2001. Since 1994–1995, the rate increased among all provinces, with the greatest percent increases in Manitoba (107%), followed by New Brunswick (64%) and Ontario (49%). Compared to the previous year, the greatest percent increases were seen among Newfoundland and Labrador residents (12%), followed by Ontario (11%) and Prince Edward Island (10%). One-year decreases were seen in Nova Scotia (-18%) and British Columbia (-3%).

Table 10. Age-Standardized Rates of Total Knee Replacement Procedures Performed in Canada Based on Patient Residence, 1994–1995, 2000–2001 and 2001–2002

Province	Total knee replacement 1994–1995	Total knee replacement 2000–2001	Total knee replacement 2001–2002	7-year % change	1-year % change
Newfoundland and Labrador[1]	33.6[1]	39.6	44.5	+32.4%	+12.4%
Prince Edward Island	61.2	65.1	71.4	+16.7%	+9.7%
Nova Scotia	67.6	100.6	82.7	+22.3%	-17.8%
New Brunswick	50.8	80.8	83.1	+63.6%	+2.8%
Quebec	29.0	37.0	39.2	+35.2%	+5.9%
Ontario	60.9	81.8	90.5	+48.6%	+10.6%
Manitoba	46.3	91.4	96.0	+107.3%	+5.0%
Saskatchewan	70.0	81.2	85.2	+21.7%	+4.9%
Alberta	70.0	82.2	87.7	+25.3%	+6.7%
British Columbia	46.9	64.4	62.2	+32.6%	-3.4%
Territories	**	**	**	N/A	N/A
Canada[2]	**50.5**	**68.5**	**72.4**	**+43.4%**	**+5.7%**

[1] For Newfoundland and Labrador, 1995–1996 numbers are used, as 1994–1995 data are incomplete.
[2] Patients with unknown residence are excluded.
** Yukon Territory, Northwest Territories and Nunavut rates are suppressed due to small numbers but included in national average.
N/A—Not applicable

Source: Hospital Morbidity Database, CIHI

Patient Demographics

The majority of total hip and knee replacements were performed on patients 65 years of age and older (66% and 71%, respectively). In 2001–2002, nearly a third (32%) of Canadian hip replacement recipients and 40% of knee replacement recipients were between the ages 65 and 74 years (Figures 11 and 12). In contrast, only 5% of patients who underwent a hip replacement, and 1% of those who underwent a knee replacement, were younger than 45 years of age.

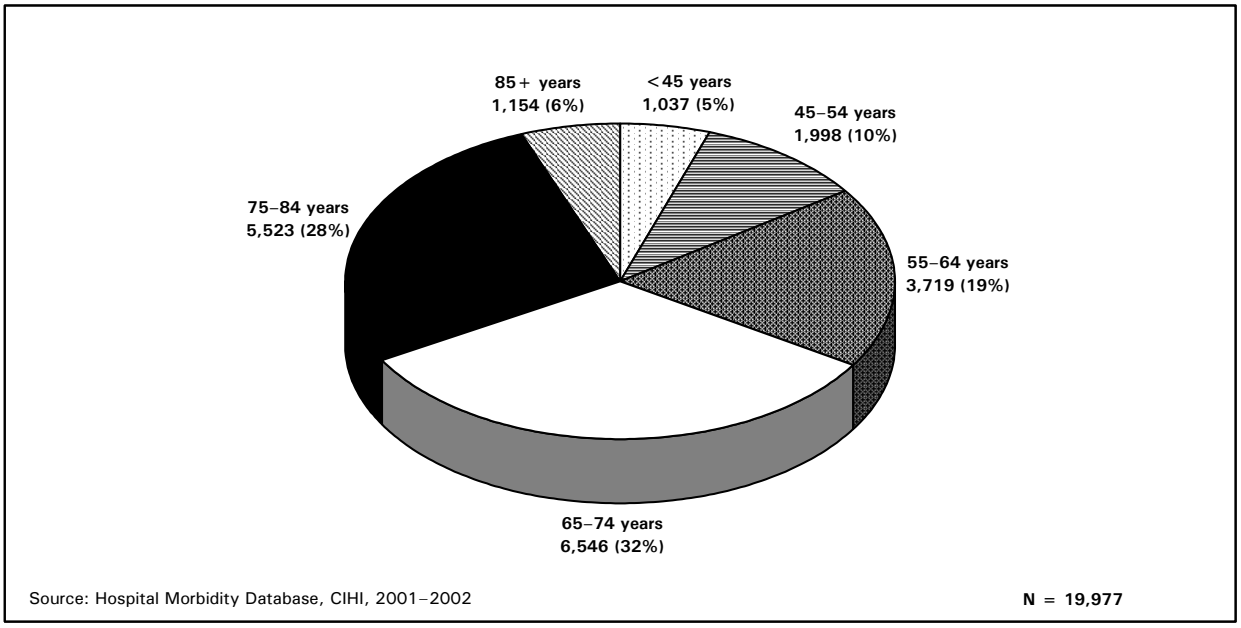


Figure 11. Distribution of Total Hip Replacement Procedures by Patient Age, Canada, 2001–2002

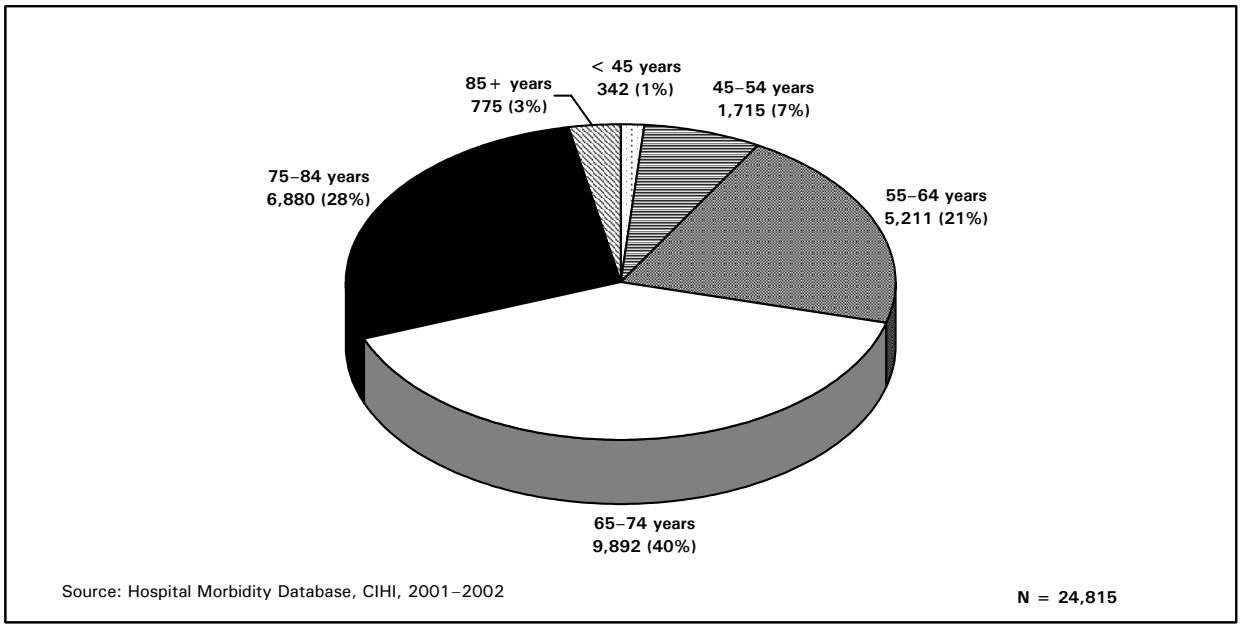
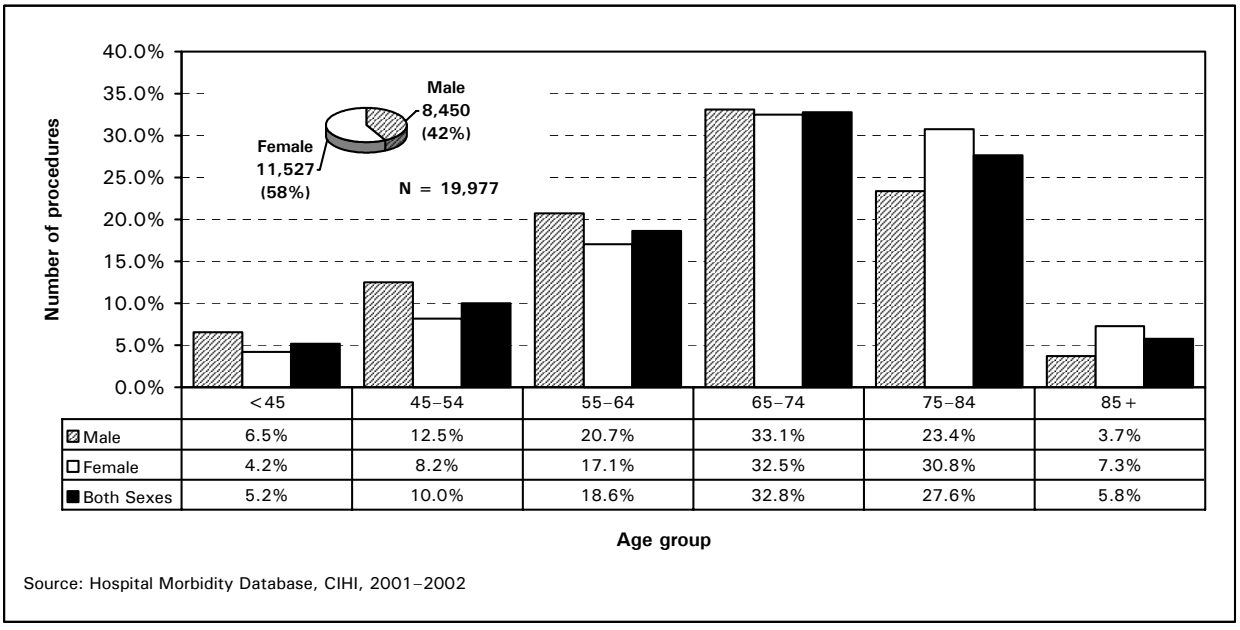


Figure 12. Distribution of Total Knee Replacement Procedures by Patient Age, Canada, 2001–2002

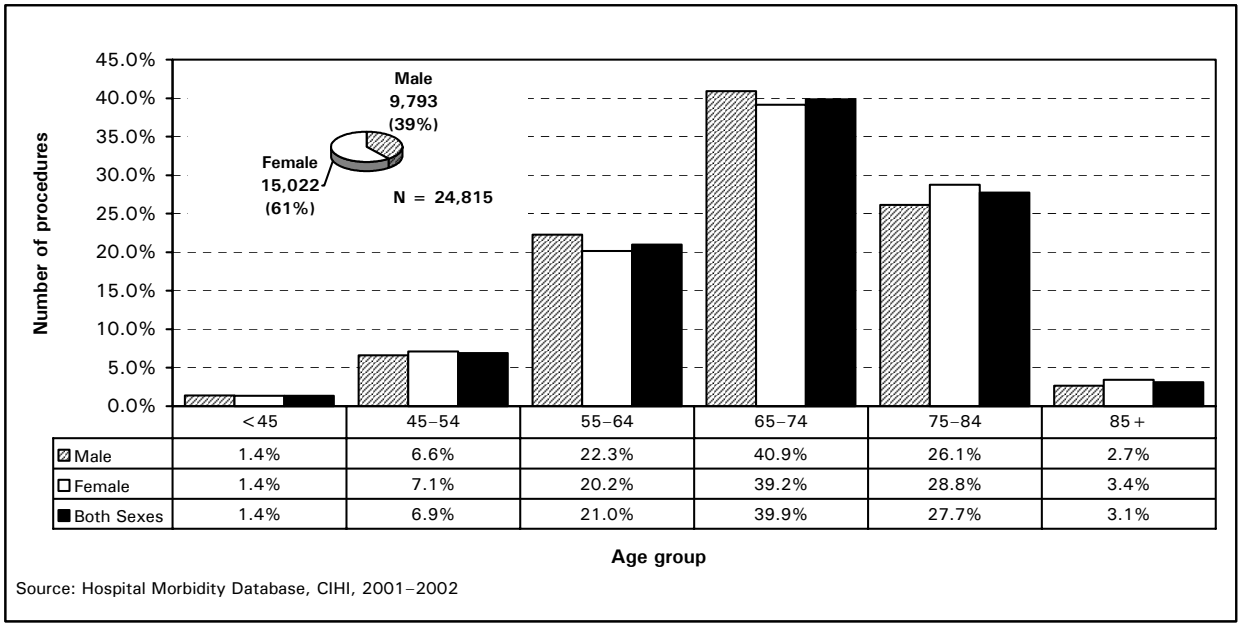
Among total hip replacement recipients, 58% were female, and 42% were male, in 2001–2002. The 65+ age group represented 71% of total hip replacement procedures among women, 60% among men. Procedures among persons under 55 years of age represented 13% of total hip replacement procedures among women and 19% among men (Figure 13).



	<45	45–54	55–64	65–74	75–84	85+
Male	6.5%	12.5%	20.7%	33.1%	23.4%	3.7%
Female	4.2%	8.2%	17.1%	32.5%	30.8%	7.3%
Both Sexes	5.2%	10.0%	18.6%	32.8%	27.6%	5.8%

Figure 13. Percentage Distribution of Total Hip Replacement Procedures by Age Group and Sex, Canada, 2001–2002

Among total knee replacement recipients, 61% were female, and 39% were male, in 2001–2002. The age distributions by sex were very similar (Figure 14). The 65+ age group represented 71% of total knee replacement procedures among women and 70% among men. Procedures among persons under 55 years of age represented 9% of total knee replacement procedures among women, 8% among men.



	<45	45–54	55–64	65–74	75–84	85+
Male	1.4%	6.6%	22.3%	40.9%	26.1%	2.7%
Female	1.4%	7.1%	20.2%	39.2%	28.8%	3.4%
Both Sexes	1.4%	6.9%	21.0%	39.9%	27.7%	3.1%

Source: Hospital Morbidity Database, CIHI, 2001–2002

Figure 14. Percentage Distribution of Total Knee Replacement Procedures by Age Group and Sex, Canada, 2001–2002

Tables 11 and 12 show the number of total hip and knee replacements by age group and sex for 2001–2002, compared to 1994–1995. For total hip replacement procedures, the largest seven-year increases were in the 85+ year age group (62% and 60% increase), followed by the 45 to 54 age group (47% and 50% increase) among both men and women, respectively.

Among total knee replacement procedures, the order was reversed. The largest seven-year increases were in the 45 to 54 age group (130% and 169%), followed by the 85+ age group (123% and 111% increase) among men and women, respectively.

Table 11. Number and Distribution of Total Hip Replacement Procedures by Age Group and Sex, Canada, 2001–2002 Compared to 1994–1995

Age group	Males			Females		
	1994–1995	2001–2002	7-year % change	1994–1995	2001–2002	7-year % change
<45 years	489	553	13.1%	475	484	1.9%
45–54 years	716	1,055	47.3%	630	943	49.7%
55–64 years	1,609	1,753	8.9%	1,659	1,966	18.5%
65–74 years	2,475	2,798	13.1%	3,746	3,748	0.1%
75–84 years	1,470	1,976	34.4%	2,798	3,547	26.8%
85+ years	194	315	62.4%	526	839	59.5%
Total	**6,953**	**8,450**	**21.5%**	**9,834**	**11,527**	**17.2%**

Source: Hospital Morbidity Database, CIHI

Table 12. Number and Distribution of Total Knee Replacement Procedures by Age Group and Sex, Canada, 2001–2002 Compared to 1994–1995

Age group	Males			Females		
	1994–1995	2001–2002	7-year % change	1994–1995	2001–2002	7-year % change
<45 years	104	136	30.8%	155	206	32.9%
45–54 years	282	648	129.8%	397	1067	168.8%
55–64 years	1,292	2,181	68.8%	1,684	3,030	79.9%
65–74 years	2,754	4,008	45.5%	4,170	5,884	41.1%
75–84 years	1,564	2,559	63.6%	2,597	4,321	66.4%
85+ years	117	261	123.1%	244	514	110.7%
Total	**6,113**	**9,793**	**60.2%**	**9,247**	**15,022**	**62.5%**

Source: Hospital Morbidity Database, CIHI

Tables 13 and 14 show the age-specific rates for total hip replacements and total knee replacement by sex for 2001–2002 compared to 1994–1995. For total hip replacement procedures, the highest age–specific rates were in the 75 to 84 age group (373 and 444 per 100,000 for men and women, respectively), followed by the 65 to 74 age group (277 and 329 per 100,000, respectively). The largest seven-year increases were in the 85+ age group (18% and 19%), followed by the 45 to 54 age group (15% and 16%).

For total knee replacement procedures, the highest age-specific rate was in the 75 to 84 age group among men (483 per 100,000) and women (541 per 100,000). The largest seven-year increases were in the 45 to 54 age group for both men and women (79% and 108% increase), followed by the 85+ age group (63% and 57%).

It is important to note that a substantial rate increase (from 29% to 108%) was seen across all age groups and both sexes for total knee replacement procedures from 1994–1995 to 2001–2002.

Table 13. Age-Specific Rates (per 100,000 population) of Total Hip Replacement Procedures by Sex, Canada, 2001–2002 Compared to 1994–1995

Age group	Males			Females		
	1994–1995	2001–2002	7-year % change	1994–1995	2001–2002	7-year % change
<45 years	4.9	5.5	+12.2%	4.9	5.0	+2.0%
45–54 years	40.8	46.9	+15.0%	35.9	41.6	+15.9%
55–64 years	131.1	121.8	-7.1%	131.8	132.3	+0.4%
65–74 years	267.5	277.0	+3.6%	335.8	328.6	-2.1%
75–84 years	353.2	373.2	+5.7%	434.0	443.8	+2.3%
85+ years	205.0	242.7	+18.4%	236.6	280.9	+18.7%
Total	**48.2**	**54.7**	**+13.5%**	**66.9**	**73.1**	**+9.3%**

Source: Hospital Morbidity Database, CIHI

Table 14. Age-Specific Rates (per 100,000 population) of Total Knee Replacement Procedures by Sex, Canada, 2001–2002 Compared to 1994–1995

Age group	Males			Females		
	1994–1995	2001–2002	7-year % change	1994–1995	2001–2002	7-year % change
<45 years	1.0	1.3	+30.0%	1.6	2.1	+31.3%
45–54 years	16.1	28.8	+78.9%	22.6	47.1	+108.4%
55–64 years	105.3	151.7	+44.1%	133.8	203.9	+52.4%
65–74 years	297.0	396.9	+33.6%	373.8	516.3	+38.1%
75–84 years	375.8	483.3	+28.6%	402.9	540.7	+34.2%
85+ years	123.6	201.1	+62.7%	109.7	172.1	+56.9%
Total	**42.4**	**63.4**	**+49.5%**	**62.9**	**95.3**	**+51.5%**

Source: Hospital Morbidity Database, CIHI

Inter-Provincial/Territorial Movements

With the exception of Yukon Territory and Nunavut, the majority of patients had their surgeries done in their home province. However, a small proportion of patients had their replacements done in another province. Possible reasons include shorter wait time, or access to a subspeciality not available locally in their home province. As total joint replacements are not performed in Yukon Territory and Nunavut, residents of these two territories need to travel to neighboring provinces of Alberta or British Columbia to have their hip and knee replacements done.

The provincial/territorial movements of total hip replacement patients are depicted in Table 15. Residents of Northwest Territories and Prince Edward Island were most likely to have their total hip replacement surgery in another province. While some residents of Northwest Territories (26.7%) had their hip replacements done in Alberta, roughly 14% of residents of Prince Edward Island had their hip replacements done in Nova Scotia or in New Brunswick. In contrast, residents of Ontario (0.1%) and Alberta (0.6%) were least likely to travel to another province for their hip replacement surgery.

When considering the absolute number of patients, residents of British Columbia (n = 64) and Quebec (n = 28) traveled to another province to have their hip replaced than residents of any other province. 57 of the 64 patients from British Columbia traveled to Alberta and, 22 of the 28 patients from Quebec traveled to Ontario. Almost all patients who were treated out of province from Nova Scotia went to New Brunswick, while 16 of 20 residents from Saskatchewan went to Alberta.

With respect to the flow of patients into provinces for hip replacement surgery, New Brunswick and Alberta (4.1% and 3.7% respectively) had the highest proportion of out-of-province patients. In absolute numbers, however, Alberta (n = 79) and Ontario (n = 44) received the highest number of patients for a total hip replacement.

Table 15. Movement of Total Hip Replacement Patients Across Provinces, 2001–2002

Province	Number (%) of patients residing in this province who had their total hip replacement done in another province	Number (%) out-of-province patients who had their total hip replacement performed in this province
Newfoundland and Labrador	6 (2.6%)	1 (0.4%)
Prince Edward Island	14 (13.9%)	1 (1.1%)
Nova Scotia	19 (2.7%)	18 (2.6%)
New Brunswick	4 (0.8%)	22 (4.1%)
Quebec	28 (0.8%)	0 (0%)
Ontario	11 (0.1%)	44 (0.5%)
Manitoba	16 (1.9%)	9 (1.1%)
Saskatchewan	20 (2.4%)	20 (2.4%)
Alberta	13 (0.6%)	79 (3.7%)
British Columbia	64 (2.3%)	25 (0.9%)
Northwest Territories	4 (26.7%)	1 (8.3%)
Yukon Territory	13 (100%)*	0 (0%)
Nunavut	8 (100%)*	0 (0%)

*No joint replacements performed in Nunavut and Yukon Territory.

Notes: There were 2 total hip replacement procedures performed in Manitoba for which the patients' home province was unknown. Denominator for percentages is number of patients (Canadian residents only) treated in that province.

Source: Hospital Morbidity Database, CIHI

Table 16 shows the movement of patients who underwent a total knee replacement in Canada in 2001–2002. Residents of Northwest Territories (10.5%), Nova Scotia (2.9%) and Saskatchewan (2.7%) were most likely to have their total knee replacement surgery in another province. Residents of Northwest Territories went to Alberta and, 24 of the 26 residents of Nova Scotia went to New Brunswick and the remaining went to Ontario. 22 of 27 residents of Saskatchewan went to Alberta. As with hip replacement recipients, only a small proportion of residents of Alberta and Ontario (< 1%) had their knee replacement surgeries out-of-province. The majority of out-of-province knee replacements for Quebec residents were carried out in Ontario and, almost all out-of-province patients from British Columbia and Saskatchewan went to the neighboring province of Alberta to have their knee replacement surgery. Accordingly, Alberta (n = 76) and Ontario (n = 63) received the highest number of out-of-province patients for a total knee replacement. Among provinces, New Brunswick (4%) and Alberta (3%) had the highest proportion of out-of-province residents.

Table 16. Movement of Total Knee Replacement Patients Across Provinces, 2001–2002

Province	Number (%) of patients residing in this province who had their total knee replacement done in another province	Number (%) of out-of-province patients who had their total knee replacement done in this province
Newfoundland and Labrador	1 (0.4%)	2 (0.8%)
Prince Edward Island	2 (1.8%)	0 (0%)
Nova Scotia	26 (2.9%)	8 (0.9%)
New Brunswick	4 (0.6%)	28 (3.9%)
Quebec	48 (1.4%)	0 (0%)
Ontario	5 (<0.1%)	63 (0.6%)
Manitoba	8 (0.7%)	8 (0.6%)
Saskatchewan	27 (2.7%)	13 (1.3%)
Alberta	9 (0.4%)	76 (3.1%)
British Columbia	57 (2.0%)	19 (0.7%)
Northwest Territories	2 (10.5%)	6 (26.1)
Yukon Territory	17 (100%)*	0 (0%)
Nunavut	17 (100%)*	0 (0%)

*No joint replacements were performed in Nunavut and Yukon Territory.

Notes: There were 5 total knee replacement procedures performed in Manitoba for which the patients' home provinces were unknown. Denominator for percentages is number of patients (Canadian residents only) treated in that province.

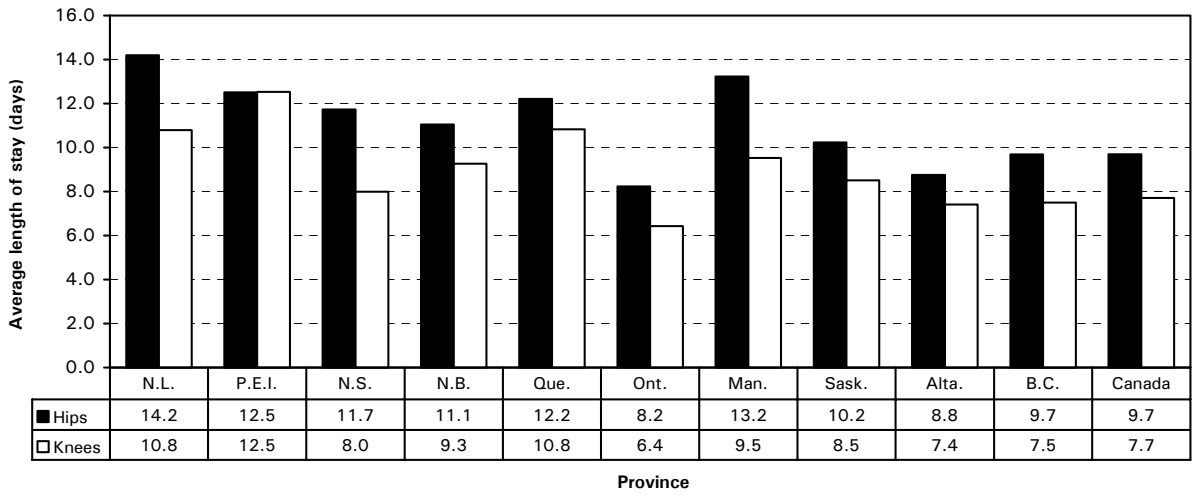
Source: Hospital Morbidity Database, CIHI

Length of Hospital Stay

Important Note: *Analyses presented in this section are based on the province where the procedure was performed as opposed to the province of patient residence. Non-Canadian residents and patients of unknown residence are included in this analysis.*

Provincial average lengths of stay for total hip and knee replacement patients in 2001–2002 are shown in Figure 15. Total hip replacement recipients had higher lengths of stay than patients undergoing a total knee replacement in all provinces except Prince Edward Island. On average, patients with a total hip replacement remained in hospital for 9.7 days compared to 7.7 days for those receiving a total knee replacement. Ontario and Alberta had lower average lengths of stay than the national average for both total hip and total knee replacements, while British Columbia had a lower average rate only for total knee replacements. In contrast, Prince Edward Island, Newfoundland and Labrador, Quebec and Manitoba all had higher-than-national-average lengths of stay for both total hip and knee procedures.

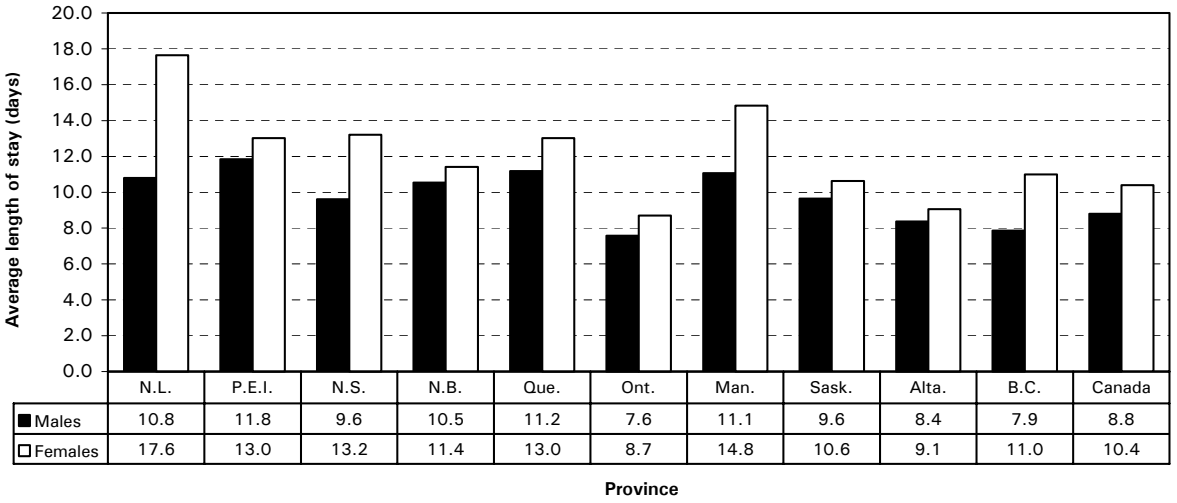
On average, women undergoing a total hip or total knee replacement procedure remained in hospital longer than men undergoing the same procedures in all provinces (Figures 16 and 17).



	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
■ Hips	14.2	12.5	11.7	11.1	12.2	8.2	13.2	10.2	8.8	9.7	9.7
□ Knees	10.8	12.5	8.0	9.3	10.8	6.4	9.5	8.5	7.4	7.5	7.7

There were 2 cases with invalid length of stay values. Northwest Territories numbers suppressed due to small numbers but included in national average. No total joint replacements performed in Yukon Territory and Nunavut.
Source: Hospital Morbidity Database, CIHI, 2001–2002

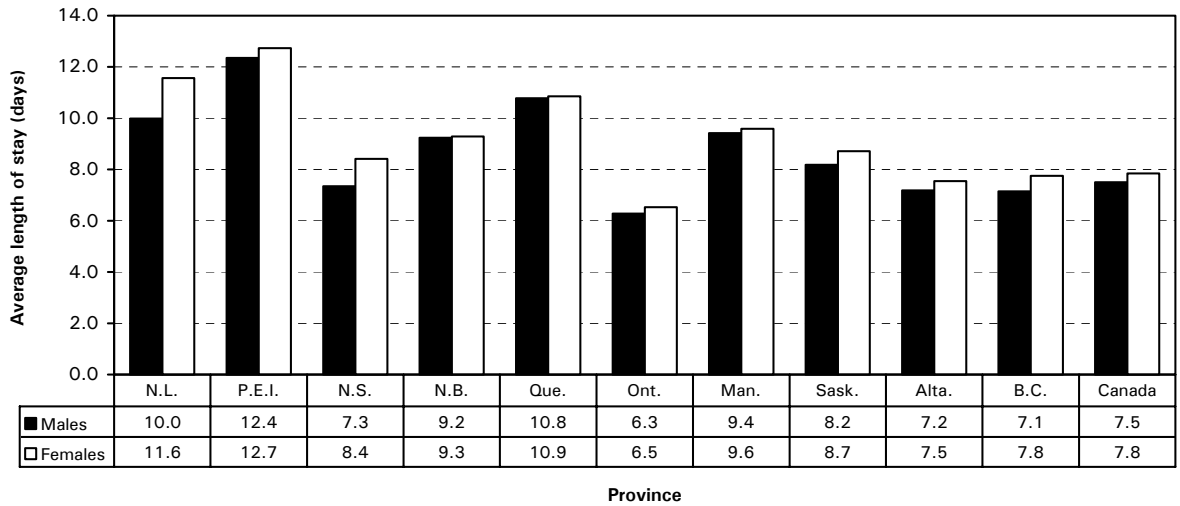
Figure 15. Average Length of Stay (Days) for Total Hip and Total Knee Replacement Patients by Province, 2001–2002



	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
■ Males	10.8	11.8	9.6	10.5	11.2	7.6	11.1	9.6	8.4	7.9	8.8
□ Females	17.6	13.0	13.2	11.4	13.0	8.7	14.8	10.6	9.1	11.0	10.4

Northwest Territories numbers suppressed due to small numbers but included in national average. No total joint replacements performed in Yukon Territory and Nunavut.
Source: Hospital Morbidity Database, CIHI, 2001–2002

Figure 16. Average Length of Stay for Total Hip Replacement Patients by Sex and Province, 2001–2002



	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Canada
■ Males	10.0	12.4	7.3	9.2	10.8	6.3	9.4	8.2	7.2	7.1	7.5
□ Females	11.6	12.7	8.4	9.3	10.9	6.5	9.6	8.7	7.5	7.8	7.8

There were 2 cases with invalid length of stay values. Northwest Territories numbers suppressed due to small numbers but included in national average. No total joint replacements performed in Yukon Territory and Nunavut.
Source: Hospital Morbidity Database, CIHI, 2001–2002

Figure 17. Average Length of Stay for Total Knee Replacement Patients by Sex and Province, 2001–2002

There was a noticeable decrease in the length of stay for total hip and knee replacements in all provinces since 1994–1995. Nationally, the average length of stay for patients undergoing a total hip replacement decreased by 29% from 13.6 days in 1994–1995 to 9.7 days in 2001–2002. Similarly, total knee replacement recipients now spend on average 7.7 days in hospital compared to 12.2 days in 1994–1995, a decrease of 37%.

Inhospital Mortality

Post-operative inhospital mortality is a relatively rare event among patients receiving a total hip or a total knee replacement (Table 17). Overall, in 2001–2002, less than 1% of patients undergoing total hip or total knee replacement surgery died in hospital (0.8% and 0.2%, respectively).

The risk of post-operative inhospital death appears to increase with age. For example, the percentage mortality of total hip replacement patients under 75 years was 0.3%, compared with 4.7% for patients over the age of 85. Among knee replacement patients, the percent mortality increased from 0.1% among patients under age 75 to 1.0% among patients aged 85 and older.

Table 17. Number of Inhospital Deaths Among Total Hip and Total Knee Replacement Patients by Age Group, Canada, 2001–2002

Age group	Total hip replacement patients		Total knee replacement patients	
	Number of recipients	Number of deaths	Number of recipients	Number of deaths
<75	13,197	46 (0.3%)	16,696	24 (0.1%)
75–84	5,499	60 (1.1%)	6,742	20 (0.3%)
85+	1,143	54 (4.7%)	764	8 (1.0%)
Total	**19,839**	**160 (0.8%)**	**24,202**	**52 (0.2%)**

Source: Hospital Morbidity Database, CIHI

Surgical and Clinical Characteristics

Important Note: *For this remaining section of the report, analyses are based on data submitted by orthopaedic surgeons directly to the CJRR or via the Ontario Joint Replacement Registry.*

Of the 16,819 submissions to the CJRR for total hip and total knee replacements for patients admitted between April 1, 2002 and March 31, 2003, 46% (n = 7,685) were total hip replacements and 54% (n = 9,134) were total knee replacements (Figure 18).

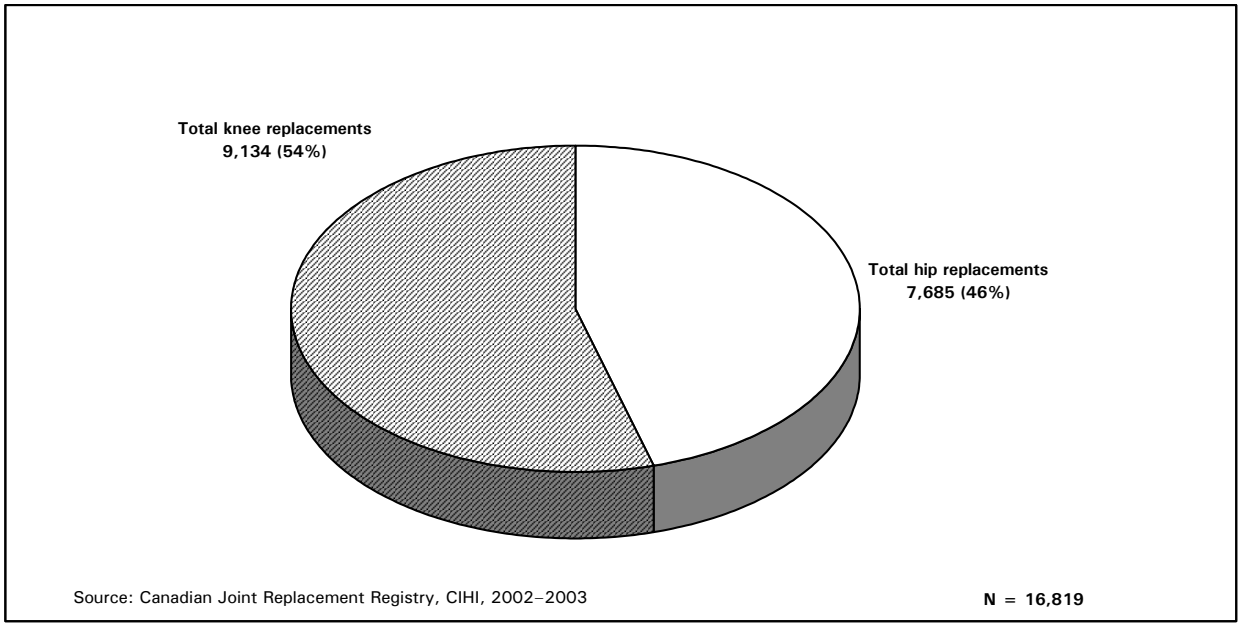


Figure 18. Total Hip and Total Knee Replacement Procedures Submitted in 2002–2003

Type of Replacement

Table 18 shows that 53% of hip replacement and 49% of knee replacements submitted were performed on the right side (n = 4,107 and 4,439, respectively), while 45% of both hips and knees were done on the left side (n = 3,467 and 4,099 respectively).

Of knee replacements, 6% were bilaterals, as opposed to less than 1% for these procedures done for hips. In total there were 638 bilateral hip and knee replacements performed, which represented 4% of all replacements submitted. A bilateral procedure consists of a total hip or total knee replacement that is performed on both the right and the left side of the same individual. The procedures may be two primary replacements, two revisions or one primary and one revision. Bilateral procedures include both simultaneous bilateral surgeries, where both replacements are performed during the same admission, and staged bilateral surgeries, where the replacements are carried out during two separate surgeries. Replacements where the side was unknown accounted for 69 (< 1%) surgeries.

Table 18. Total Hip and Knee Replacements by Side Location, 2002–2003

Joint	Side				All procedures
	Right only	Left only	Bilateral	Not stated	
Hips	4,107	3,467	60	51	7,685
% of all procedures	53.4%	45.1%	0.8%	0.7%	100.0%
Knees	4,439	4,099	578	18	9,134
% of all procedures	48.6%	44.9%	6.3%	0.2%	100.0%
Both hips and knees	8,546	7,566	638	69	16,819
% of all procedures	50.8%	45.0%	3.8%	0.4%	100.0%

Among total hip replacements, 87% (n = 6,673) were primary surgeries and 13% (n = 1,006) were revisions (Table 19). Primary total knee replacements accounted for 94% (n = 8,562) of all total knee replacements (Table 20). Revision surgeries accounted for the remaining 6% (n = 559).

Table 19. Type of Total Hip Replacement Procedures, 2002–2003

Type of replacement	Number of replacements	Percent of total
Primary	**6,673**	**86.9%**
Revisions	**1,006**	**13.1%**
First revision	734	9.6%
Second revision	199	2.6%
Third revision	56	0.7%
>3 revisions	17	0.2%
Excisions	**3**	**<0.1%**
Total	**7,682**	**100%**

Note: There are 3 hip surgeries for which type of procedure was not indicated.

Source: Canadian Joint Replacement Registry, CIHI, 2002–2003

Table 20. Type of Total Knee Replacement Procedures, 2002–2003

Type of replacement	Number of replacements	Percent of total
Primary	**8,562**	**93.8%**
Revision	**559**	**6.1%**
First revision	465	5.1%
Second revision	77	0.8%
Third revision	13	0.1%
>3 revisions	4	0.0%
Excision	**5**	**0.1%**
Total	**9,126**	**100%**

Note: There are 8 knee surgeries for which type of procedure was not indicated.

Source: Canadian Joint Replacement Registry, CIHI, 2002–2003

Indications for Surgery

For primary replacements only, surgeons were asked to record *one or more* diagnosis groupings that were applicable to the patient. Degenerative osteoarthritis was the most common diagnosis grouping indicated for both primary total hip replacements (81%) and primary total knee replacements (93%) (Figures 19 and 20).

For primary total hip replacements, the second most commonly reported diagnosis grouping was osteonecrosis (7%), followed by inflammatory arthritis (5%). For primary total knee replacements, the second most commonly reported grouping was inflammatory arthritis (5%), followed by post-traumatic osteoarthritis (2%).

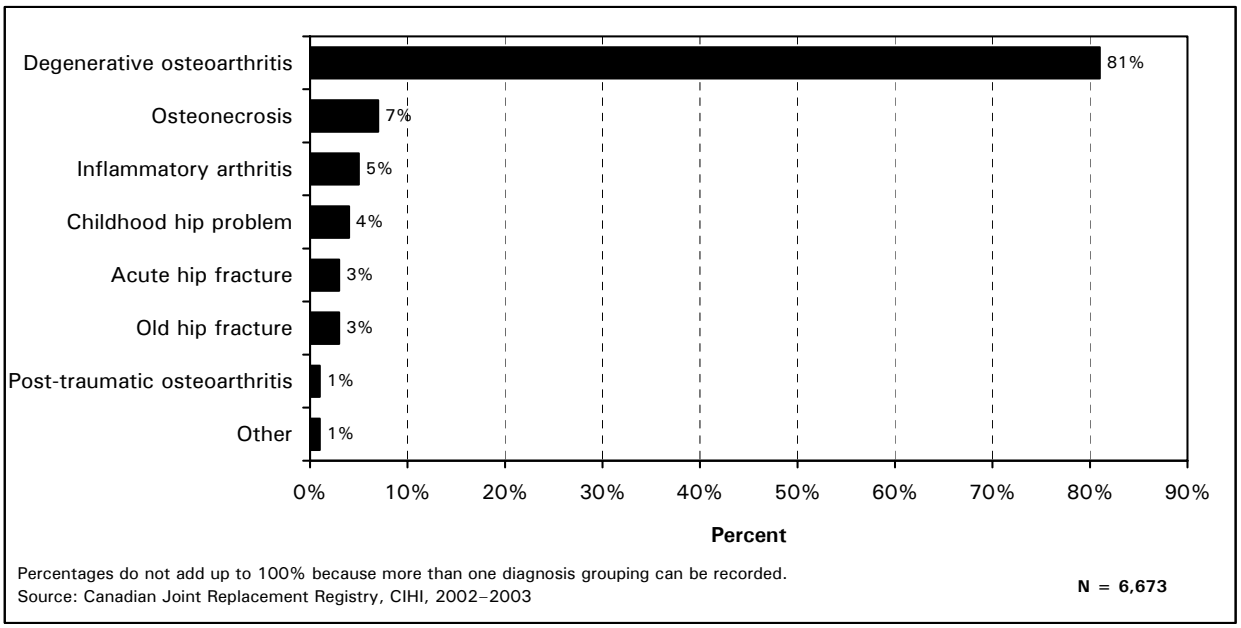


Figure 19. Primary Total Hip Replacement Procedures by Diagnosis Grouping

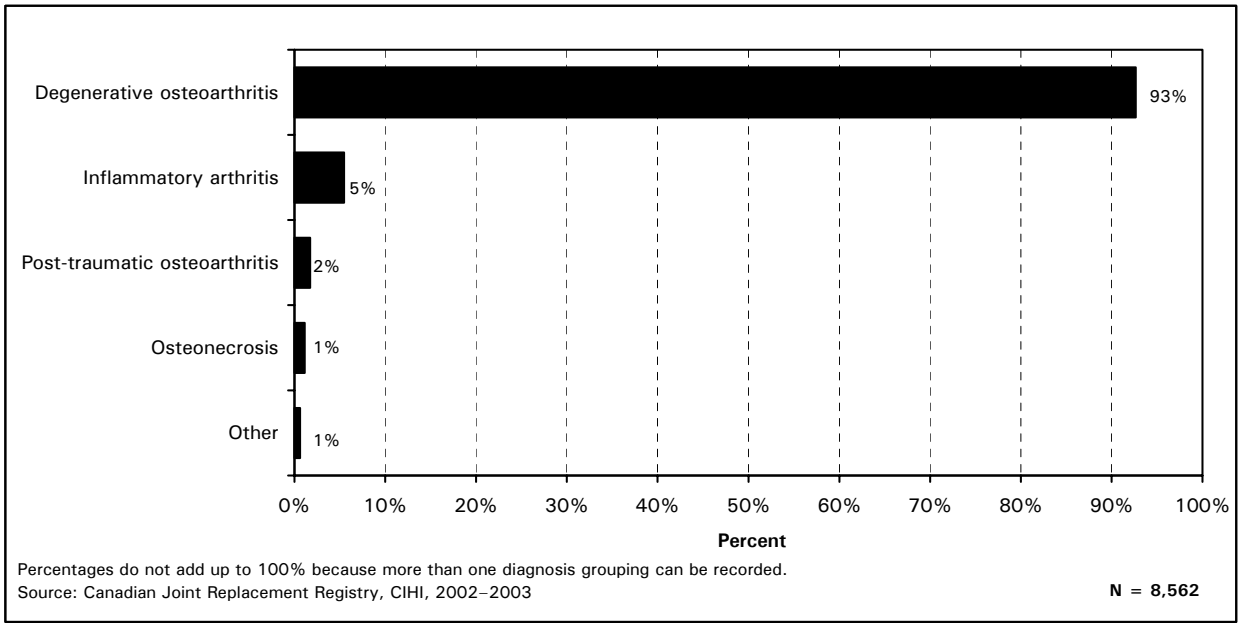


Figure 20. Primary Total Knee Replacement Procedures by Diagnosis Grouping

Reasons for Revision

For revision replacements only, surgeons were asked to record *one or more* reasons for revision among a specified list of categories.

The most common reason for revision among hip replacements was aseptic loosening (55%), followed by osteolysis (33%) and poly wear (30%) (Figure 21).

Among the knee replacement revisions, the most common reason for revision reported was aseptic loosening (39%), followed by poly wear (36%), and instability (26%) (Figure 22).

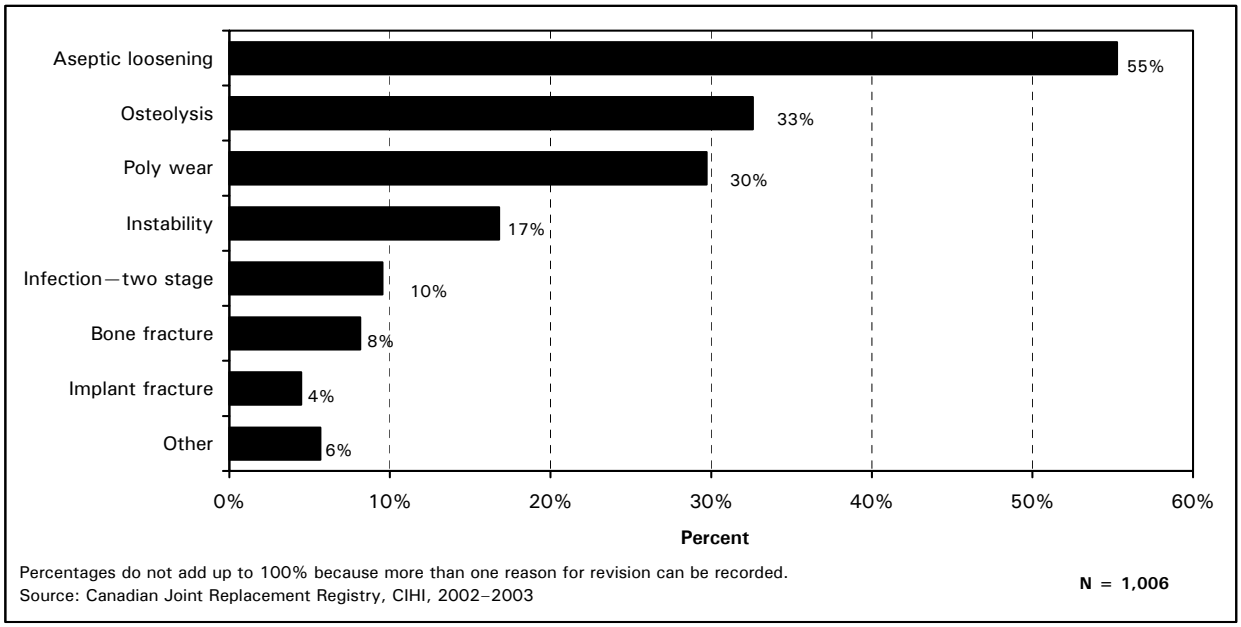


Figure 21. Revised Total Hip Replacement Procedures by Reason for Revision

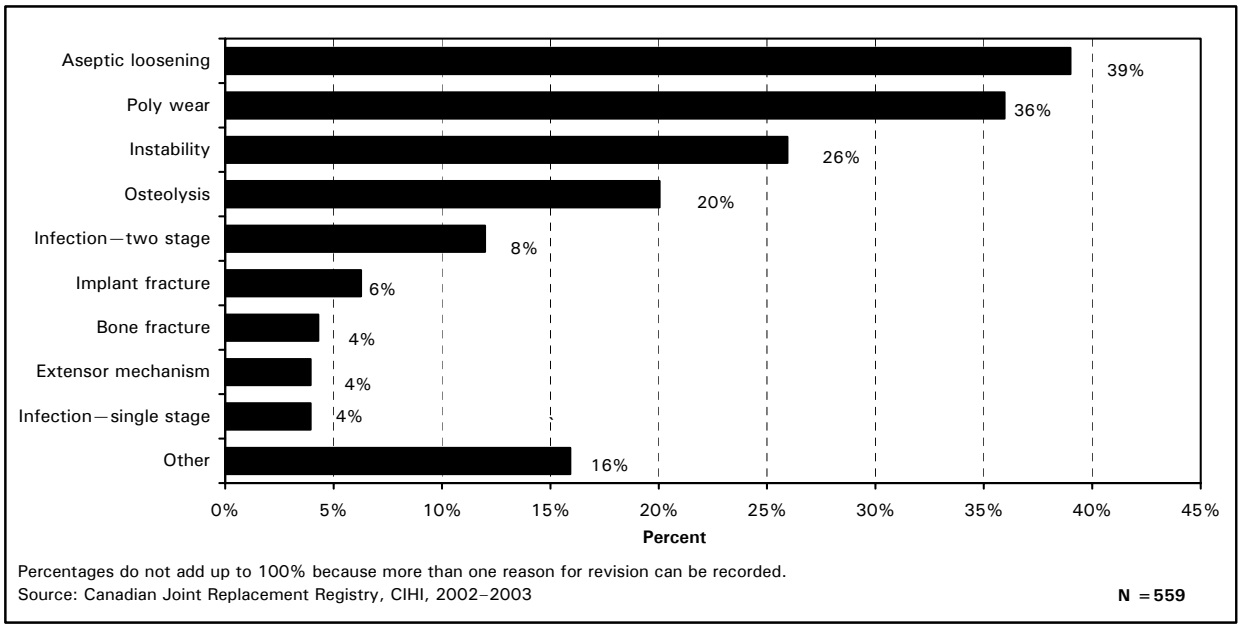


Figure 22. Revised Total Knee Replacement Procedures by Reason for Revision

Previous Operations

Among primary total hip replacement procedures, 93% (n = 6,205) had no previous operation recorded.

Among primary total knee replacement procedures (Figure 23), 72% did not have a previous operation reported. Arthroscopic debridement was reported 15% of the time, with arthroscopic menisectomy and open menisectomy reported 7% and 6% of the time, respectively.

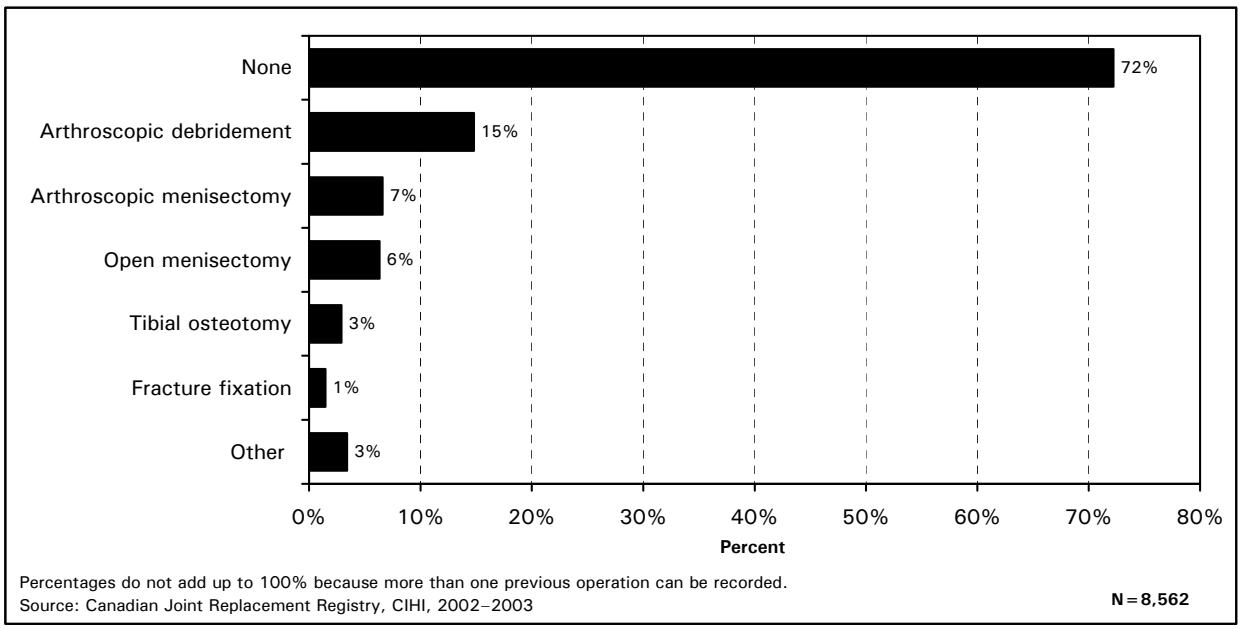
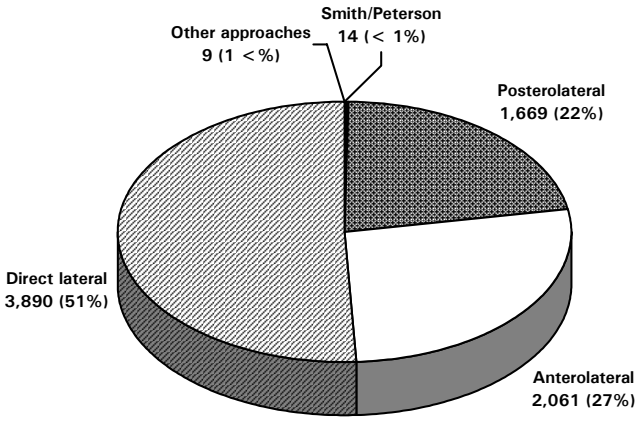


Figure 23. Primary Total Knee Replacement Procedures by Previous Operation

Surgical Approach

The distribution of total hip replacement procedures by surgical approach is shown in Figure 24. Half of the procedures were reported to have employed the direct lateral approach (51%), followed by the anterolateral approach (27%), and the posterolateral approach (22%). The Smith/Peterson approach was used in less than 1% of surgeries.



Note: Surgical approach information was missing in 36 surgeries.
Source: Canadian Joint Replacement Registry, CIHI, 2002–2003

N = 7,643

Figure 24. Total Hip Replacement Procedures by Surgical Approach

Figure 25 shows the distribution of surgical approaches among total knee replacements. The medial approach was used in the majority (86%) of procedures. The intravastus and subvastus approaches were used in only 10% and 2% of the procedures, respectively.

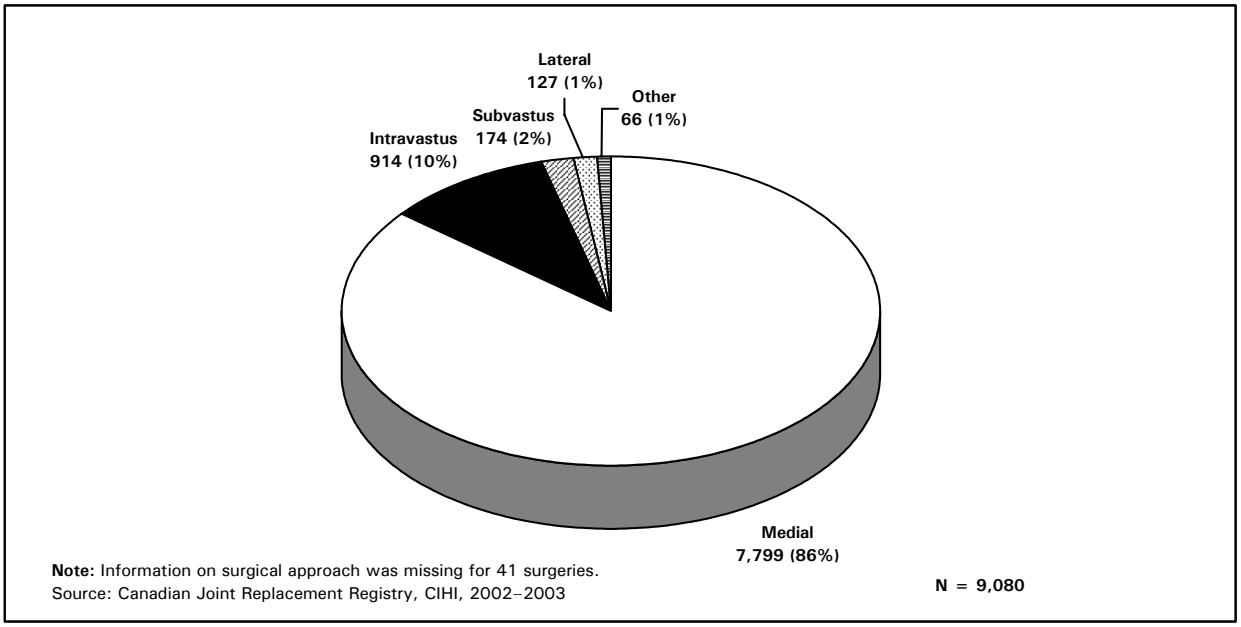


Figure 25. Total Knee Replacement Procedures by Surgical Approach

Antibiotic Prophylaxis and Deep Vein Thrombosis Prevention

Administration of antibiotics to prevent post-operative infection following a total hip or total knee replacement appears to be a widespread practice among Canadian orthopaedic surgeons. Of total hip and knee replacement procedures, 99% (n = 16,710) reported the administration of antibiotics.

Total joint replacement surgery is associated with a high risk of deep venous thrombosis (DVT). DVT prevention was reported in almost all (99.5%) total hip and total knee replacement procedures in this sample. The three most common DVT prophylactic agents used were low molecular weight Heparin (55%), Warfarin (48%), and pneumatic stockings (8%) (Figure 26).

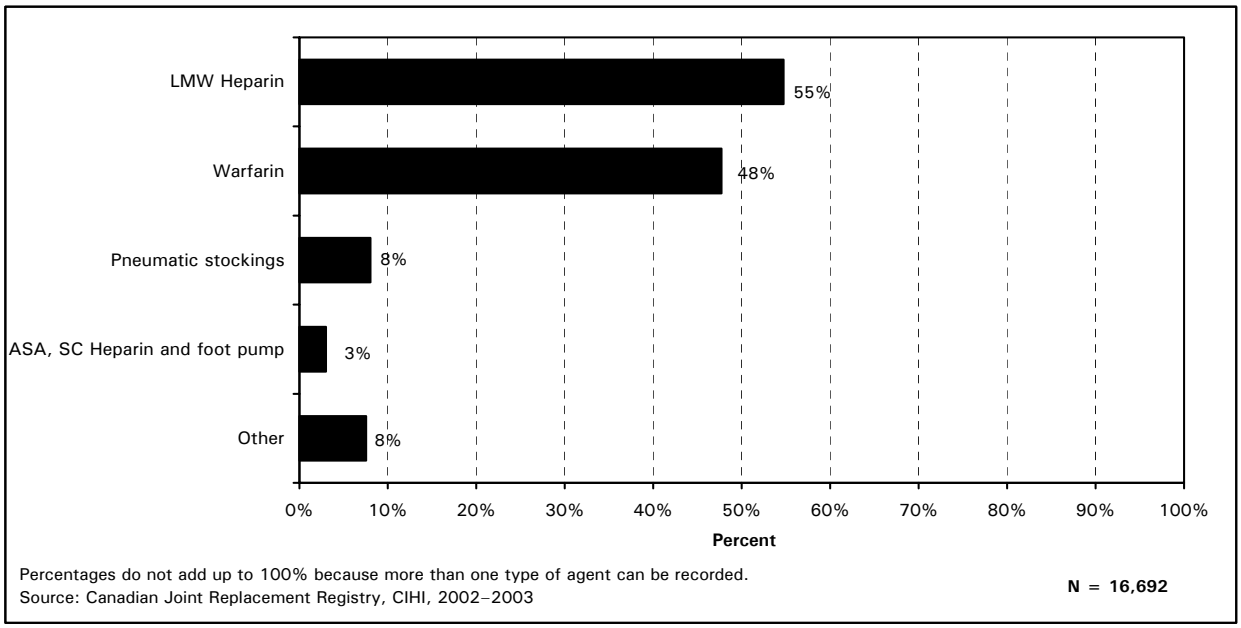


Figure 26. DVT Prevention by Type of Agent Used

Component Characteristics

Tables 21 and 22 provide the frequencies with which arthroplastic components were replaced in primary and revision total hip and total knee replacement procedures. In general, all components were replaced in almost every primary procedure. With revision procedures, however, the frequency with which components were replaced varied significantly between components. For total hip replacement revisions, the percentage of component replacement was highest for femoral heads (92%) and lowest for femoral stems (59%). In the case of total knee replacement revisions, the percentage of component replacement was higher for the tibial component (93%) than for the femoral component (74%). The patella component was resurfaced in just about half (49%) of all total knee replacement revisions.

Table 21. Total Hip Replacements (Primary and Revisions) by Type of Components Replaced, 2002–2003

Response category	Primary components replaced							
	Femoral stem	%	Femoral head	%	Acetabular component	%	Acetabular inserts	%
Yes	6,655	99.7%	6,642	99.5%	6,570	98.5%	6,190	92.8%
No	10	0.1%	25	0.4%	91	1.4%	467	7.0%
Not stated	8	0.1%	6	0.1%	12	0.2%	16	0.2%
Total primaries	**6,673**	**100.0%**	**6,673**	**100.0%**	**6,673**	**100.0%**	**6,673**	**100.0%**
Revision components replaced								
Yes	589	58.5%	930	92.4%	662	65.8%	797	79.2%
No	417	41.5%	75	7.5%	343	34.1%	209	20.8%
Not stated	0	0.0%	1	0.1%	1	0.1%	0	0.0%
Total revisions	**1,006**	**100.0%**	**1,006**	**100.0%**	**1,006**	**100.0%**	**1,006**	**100.0%**

Source: Canadian Joint Replacement Registry, CIHI, 2002–2003

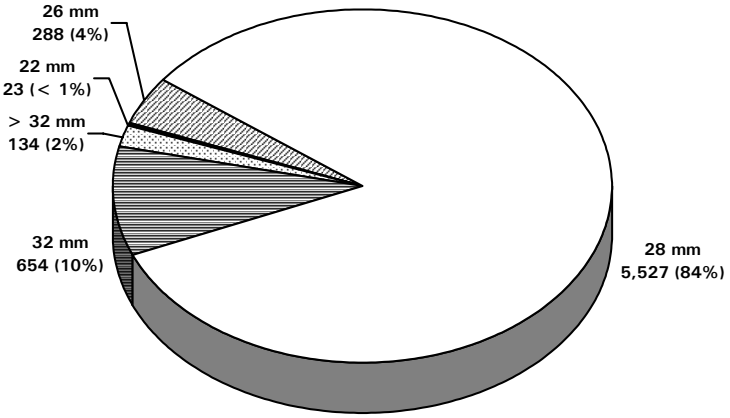
Table 22. Total Knee Replacements (Primary and Revisions) by Type of Components Replaced, 2002–2003

Response category	Primary components replaced/resurfaced					
	Femoral component replaced	%	Tibial component replaced	%	Patella component resurfaced	%
Yes	8,548	99.8%	8,511	99.4%	6,477	75.6%
No	7	0.1%	43	0.5%	2,074	24.2%
Not stated	7	0.1%	8	0.1%	11	0.1%
Total primaries	**8,562**	**100.0%**	**8,562**	**100.0%**	**8,562**	**100.0%**
Revision components replaced/resurfaced						
Yes	413	73.9%	518	92.7%	273	48.8%
No	146	26.1%	41	7.3%	284	50.8%
Not stated	0	0.0%	0	0.0%	2	0.4%
Total revisions	**559**	**100.0%**	**559**	**100.0%**	**559**	**100.0%**

Source: Canadian Joint Replacement Registry, CIHI, 2002–2003

Figures 27 and 28 show the distribution of reported head sizes for replaced femoral heads among primary and revised total hip replacements, respectively. Among primary hip replacements, by far, the most frequently reported head size was 28 mm (84%). The 32 mm head size was used in only 10% of the procedures.

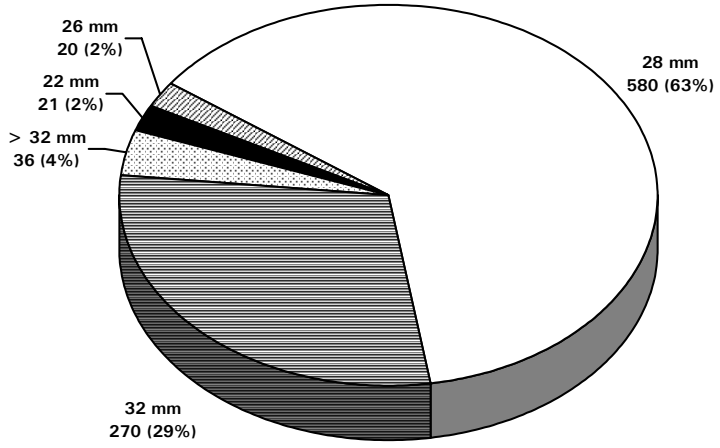
Among revised total hip replacements, 28 mm was again the leading choice (63%), with the 32 mm head size representing 29% of the procedures.



Note: There were 16 primary femoral head replacements for which size was not indicated.
Source: Canadian Joint Replacement Registry, CIHI, 2002–2003

N = 6,626

Figure 27. Primary Total Hip Replacements by Size of Replaced Femoral Head



Note: There were 3 revision femoral head replacements for which size was not indicated.
Source: Canadian Joint Replacement Registry, CIHI, 2002–2003

N = 927

Figure 28. Revised Total Hip Replacements by Size of Replaced Femoral Head

Fixation Methods

Figures 29 and 30 show the type of fixation method used for replaced femoral stems and replaced acetabular components, respectively, among total hip replacements. Cement was used in just under half (44%) of the procedures for femoral stems, but only for 7% of the procedures for acetabular components.

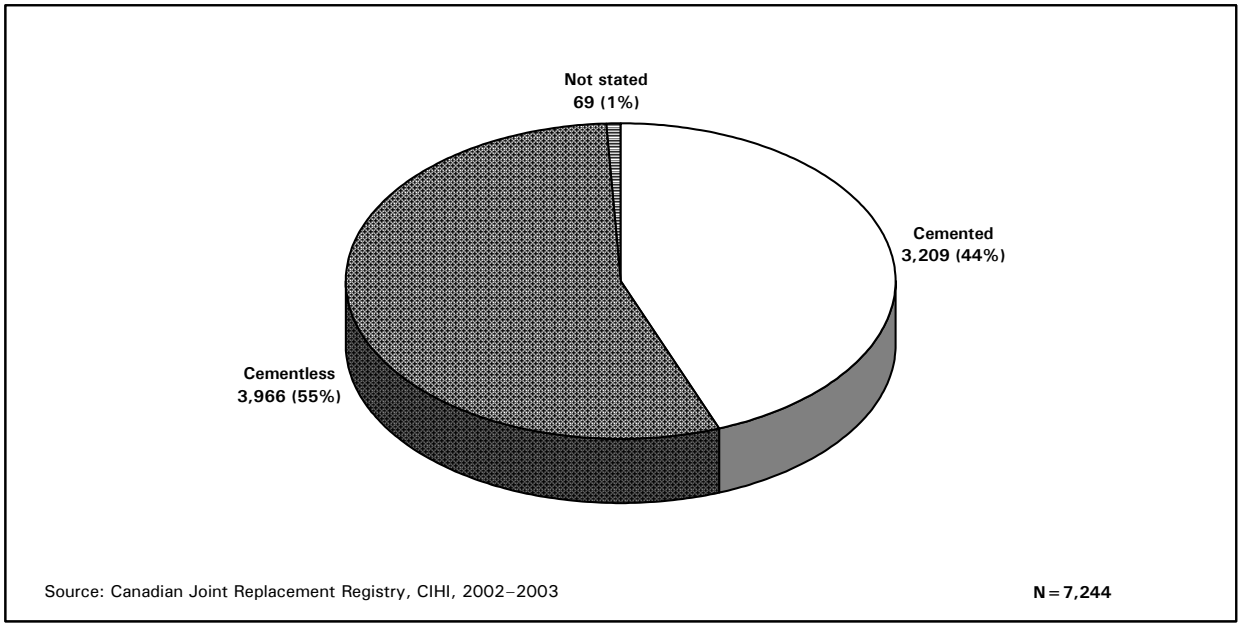


Figure 29. Replaced Femoral Stems by Fixation Method, Total Hip Replacements

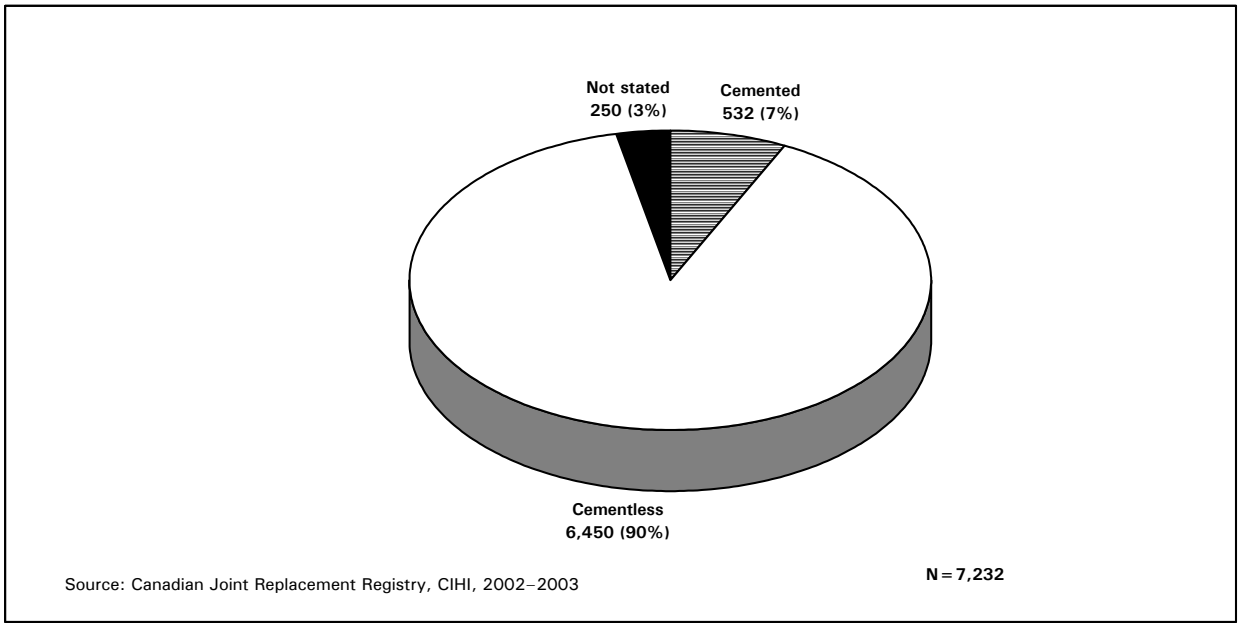


Figure 30. Replaced Acetabular Components by Fixation Method, Total Hip Replacements

Figures 31, 32, and 33 show the type of fixation method used for replaced femoral, tibial, and resurfaced patella components, respectively, among knee replacement surgeries. Cement use was by far the most common fixation method: 85% of the time among femoral replacements, 96% among tibial replacements and 98% among resurfaced patella components.

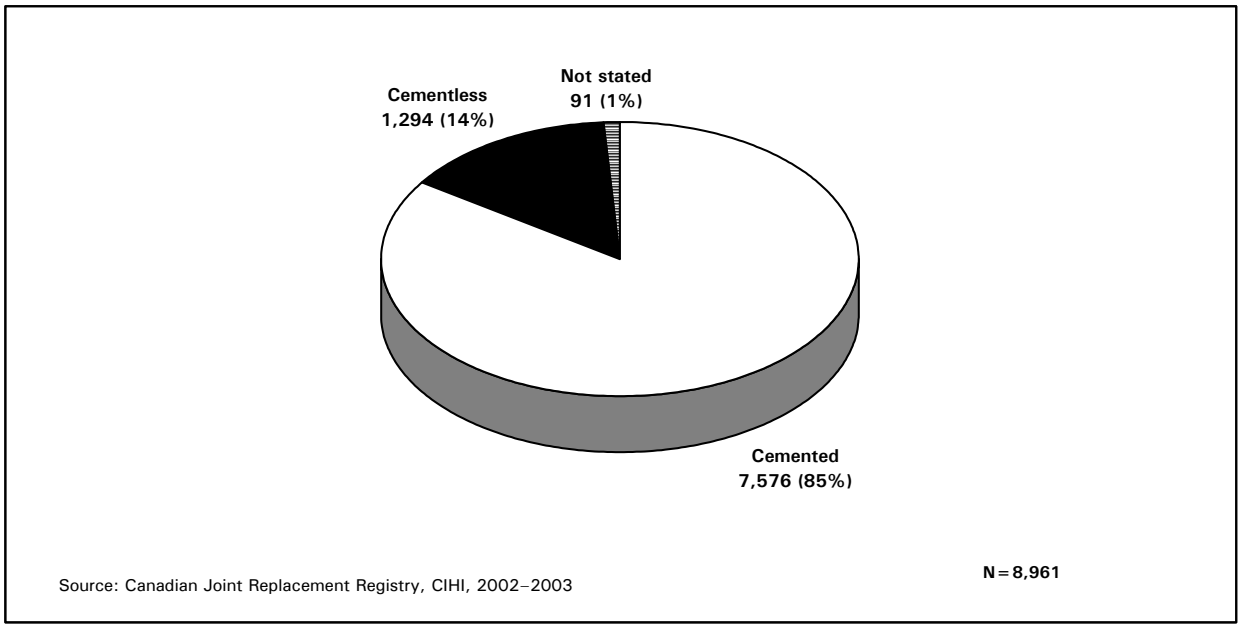


Figure 31. Replaced Femoral Components by Fixation Method, Total Knee Replacements

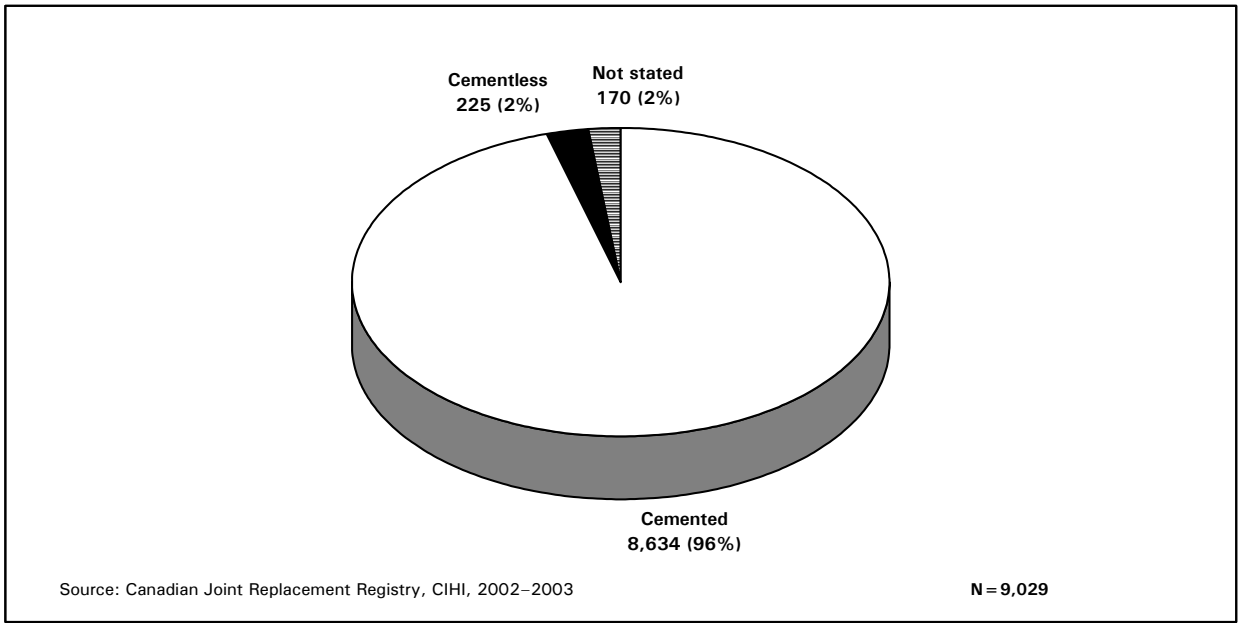


Figure 32. Replaced Tibial Components by Fixation Method, Total Knee Replacements

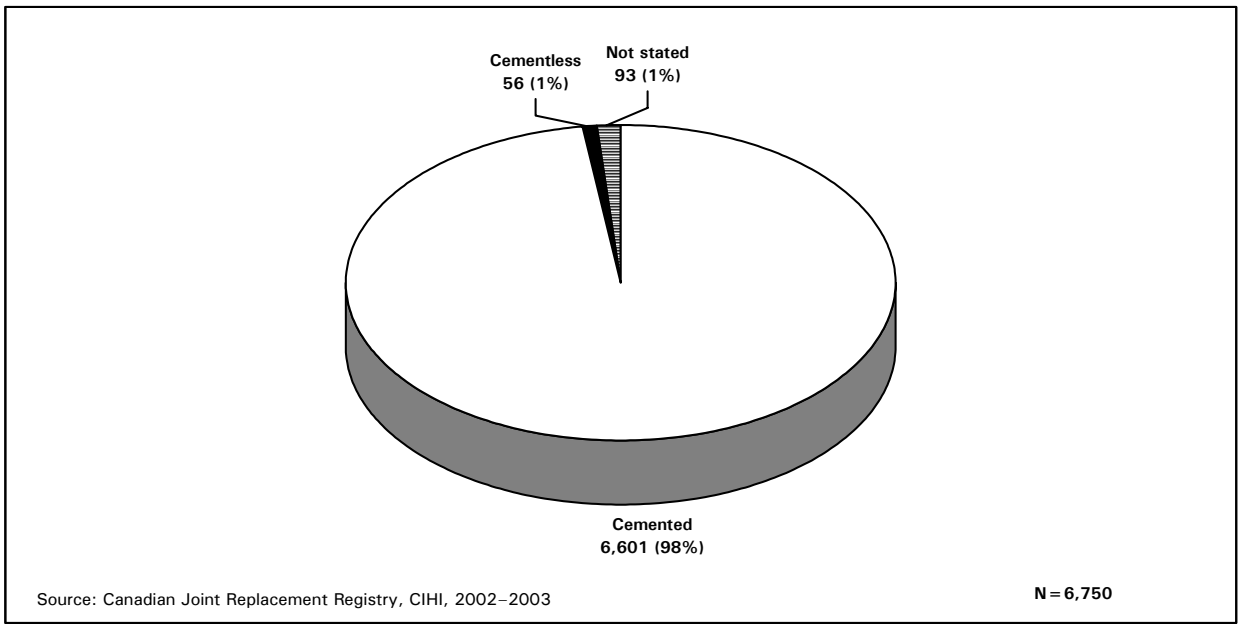


Figure 33. Resurfaced Patella Components by Fixation Method, Total Knee Replacements

Material Composition

Figure 34 shows the various combinations of femoral head and acetabular liner material used in total hip replacements for which the material composition was reported for both replaced components. The most frequently reported combination was a cobalt chrome femoral head with a polyethylene standard liner (46%), followed by a similar combination of a cobalt chrome head with a polytheylene cross-linked liner (39%).

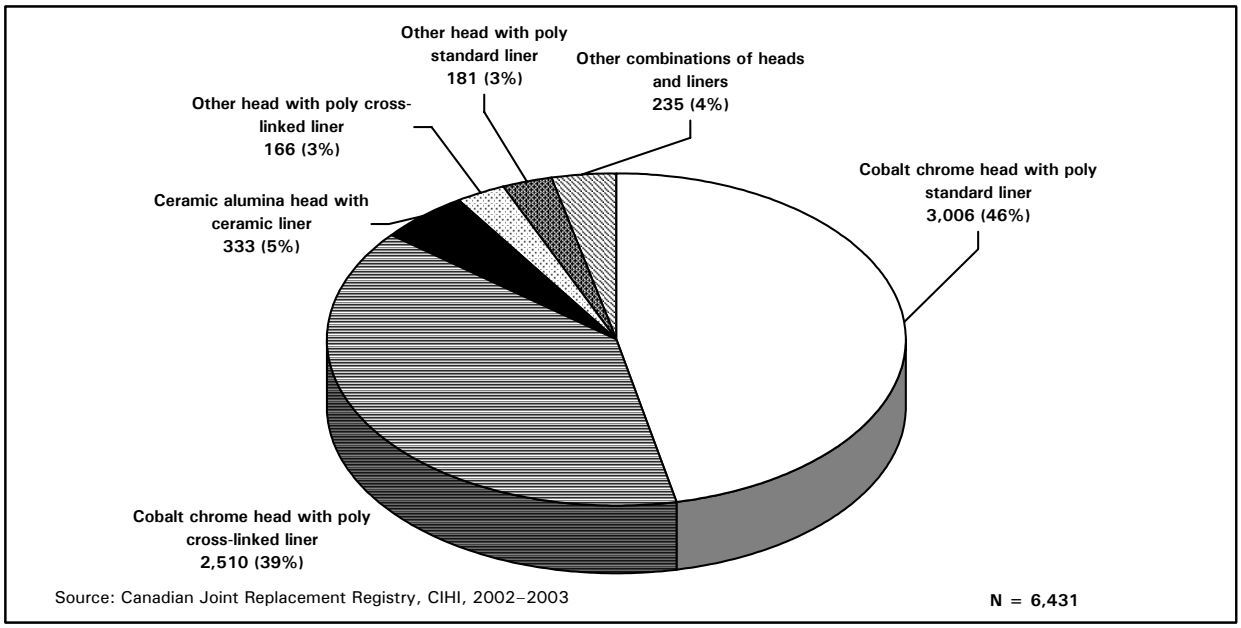


Figure 34. Replaced Femoral Heads and Acetabular Liners by Material Composition

Discussion

The CJRR 2004 Annual Report makes use of multiple data sources to highlight important trends and regional variations for total hip and knee replacements across Canada. This information will be useful to decision-makers involved in managing health care systems and for orthopaedic surgeons and related care providers. The surgical data also provides surgeons with a valuable tool to use in improving their practices and related patient outcomes. The CJRR's success to-date is in large part due to the collaborative work of the many partners involved.

The CJRR data presented in this report highlight several important variations in the rates and lengths of stay for total hip and knee replacements across Canada. The CJRR can be used to dig deeper into these issues to gain a better understanding of the reasons for these variations. Furthermore, the CJRR can be used to inform decisions and policies intended to improve access to these services and to promote better long-term outcomes for the patients who need these services.

Two significant changes to the CJRR since the last annual report are the addition of Ontario Joint Replacement Registry (OJRR) data to the CJRR and the coding classification change among hospitals in five provinces and one territory from ICD-9/CCP and ICD-9-CM to ICD-10-CA/CCI.

The flow of OJRR data to the CJRR via the Ontario Ministry of Health and Long-Term Care is a landmark event in the history of the CJRR. Ontario is estimated to have one third (34%) of orthopaedic surgeons in Canada who perform hip and knee replacements. With over 7,500 additional procedures from the OJRR, Ontario data now comprises almost half (45%) of the CJRR's 2002–2003 dataset.

ICD-10-CA/CCI coding allows for greater detail in the coding for hip and knee replacements. Most importantly, partial knee replacements can now be distinguished from total knee replacements, a feature not available in the CCP classification system. The switch to the new coding classification system, ICD-10-CA/CCI is occurring in a staggered manner across the country. All provinces and territories except Manitoba and Quebec will have made the change as of the 2002-2003 Hospital Morbidity Database. This data year will be presented in the next CJRR annual report. Manitoba will report in the new classification system in the 2003–2004 data year. At the time of publication, Quebec had not yet indicated a date of implementation for ICD-10-CA/CCI. In the interim, national reporting will consist of a mix of classification systems.

Several factors likely contribute to the variations in provincial/territorial rates and lengths of stay for total hip and knee replacements in Canada. Variations in clinical practices regarding indications for medical management and surgical treatment of these conditions can play a role.[11] Other factors related to access to care may also play a role, as measured by referral patterns, the number of hospital beds dedicated to orthopaedic patients, operating room time and health human resources (i.e. population density of orthopaedic surgeons and referring physicians). A 1999 Canadian study that examined reasons for regional variation in the knee replacement surgery in Ontario found that after controlling for

age, sex and access to care, opinions or enthusiasms of orthopaedic surgeons for the procedure were found to be the primary determinant of geographical variation.[12] The prevalence of predisposing clinical conditions (e.g. osteoarthritis) and patient preferences also influence the demand for total joint replacements. Lastly, the aging of the population contributes to an increase in demand for total hip and knee replacement procedures. It is important to note that rates in this report have already been adjusted for differences in age structures between provinces and territories. This means that other factors also account for the variation in rates. It is likely that a portion of this variation is due to differences in the case mix of patients (e.g. different ratios for primaries to revisions as well as emergency to elective surgeries) across the provinces. Primary and revision surgeries as well as emergency and elective operations are included in the reported counts of total hip and knee replacements.

With the exception of Nunavut and Yukon Territory, where total joint replacements are not performed, we do not know all the reasons why patients relocate to another province to have their total joint replacement done. The CJRR has the capacity to provide detailed intra-provincial analyses of the proportion of patients who go outside their home region for these procedures.

The CJRR is a valuable source of information that can be used by policy-makers and providers to plan current and future delivery of services.

Future Directions

The CJRR is expected to continue on its growth trajectory and become an increasingly relevant source of health information for decision-makers. The amount of data captured from orthopaedic surgeons will continue to increase as more surgeons participate in the CJRR and the OJRR. Regular electronic data submissions will also increase over the coming years (e.g. plans are underway to receive electronic data from a large British Columbia facility in 2004–2005). Data from this facility will be included in the next CJRR annual report.

Over the next year, CIHI will conduct a comprehensive data quality evaluation of CJRR, based on CIHI's Data Quality Framework, and will post data quality information on the external website. A privacy impact assessment of the CJRR is in its final stages and will be available on the website shortly. Data quality and privacy practices are high priority issues for CJRR and CIHI.

A national registry provides the most effective and pragmatic approach for assessing the outcomes and quality of orthopaedic prostheses, as well as best practices, and cost-effectiveness. Following hip and knee replacement recipients over time will enable the registry to determine which implants are least likely to be replaced. The CJRR is an excellent resource for planning health services, aiding decision-making and carrying out health services research.

In the coming fiscal year, the CJRR will be exploring ways to include data on wait times to determine if the CJRR can be used to quantify the patient population on wait lists for a total hip or knee replacement in Canada. Little is currently known about how many patients are waiting for a total joint replacement in Canada and how long they wait to have their operation once a decision is made to proceed with the surgery. Wait time may impact on the pre-operative physical functioning and post-operative clinical outcomes of joint replacement candidates. Information on surgical wait times has been made available in some parts of the country, including British Columbia,[13] Alberta[14] and Saskatchewan.[15]

Over time, the CJRR will be able to measure and monitor revision rates for these surgeries by tracking individual patients who have had a primary total hip and total knee replacement and subsequently require a revision operation. This will fill an important gap by providing information on the outcomes of these surgeries and the implants used over time.

Other avenues that may be explored by the CJRR in the future are providing cost-related data on total joint replacement in Canada, length and impact of rehabilitation care following surgery on the recovery process, and the relationship between injury (i.e. hip fracture) and total hip replacement.

References

1. Canadian Institute for Health Information (CIHI). *Canadian Joint Replacement Registry (CJRR). Total Hip and Total Knee Replacements in Canada (includes 1994–1995 to 1999–2000 data).* 2002.

2. Canadian Institute for Health Information (CIHI). *Canadian Joint Replacement Registry (CJRR) Supplementary report. Total Hip and Total Knee Replacements)*. 2002.

3. Brady O. W., Masri B. A., Garbuz D. S. and Duncan C. P. "Rheumatology: 10. Joint replacement of the hip and knee—when to refer and what to expect." *Canadian Medical Association Journal*, 2000; 163(10):1285–1291.

4. Moran C. G. and Horton T. C. "Total knee replacement: the joint of the decade. A successful operation, for which there is a large unmet need." *British Medical Journal*, 2000; 320:820.

5. Health Canada. *Arthritis in Canada: An Ongoing Challenge.* Ottawa: Health Canada, 2003 (Cat. #H39-4/14-2003E).

6. Sochart D. H., Long A. L. and Porter M. L. "Joint responsibility: the need for a national arthroplasty register." *British Medical Journal*, 1996; 313 (7049):66-67.

7. *CIHI Data Quality Framework.* Canadian Institute for Health Information. August 2003.

8. Ontario Joint Replacement Registry. *Total Joint Replacements in Ontario: First Edition*, 2003 (in press).

9. Statistics provided to CIHI by Med-Écho, Quebec, October 2003.

10. Herberts P. and Malchau H. "Long-term registration has improved the quality of hip replacement. A review of the Swedish THR Register comparing 160,000 cases." *Acta Orthop Scand*, 2000; 71(2):111-121.

11. Goel V., William J. I., Anderson C. M., Blackstien-Hirsch P., Fooks C., and Naylor C. D. (eds). *Patterns of Health Care in Ontario: ICES Practice Atlas 2nd Edition*. Institute for Clinical Evaluative Sciences. 1996.

12. Wright J. G., Hawker G. A., Bombardier C., Croxford R., Dittus R. S., Freund D. A., and Coyte P. C. *Physician Enthusiasm as an Explanation for Area Variation in the Utilization of Knee Replacement Surgery.* Med. Care 1999; 37(9):946–956.

13. British Columbia Ministry of Health Services Surgical Wait List Registry http://www.healthservices.gov.bc.ca/waitlist/

14. Alberta Waitlist Registry http://www.health.gov.ab.ca/AWR/WaitListData.jsp

15. Saskatchewan Surgical Care Network Wait List Information http://www.sasksurgery.ca/wait-list-info.html

Appendix A

Glossary

Glossary

Age-Standardized Rate
A rate that is statistically modified to eliminate the effect of different age distributions in the population over time, or between different populations.

Percent Revisions
The number of revisions relative to the total number of replacements.

Revision
Exchange or removal of any components. This may include the exchange of the liner or head component.

Revision Rate
The revision rate is the percentage of primary replacements that have had a subsequent removal or exchange of one or more components.

Total Hip Replacement
Total hip replacement (THR) or total hip arthroplasty (THA) involves the replacement of both the upper femur and the acetabulum. The two parts of the hip joint are removed and replaced with smooth artificial surfaces. This hip is composed of the hip socket (acetabulum, a cup-shaped bone in the pelvis) and the "ball" or head of the femur. The artificial socket is made of high-density plastic, while the artificial ball with its stem is made of a strong stainless steel metal. These artificial pieces are implanted into healthy portions of the pelvis and femur and affixed with a bone cement (methyl methacrylate) or through a cementless procedure in which the implant has a rough surface that the bone grows into over time (WCWL Project, Literature Review on Hip and Knee Joint Replacement, 2000).

Total Knee Replacement
Total knee replacement (TKR) or total knee arthroplasty (TKA), involves the replacement of injured or damaged parts of the knee joint with artificial components. The procedure is performed by separating the muscles and ligaments around the knee to expose the knee capsule. The capsule is opened, exposing the inside of the joint. The ends of the thighbone (femur) and the shinbone (tibia) are removed, and often the underside of the kneecap (patella) is removed. The artificial parts are then cemented into place. The new knee consists of a metal shell on the end of the femur, a metal and plastic trough on the tibia, and if needed, a plastic button on the kneecap (WCWL Project, Literature Review on Hip and Knee Joint Replacement, 2000).

Appendix B

Additional Tables and Figures

Appendix B—Additional Tables and Figures

Table of Contents

Tables

Table B.1. CCI and CCP Hip Replacement Codes in 2001–2002 ..... B–1

Table B.2. CCI and CCP Codes for Total Knee Replacements in 2001–2002 ..... B–2

Table B.3. Partial and Total Knee Replacement Procedures by Submitting Hospital Province, ICD-10-CA/CCI Provinces Only B–3

Table B.4. Number of Total Hip Replacement Procedures Performed in Canada Based on Patient Residence, 1994–1995 to 2001–2002 ..... B–4

Table B.5. Number of Total Knee Replacement Procedures Performed in Canada Based on Patient Residence, 1994–1995 to 2001–2002 ..... B–5

Table B.6. Number of Primary and Revision Total Hip Replacements Performed in Canada by Province, 2001–2002 ..... B–6

Table B.7. Number of Primary and Revision Total Knee Replacements Performed in Canada by Province, 2001–2002 ..... B–7

Figures

Figure B.1. Distribution of Total Hip Replacement Procedures Submitted by Participating Surgeons, by Patient Age B–8

Figure B.2. Distribution of Total Knee Replacement Procedures Submitted by Participating Surgeons, by Patient Age B–8

Table B.1. CCI and CCP Hip Replacement Codes* in 2001–2002

1.VA.53.^^ Implantation of internal device, hip joint	Cemented	Uncemented	Using bone autograft (uncemented)	Using bone homograft (uncemented)	Using combined bone graft and cement or paste
Open approach					
Dual-component prosthetic device (femoral and acetabular)	1.VA.53.LA-PN-N	1.VA.53.LA-PN	1.VA.53.LA-PN-A	1.VA.53.LA-PN-K	1.VA.53.LA-PN-Q
Single-component prosthetic device (femoral)	1.VA.53.LA-PM-N	1.VA.53.LA-PM	1.VA.53.LA-PM-A	1.VA.53.LA-PM-K	1.VA.53.LA-PM-Q
Robotics assisted approach (e.g. telemanipulation of tools)					
Dual-component prosthetic device (femoral and acetabular)	1.VA.53.PN-PN	1.VA.53.PN-PN-N	1.VA.53.PN-PN-A	1.VA.53.PN-PN-K	1.VA.53.PN-PN-Q
Single-component prosthetic device (femoral)	1.VA.53.PN-PM	1.VA.53.PN-PM-N	1.VA.53.PN-PM-A	1.VA.53.PN-PM-K	1.VA.53.PN-PM-Q

Rubric	CCP code	CCP description
93.5–Total hip replacement	93.51	Total hip replacement, cemented
	93.59	Other total hip replacement
	93.52	Revision of total hip replacement, cemented
	93.53	Revision of total hip replacement, uncemented

Note:

1.VA.53.^^ **Implantation of internal device, hip joint**

Includes: Arthroplasty with implantation prosthetic device, hip
Hemiarthroplasty with implantation prosthetic device, hip
Replacement, hip, using prosthetic device
Reduction with fixation and implantation of prosthetic device, hip

Excludes: Implantation, prosthetic device to acetabulum alone

* For CCI codes, only dual component prosthetic device codes are considered in this report, as they refer to total, not partial hip replacements.

Table B.2. CCI and CCP Codes for Total Knee Replacements* in 2001–2002

1.VG.53.^^ Implantation of internal device, knee joint	Cemented	Uncemented	With bone autograft	With bone homograft	With combined bone graft and cement or paste
Cement spacer (temporary) (impregnated with antibiotics)	1.VG.53.LA-SL-N	---	---	---	---
Dual-component prosthetic device (bicondylar)	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
Single-component prosthetic device (unicondylar)	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
Tri-component prosthetic device (medial, lateral and patellofemoral)	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

Rubric	CCP code	CCP description
93.4—Arthroplasty of the knee and ankle	93.41	Total knee replacement, (geomedic) (polycentric)
	93.40	Revision of total knee replacement, (geomedic) (polycentric)

Note:

1.VG.53.^^	**Implantation of internal device, knee joint**
Includes:	Arthroplasty with implantation of prosthetic device, knee
	Hemiarthroplasty with implantation of prosthetic device, knee
	Replacement, knee, using prosthetic device
Excludes:	Patellaplasty alone using prosthetic device
	Replacement, patellofemoral alone

* All CCI codes are considered within this report.

Table B.3. Partial and Total Knee Replacement Procedures by Submitting Hospital Province, ICD-10-CA/CCI Provinces Only

Submitting hospital province	Extent of knee replacement procedure					
	Partial* (CCI)		Total** (CCI)		All knee replacements (CCI)	
	Number	%	Number	%	Number	%
Newfoundland and Labrador	16	6.2%	242	93.8%	258	100.0%
Prince Edward Island	6	5.5%	104	94.5%	110	100.0%
Nova Scotia	51	5.8%	825	94.2%	876	100.0%
Saskatchewan¥	13	2.0%	634	98.0%	647	100.0%
British Columbia	222	7.7%	2,661	92.3%	2,883	100.0%
Total	**308**	**6.5%**	**4,466**	**93.5%**	**4,774**	**100.0%**

* CCI codes (Partial): 1VG53-LAPM, 1VG53-LASL
** CCI codes (Total): 1VG53-LAPP, 1VG53-LAPN
¥ Only parts of Saskatchewan adopted ICD-10-CA/CCI in 2001–2002

Source: Hospital Morbidity Database, CIHI, 2001–2002

Table B.4. Number of Total Hip Replacement Procedures Performed in Canada Based on Patient Residence, 1994–1995 to 2001–2002

Province	1994–1995	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	2000–2001	2001–2002
Newfoundland and Labrador	*	203	205	187	182	201	218	230
Prince Edward Island	104	95	109	106	111	104	110	101
Nova Scotia	734	749	730	772	841	825	781	697
New Brunswick	429	466	488	510	451	511	514	525
Quebec	2,527	2,617	2,447	2,611	2,964	2,979	3,188	3,374
Ontario	6,988	7,110	7,306	7,646	7,916	8,433	8,078	8,469
Manitoba	664	689	745	828	921	967	867	870
Saskatchewan	821	851	922	849	825	861	885	850
Alberta	1,786	1,868	1,944	1,741	1,802	1,992	2,036	2,076
British Columbia	2,383	2,713	2,706	2,659	2,543	2,931	2,892	2,747
Northwest Territories[1]	1	11	8	9	9	14	10	15
Yukon Territory	8	13	7	20	15	12	15	13
Nunavut	N/A	N/A	N/A	N/A	N/A	1	4	8
Unknown[2]	*	199	206	203	184	205	189	2
Canada	**16,787**	**17,584**	**17,823**	**18,141**	**18,764**	**20,036**	**19,787**	**19,977**

[1] Includes Nunavut until 1999.
[2] Excludes non-Canadian residents.
* 1994–1995 data is incomplete for Newfoundland and Labrador and for patients with unknown residence.
N/A—Not applicable

Source: Hospital Morbidity Database, CIHI

Table B.5. Number of Total Knee Replacement Procedures Performed in Canada Based on Patient Residence, 1994–1995 to 2001–2002

Province	1994–1995	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	2000–2001	2001–2002
Newfoundland and Labrador	*	175	220	186	194	198	226	254
Prince Edward Island	88	75	73	81	101	104	101	112
Nova Scotia	679	894	906	933	981	1,039	1,077	896
New Brunswick	402	504	565	611	653	643	685	717
Quebec	2,146	2,264	2,287	2,427	2,696	2,796	3,069	3,325
Ontario	6,839	7,693	8,303	9,054	9,580	10,220	10,426	11,821
Manitoba	578	661	725	911	989	1,217	1,178	1,244
Saskatchewan	840	778	904	952	931	870	975	1,023
Alberta	1,587	1,782	2,000	1,857	1,729	1,984	2,223	2,443
British Columbia	1,875	2,329	2,401	2,492	2,499	2,970	2,946	2,920
Northwest Territories[1]	2	2	15	19	27	17	15	19
Yukon Territory	4	11	13	14	8	22	10	17
Nunavut	N/A	N/A	N/A	N/A	N/A	8	10	18
Unknown[2]	*	176	194	172	144	214	189	6
Canada	**15,360**	**17,344**	**18,606**	**19,709**	**20,532**	**22,302**	**23,130**	**24,815**

[1] Includes Nunavut until 1999.
[2] Excludes non-Canadian residents.
* 1994–1995 data is incomplete for Newfoundland and Labrador and for patients with unknown residence.
N/A—Not applicable

Source: Hospital Morbidity Database, CIHI

Table B.6. Number of Primary and Revision Total Hip Replacements Performed in Canada by Province of Residence, 2001–2002

Province	Number of primary replacements	Number of revision replacements	Total number of replacements	Percent revisions
Newfoundland and Labrador	200	30	230	13.0%
Prince Edward Island	91	10	101	9.9%
Nova Scotia	594	103	697	14.8%
New Brunswick	449	76	525	14.5%
Quebec[1]	3,372	2	3,374	N/A
Ontario	7,601	868	8,469	10.2%
Manitoba	728	142	870	16.3%
Saskatchewan	757	93	850	10.9%
Alberta	1,851	225	2,076	10.8%
British Columbia	2,421	326	2,747	11.9%
Territories[2]	29	7	36	19.4%
Unknown[3]	2	0	2	0.0%
Canada[4]	**14,723**	**1,880**	**16,603**	**11.3%**

[1] Revision procedures are not coded separately from primary procedures in Quebec. Therefore, the revision count shown for this province is incomplete.
[2] Includes Northwest Territories, Yukon Territory and Nunavut.
[3] Excludes non-Canadian residents.
[4] Total for Canada excludes counts for Quebec.
N/A—Not applicable

Source: Hospital Morbidity Database, CIHI, 2001–2002

Table B.7. Number of Primary and Revision Total Knee Replacements Performed in Canada by Province of Residence, 2001–2002

Province	Number of primary replacements	Number of revision replacements	Total number of replacements	Percent revisions
Newfoundland and Labrador	245	9	254	3.5%
Prince Edward Island	106	6	112	5.4%
Nova Scotia	807	89	896	9.9%
New Brunswick	628	89	717	12.4%
Quebec[1]	3,321	4	3,325	N/A
Ontario	10,900	921	11,821	7.8%
Manitoba	1,132	112	1,244	9.0%
Saskatchewan	941	82	1,023	8.0%
Alberta	2,255	188	2,443	7.7%
British Columbia	2,721	199	2,920	6.8%
Territories[2]	50	4	54	7.4%
Unknown[3]	5	1	6	16.7%
Canada[4]	**19,790**	**1,700**	**21,490**	**7.9%**

[1] Total knee revision codes were not identified for Quebec in the Hospital Morbidity Database in 2001–2002. Therefore, the revision count shown for this province is incomplete.
[2] Includes Northwest Territories, Yukon Territory and Nunavut.
[3] Excludes non-Canadian residents.
[4] Total for Canada excludes counts for Quebec.
N/A—Not applicable

Note: Excluded from this table are 255 additional total knee revision procedures performed in 2001–2002 in Quebec facilities and submitted separately by Med-Écho. These counts were not included because the province of patient residence was unknown.

Source: Hospital Morbidity Database, CIHI, 2001–2002

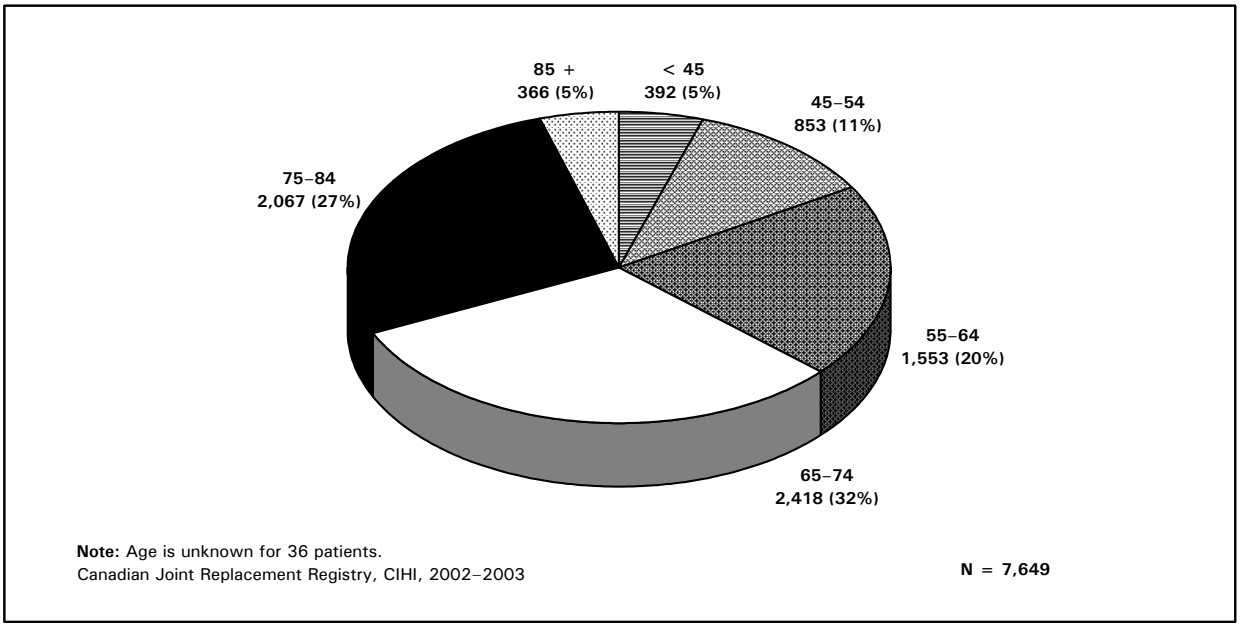


Figure B.1. Distribution of Total Hip Replacement Procedures Submitted by Participating Surgeons, by Patient Age

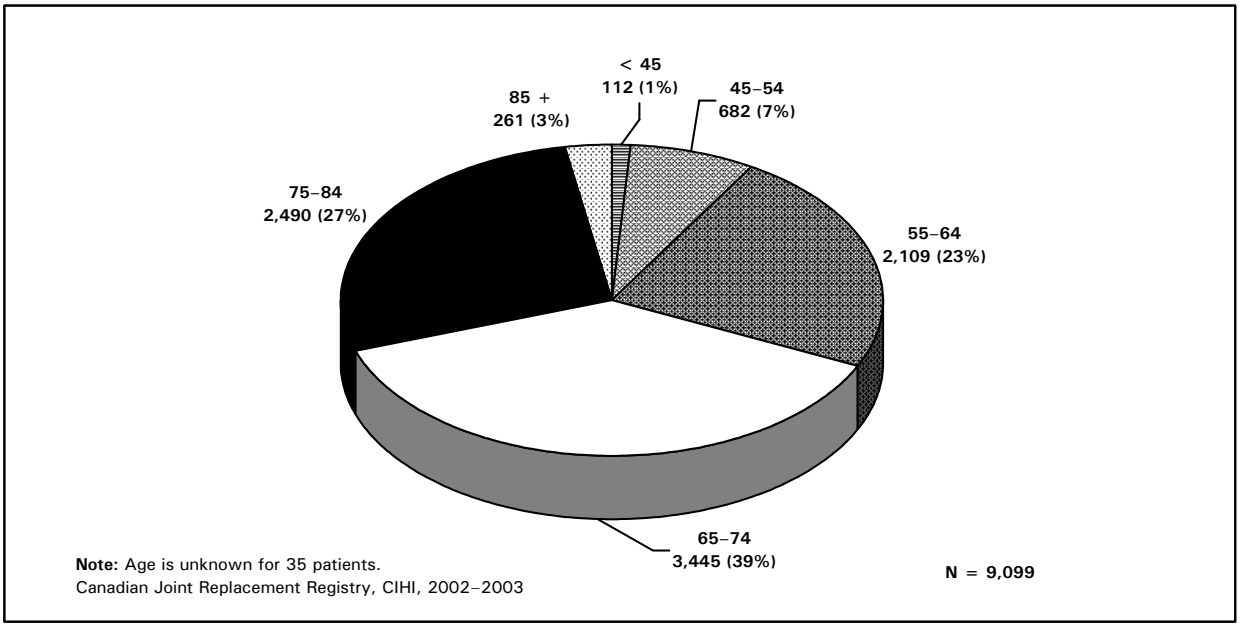


Figure B.2. Distribution of Total Knee Replacement Procedures Submitted by Participating Surgeons, by Patient Age


ten
years
dix
ans
taking health information further
à l'avant-garde de l'information sur la santé