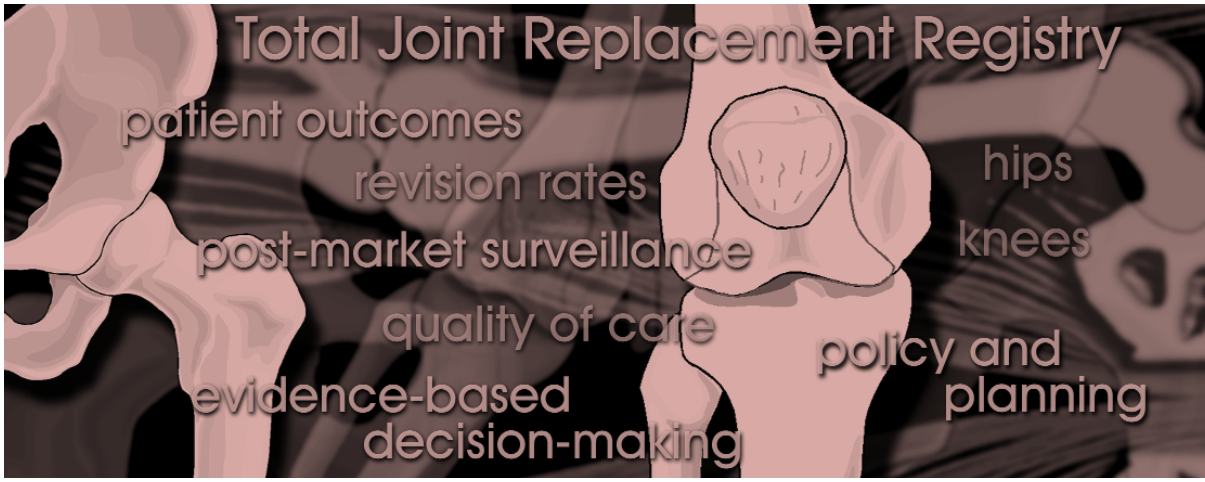
(CJRR) CANADIAN JOINT REPLACEMENT REGISTRY



2002 SUPPLEMENTARY REPORT

TOTAL HIP AND TOTAL KNEE REPLACEMENTS

Canadian Institute
for Health Information

Institut canadien
d'information sur la santé

Canadian Joint Replacement Registry (CJRR)
2002 Supplementary Report

Total Hip and Total Knee Replacements

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ISBN 1-55392-081-3 (PDF)

Cette publication est disponible en français sous le titre : « Registre canadien des remplacements articulaires (RCRA), Rapport complémentaire de 2002, Arthroplasties totales de la hanche et du genou »
ISBN 1-55392-072-4

Acknowledgements

The CJRR team at CIHI would like to acknowledge 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.

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Canadian Joint Replacement Registry (CJRR)
2002 Supplementary Report
Total Hip and Total Knee Replacements

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Executive Summary

The purpose of the CJRR 2002 Supplementary report is to provide additional information on total hip and total knee replacement surgeries in Canada, including summary statistics using preliminary surgical and clinical CJRR data. In Canada, close to 43,000 total hip and total knee replacements were performed in 2000/2001 compared to just over 32,000 procedures in 1994/95, representing a 33.5% increase over this 7-year period.

Hip and knee replacements can provide significant pain relief and considerable improvement in a patient's functional status and quality of life.[2,3] These benefits extend to all age groups, including patients over the age of 80 years.[3] In view of the excellent outcomes associated with total joint replacement surgeries, these procedures will likely continue to increase in most developed countries as technologies advance and populations age.[4]

Canadian Joint Replacement Registry

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. At the time of publication, more than 51% of eligible orthopaedic surgeons in Canada (excluding Ontario) participated in the registry. Orthopaedic surgeons in Ontario submit their data to the OJRR, which are then electronically forwarded to CJRR.

Methodology

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

Surgical and orthopaedic implant data presented in this report are based on 2,296 procedures submitted by surgeons participating in the CJRR between May 1, 2001 and March 31, 2002. This represents 5% of the more than 42,000 total hip and total knee replacements that are performed in Canada annually.

Results

Total joint replacements are more commonly performed among females than males. Between April 1, 2000 and March 31, 2001, 57% of all total hip replacements and 60% of all total knee replacements were performed among women in Canada. The mean age of patients undergoing a total hip and total knee replacement was 67.8 years and 69.2 years, respectively. The national age and sex breakdown is very similar to that seen in the CJRR sample of 2,296 cases where the mean age of a total hip replacement recipient was 68.2 years and that of a total knee replacement recipient was 69.5 years. The male to female breakdown in the CJRR sample is identical to the national breakdown.

Among the 2,296 cases in the CJRR sample, degenerative osteoarthritis was the most common diagnosis for a primary total hip (85%) and a primary total knee replacement (93%). Other common diagnoses were osteonecrosis, inflammatory arthritis and post-traumatic osteoarthritis.

Between April 1, 2000 and March 31, 2001, the percentage of revisions was 10.6% (1,770 out of 16,622) for total hip replacements and 7.9% (1,579 out of 20,086) for total knee replacements in Canada (excluding Quebec). This is comparable to the CJRR sample where the percentage of revisions for total hip replacement was 11.4% (113 out of 994) and 4.6% (60 out of 1,302) for total knee replacements. Preliminary results show that the most common reasons for revising a total hip replacement are aseptic loosening (65%), osteolysis (34%), poly wear (32%), and instability (15%). Among the revised knee replacements, the same group comprised the top four reasons, as follows: aseptic loosening (53%), poly wear (32%), osteolysis (15%), and instability (10%).

Administration of antibiotics to prevent post-operative infection appeared to be standard practice among Canadian orthopaedic surgeons, with 99.3% of total hip replacement patients and 98.8% of knee replacement patients receiving antibiotics prophylactically. Deep vein thrombosis (DVT) prevention was also very common, with 98.6% of patients receiving at least one type of DVT prophylaxis. The two most common prophylactic agents used for both procedures were warfarin and low molecular weight heparin.

Provincial Comparisons

Between April 1, 2000 and March 31, 2001, Manitoba and New Brunswick had the highest percentage of hip replacement revisions at 15.2% and 15.0%, respectively, while Prince Edward Island (7.6%) and Saskatchewan (7.9%) had the lowest percentages. For revisions of knee replacements, New Brunswick (13.0%) had the highest percentage, while Prince Edward Island (5.9%) and British Columbia (6.8%) had the lowest percentages.

Intra-provincial or regional movement of total joint replacement recipients is also reported for the first time in this report. As expected, regional movement of patients is more common than inter-provincial movement of patients.

Discussion

Although current data cannot be used for determining revision rates, the registry will be able to measure and monitor revision rates by following patients over time and conducting post-market surveillance of orthopaedic implants.

The age distribution of total hip and total knee replacement recipients in the CJRR sample is very similar to the age distribution of all patients who had undergone these surgeries in Canada in 2000/2001. As participation in the registry continues to increase, it is expected that differences between CJRR data and national joint replacement numbers become less pronounced.

Copies of the 2002 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 CIHI website. Queries regarding this report may be addressed to cjrr@cihi.ca.

Introduction

This is the supplemental report to the first annual report from the Canadian Joint Replacement Registry (CJRR) published in January 2002.[1] The aim of this report is to provide a first look at surgical and clinical aspects of total hip and total knee replacements performed in Canada. This report also presents sub-provincial analyses of total joint replacements, including regional rates and regional movements of joint replacement patients. Joint replacement data for this report are obtained from three sources, namely orthopaedic surgeons participating in the CJRR and two hospital separation databases managed by the Canadian Institute for Health Information (CIHI), the Hospital Morbidity Database and the Discharge Abstract Database.

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.

The CJRR is a joint effort between CIHI and 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 provincial joint replacement registries.

A brief history of the development of the CJRR is described in more detail in the section titled “Canadian Joint Replacement Registry”.

Background

Total joint replacement surgery has evolved dramatically 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.[2] Significant improvements have also been observed in all dimensions of health, including pain, mobility, well-being and emotional status following a total knee replacement.[3] These benefits extend to all age groups, including patients over the age of 80 years.[3] In view of the excellent outcomes associated with total joint replacement surgeries, these procedures will likely continue to increase in most developed countries as technologies advance and populations age.[4] The number of these procedures carried out each year will also be influenced by the need for these surgeries and access to services.

In Canada, close to 43,000 total hip and total knee replacements were performed in 2000/2001 compared to just over 32,000 procedures in 1994/95, representing a 33.5% increase over this 7-year period. This increase is similar to that observed in the United States, where the number of total hip and total knee replacements increased by 34.2% from 380,000 procedures in 1994 to 510,000 procedures in 2000.[5]

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 34.8%, 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.

It is noteworthy that although the number of total knee replacement procedures continued to increase over the 7-year period, the number of total hip replacement procedures decreased. There were 19,787 total hip replacement procedures performed in 2000/2001, down from 20,036 procedures in 1999/2000, representing 249 fewer procedures or a 1.2% decline. This is also reflected by the 3.8% decrease in the age-standardized rates of total hip replacement procedures from 59.7 per 100,000 population in 1999/2000 to 57.4 per 100,000 population in 2000/2001. In contrast, the number of total knee replacement procedures continued to increase in 2000/2001, with an additional 828 procedures performed in 2000/2001 up from 22,302 procedures in 1999/2000, representing a 3.7% increase.

Over time, the CJRR will be analyzing and disseminating new information on the complex relationships between the population-based need for these surgeries, access to services, appropriate wait times and patient outcomes. For example, work is under way to establish a consortium of international registries to share and exchange information in a standard and consistent way. This information will then be used to provide a more refined understanding of the relationship between the provision of joint replacement surgery and the health of the population.

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 was modelled after the Swedish hip and knee registries, which have been operational since 1975 and 1979, respectively. The registry is managed by CIHI.

Prior to surgery, patients are asked to provide consent to have their surgical information included in the CJRR. Once written patient consent is obtained, the surgeon and/or operating room staff completes a two-page data collection form that 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 or faxed directly to CIHI in a confidential and secure manner where data verification and data entry are completed. Joint replacement data are then linked with administrative hospital data held at CIHI from the Hospital Morbidity and Discharge Abstract Databases.

At publication time, only the province of Ontario has an operational 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 data is sent electronically to CIHI by the OJRR. The flow of data collection in the CJRR is shown in the Appendix.

Privacy and confidentiality of patients and surgeons is 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 example, personal identifiable information, such as surgeon name or patient name is never released. Through its Privacy Program and Privacy, Confidentiality and Security Committee, CIHI has operationalized these policies. 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.

In the past, the coding of hip and knee replacement procedures across Canada has not distinguished between primary and revision surgeries. Consequently, the proportion of *all* replacements that are revisions, the revision rate (i.e. the proportion of *primary* replacements that are revised) and the reasons for revision could not readily be determined from existing data. In early 2000, CIHI requested that hospitals submitting data to its Discharge Abstract Database code primary total hip and total knee replacements separately from revision replacements beginning April 1, 2000. Therefore, for the first time, it is possible to determine the proportion of total hip and total knee replacements that were revisions in 2000/2001. It is important to recognize that Quebec hospitals do not submit to the Discharge Abstract Database, and as such, are not included in the calculation of percent revisions. In 2000/2001, 10.6% of total hip replacements and 7.9% of total knee replacements performed in Canada (excluding Quebec) were revisions.

In regards revision rates, data from CJRR pilot studies indicate that 10–12% of patients may eventually require a subsequent revision as a result of implant wear, loosening or

breakage. By comparison, the revision rate for cemented hip implants in Sweden is 7% and that for uncemented implants is 13%. In Sweden, the cemented implant is the predominant type of implant used for total hip replacements, accounting for 93% of the cases. In the past 5 years, only 8-9% of hip replacements have been revisions.[6] The Swedish Total Hip Register has proven effective in increasing awareness in the orthopaedic community of the risks associated with new implant technologies by identifying optimal surgical techniques and inferior orthopaedic prostheses. The CJRR captures revision operations and reasons for revision, and follows joint replacement recipients over time to monitor their outcomes. Therefore, over time, revision rates can be calculated and the most common reasons for revisions identified. 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.

Health Canada has a process in place for the evaluation and approval of medical devices prior to their release in the field. However, 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.[7] 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.

Benefits of CJRR

With close to 43,000 total joint replacements performed annually in Canada, the CJRR is one of the largest registries with the 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 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 linking this to clinical outcomes.

CJRR data can be linked with other CIHI's holdings, such as the Hospital Morbidity Database and Discharge Abstract Database to determine average lengths of stay, re-admissions including reasons for re-admission, in-hospital 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 and surgical outcomes. 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 1 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 will provide 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. A recent study by CJRR showed that a 25% reduction in the number of revisions would result in savings of approximately $8 million.[8]

Participation in the CJRR

Participation in the CJRR has been steadily increasing since orthopaedic surgeons began submitting operative data in May 2001. In July 2002, the CJRR surpassed the 50% participation mark. Between May 2001 and August 1, 2002, 348 surgeons had started participating in the CJRR either directly or through the Ontario Joint Replacement Registry (OJRR). These surgeons represent an estimated 51% of the CJRR eligible orthopaedic surgeons in Canada (excluding Ontario). Furthermore, their annual volumes represent 72% of the total hip and total knee replacements performed in Canada (excluding Ontario) annually. Orthopaedic surgeons in Ontario submit their data to the OJRR, which are then electronically forwarded to CJRR. As shown in Table 1, participation in the CJRR varies by province, with the Atlantic Provinces in the lead.

Table 1. Participation in the Canadian Joint Replacement Registry as of August 1, 2002

Province	Surgeons signed up to participate	Estimated number of surgeons[2]	% Surgeons participating	2000/2001 procedures	Total Hip Replacements[3]	Total Knee Replacements[3]	Total	% Total procedures
British Columbia	49	94	52.1	5,835	1,801	1,870	3,671	62.9
Alberta	25	50	50.0	4,408	972	1,284	2,256	51.2
Saskatchewan	17	24	70.8	1,851	873	958	1,831	98.9
Manitoba	16	23	69.6	2,090	639	794	1,433	68.6
Quebec	73	202	36.1	6,209	1,894	1,980	3,874	62.4
Nova Scotia	23	26	88.5	1,833	1,390	1,190	2,580	N/A
Newfoundland	10	13	76.9	445	237	250	487	N/A
Prince Edward Island	3	3	100.0	193	75	75	150	77.7
New Brunswick	19	25	76.0	1,276	520	675	1,195	93.7
Northwest Territories	∫	∫	∫	29	∫	∫	∫	∫
Nunavut	N/A	N/A	N/A	-	-	-	-	N/A
Yukon	N/A	N/A	N/A	-	-	-	-	N/A
Subtotal[1]	***236***	***462***	***51.1***	***24,169***	***8,411***	***9,096***	***17,507***	***72.4***
Ontario[1]	112	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	**348**	**500**	**69.6**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

[1] Ontario surgeons participate in the CJRR through the OJRR. The OJRR is implemented in a step-wise fashion across Ontario. Roll-out in progress in the following regions: South West, Central South, Central East and East. North region to follow.
[2] Number of surgeons who perform total hip and total knee replacements is not known. This list will be updated as new information becomes available.
[3] Estimated number of total hip and knee replacements performed each year by surgeons who have agreed to participate in the CJRR.
∫ Numbers are too small.

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.

Methodology and Limitations

Data Sources

Surgical and implant data presented in this report are submitted to the CJRR by orthopaedic surgeons participating in the CJRR. 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 Discharge Abstract Database.

Orthopaedic Surgeons

Surgical and orthopaedic implant data presented in this report are based on 2,296 procedures submitted by 84 of the 189 orthopaedic surgeons participating in the CJRR from 9 provinces between May 1, 2001 and March 31, 2002 (Figure 1). This represents 5% of the more than 42,000 total hip and total knee replacements that are performed in Canada annually. Therefore, results shown in this report are preliminary and should not be assumed to be representative of all total hip and total knee replacements performed across Canada. It is possible that surgeons participating in the CJRR differ from non-participating surgeons and, thus results should not be generalized to all joint replacements performed in Canada.

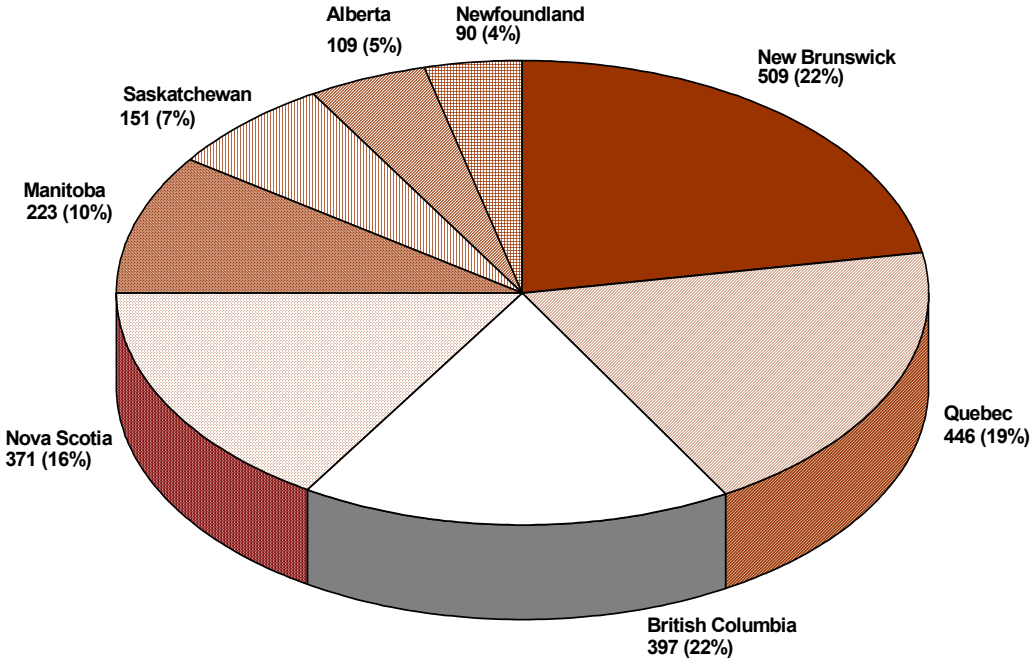


Figure 1. Number of Total Hip and Total Knee Replacement Forms by Province

Hospital Morbidity Database

The Hospital Morbidity Database 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 Discharge Abstract Database (DAD) for those provinces participating in DAD. Data for the remaining hospitals are submitted separately by the corresponding provinces and territories. Although the Hospital Morbidity Database contains fewer data elements than the DAD, it captures 100% of acute care discharges for Canada.

Discharge Abstract Database

This database contains demographic, administrative and clinical data for hospital discharges, including inpatient acute, chronic, rehabilitation as well as day surgeries. CIHI receives data directly from participating hospitals, which represent about 85% of all hospital inpatient discharges in Canada.

Statistics Canada

For the calculation of rates, national, provincial and regional fiscal estimates (October 1) are used. These are special order tabulations provided by the Demography Division of Statistics Canada. Regional rates are reported for fiscal year 1999/2000 as the regional fiscal estimates were not available at the publication of this report.

Data Elements

Hospital Morbidity and Discharge Abstract Databases

Total hip replacements include *total hip replacement with methyl methacrylate* and *other total hip replacement*, which correspond to ICD-9-CCP* codes 93.51 and 93.59, respectively. Total knee replacements correspond to ICD-9-CCP code 93.41. Until April 2000, these codes captured both primary and revision procedures. After April 2000, health care facilities submitting data to CIHI's Discharge Abstract Database were asked to use a separate CCP code for revisions. Therefore, since April 2000, revision of a total hip replacement *cemented with methyl methacrylate* is assigned the ICD-9-CCP code of 93.52, revision of a total hip replacement *uncemented* is coded 93.53 and revision of a total knee replacement (*cemented or uncemented*) is captured by ICD-9-CCP code 93.40.

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 2000/2001, the proportion of total hip replacements and total knee replacements that were revisions is 10.6% and 7.9%, respectively (excluding Quebec). The estimated proportion of total hip

* International Classification of Diseases, 9th Revision—Canadian Classification of Diagnostic, Therapeutic, and Surgical Procedures

replacements and total knee replacements that consist of emergency procedures is 6% and 1%, respectively.

Previous surgeries are excluded from the Hospital Morbidity Database as of 1998/1999 only. The proportion of total hip replacements and total knee replacements that constitute previous surgeries on an annual basis is estimated at 2.3% and 2.4%, respectively. Cancelled surgeries are excluded from the Hospital Morbidity Database for all years reported (i.e. 1994/1995 to 2000/2001).

Surgical and Implant Data

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.

Data Analysis

In calculating the rates of total hip and total knee replacements, the numerator is based on the number of procedures according to where the patient lives and not where the procedure was performed. Patients with unknown or invalid residence codes were excluded from rate calculations. Unless otherwise indicated, rates are adjusted for age and reported separately for males and females. Age-standardization is a statistical method employed to control for the effect of the age structure of the population, thereby permitting comparisons over time or between populations. Therefore, changes or differences in age-standardized rates of total hip and total knee replacements are caused or explained by factors other than changes or differences in the age structure of the population. Sex-specific rates are reported because there are considerable differences in rates of total hip and total knee replacements between males and females.

It is generally recommended that age-standardized rates be used for examining trends over time and for comparing rates across populations. The purpose of adjusting for age is to eliminate the effect of the age composition of the population, which may be different in the case of between-country comparisons or may have changed over time, in the case of longitudinal comparisons within the same population.

Univariate analyses of surgical and implant data were calculated using SAS (version 8) statistical package. National data from the Hospital Morbidity and Discharge Abstract Databases were analyzed using the Query and Analysis analytical tool.

Data Quality

The quality of total hip and total knee replacement data obtained from CIHI's Hospital Morbidity and Discharge Abstract Databases is judged to be accurate and reliable. The accuracy of hospital health record coding is greatest for major surgery and diminishes with the complexity of the information.[4]

In regards surgical and implant information, data collection forms are completed by orthopaedic surgeons and mailed or faxed directly to CIHI in a confidential and secure

manner. A data entry clerk examines the data collection forms to ensure that patient consent is obtained and the form is adequately completed. If patient consent is dubious, the data collection form is returned to the orthopaedic surgeon for 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).

Surgical and implant data presented in this report are based on a sub-set of data submitted to CIHI between May 2001 and March 2002. An initial sample consisting of 2,346 data collection forms was exported into the SAS statistical package where data edit checks were performed. Edit checks consist of a series of errors detection codes or edits intended to identify out-of-range values and problems with data logic. Error detection reports were generated and the questionable data collection forms scrutinized. Where applicable, data imputation was applied to the erroneous data element.

Based on this data quality exercise, the initial sample of 2,346 procedures was reduced to 2,296 procedures. There were close to 1,500 errors of varying degree identified, which resulted in 50 discarded data collection forms of which 26 were duplicates and the remaining 24 forms were incomplete or had too many errors. For the 2,296 forms that were included in the final sample for analyses, the problematic data elements were re-checked and, in some cases, imputations or corrections were applied based on a careful study of the entire data collection form.

A number of data elements are not included in this report as a result of important data quality issues. For example, information on cementing techniques is not available due to data logic errors. The most common inaccuracy lies in the selection of a cemented technique and a concurrent selection of a cementless method for the same component. Conversely, a cementless technique may be selected but a cement type is also selected for the same component. Since the verification and validation of these errors is quite involved as it requires follow-up with orthopaedic surgeons/OR staff, this information will be only included in the second annual CJRR report scheduled for release in January 2003.

The CJRR team is also in the process of conducting a comprehensive data quality evaluation of the CJRR specifically related to surgical and implant data, based on CIHI's Data Quality Framework[9]. The framework considers data quality from a user's perspective whereby "quality" is defined as "fitness-for-use". Data quality is assessed based on 24 characteristics rolled up into five dimension, namely timeliness, usability, relevance, accuracy and comparability. In order to identify and rank aspects of data quality needing improvement, each characteristic must be carefully evaluated. To evaluate the data quality characteristics, one of four categories (i.e. appropriate, marginal, not acceptable and unknown) is assigned to each characteristic. Once each characteristic has been evaluated, each dimension is assigned to a category. The data quality assessment is expected to be completed in the spring of 2003.

Limitations

The results pertaining to surgical and implant information presented in this report are preliminary and have not been validated through an extensive data quality study. As noted earlier, the 2,296 procedures that constitute the sample size from which the surgical and implant analyses are derived, represent approximately 5% of all total hip and total knee replacement procedures performed in Canada (excluding Ontario) between April 1, 2000 and March 31, 2001. Thus, these results are not considered generalizable to all total hip and total knee arthroplasties performed in Canada. In addition, the operative and implant information on these procedures was submitted to the CJRR by a subset of all orthopaedic surgeons who have signed up to participate in the registry. It is possible that those surgeons who have submitted data to the registry differ from surgeons who have signed up but are not yet submitting data to the registry as well as from those who have not yet signed up with the CJRR.

Results

Total Hip and Total Knee Replacement Procedures

Total knee replacements comprise 57% (N = 1,302) of the 2,296 procedures submitted to the CJRR between May 2001 and March 2002, with total hip replacements accounting for the remaining 43% (N = 994). Bilateral procedures account for just under 2% (N = 44) of all joint replacements. There were 16 bilateral hip and 28 bilateral knee replacements performed during the 11-month period. 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. Slightly over half (53%) of total hip and total knee replacements were performed on the right side (N = 1,201) compared to just under half (47%) of surgeries on the left side (N = 1,070). The side of replacement was unknown for the remaining 25 surgeries.

The majority (92.4%) of total hip and total knee replacement procedures captured for this report were primary surgeries (N = 2,116). Revision surgeries made up 7.6% (N = 173) of the 2,290 procedures where the type of replacement is known. In the case of total hip replacements, 88.5% were primary surgeries (N = 878) and the remaining 11.4% were revisions (N = 113). Primary total knee replacements (N = 1,238) account for 95.4% of all knee surgeries with revision surgeries (N = 60) accounting for the remaining 4.6% of knee replacements. Table 2 and Table 3 depict primary and revision surgeries for total hip and total knee replacements respectively.

Table 2. Type of Total Hip Replacement Procedures

Type of Replacement[1]	Number of Replacements	Percent of Total
Primary	878	88.5%
First revision	90	9.1%
Second revision	18	1.8%
Third or greater revision	5	0.5%
Subtotal—Revisions	***113***	***11.4%***
Excision (not a revision)	1	0.1%
TOTAL[1]	**992**	**100.0%**

[1]Type of replacement information is missing for 2 surgeries.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table 3. Type of Total Knee Replacement Procedures

Type of Replacement[1]	Number of Replacements	Percent of Total
Primary	1,238	95.4%
First revision	52	4.0%
Second revision	4	0.3%
Third or greater revision	4	0.3%
Subtotal—Revisions	***60***	***4.6%***
Excision (not a revision)	0	0.0%
TOTAL[1]	**1,298**	**100.0%**

[1]Type of replacement information is missing for 4 surgeries
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

As described earlier in this report, CIHI requested that hospitals submitting data to its Discharge Abstract Database (excluding Quebec) code primary total hip and total knee replacements separately from revision replacements beginning April 1, 2000. Therefore, for the first time, it is possible to determine the proportion of total hip and total knee replacements that were revisions in 2000/2001. In 2000/2001, 10.6% of total hip

replacements and 7.9% of total knee replacements performed in Canada (excluding Quebec) were revisions.

Patient Demographics

Total joint replacement procedures are more commonly performed among females than males. In the case of total hip replacements, 57% of surgeries were performed on females (N = 565) with the remaining 43% on males (N = 427). Similarly, 60% of all total knee replacements recipients were female (N = 786) and 40% were male (N = 516). There was no noticeable difference in the sex breakdown for primary and revision replacement recipients.

The mean and median age of a total hip replacement recipient was 68.2 years and 70.4 years, respectively. Primary total hip replacement recipients were slightly younger (mean age: 67.8 years) than those who underwent a revision surgery (mean age: 70.8 years), with an average age difference of 3.0 years. Patients who had a total knee replacement were similar in age as those undergoing a total hip replacement with a mean age of 69.5 years and a median age of 70.6 years. Unlike total hip replacement patients, however, patients who underwent a revision knee replacement (mean age: 68.8 years) were slightly younger than those who had their first replacement (mean age: 69.5 years), with a mean age difference of 0.7 years. It is noted that the sample size for revision surgeries is quite small.

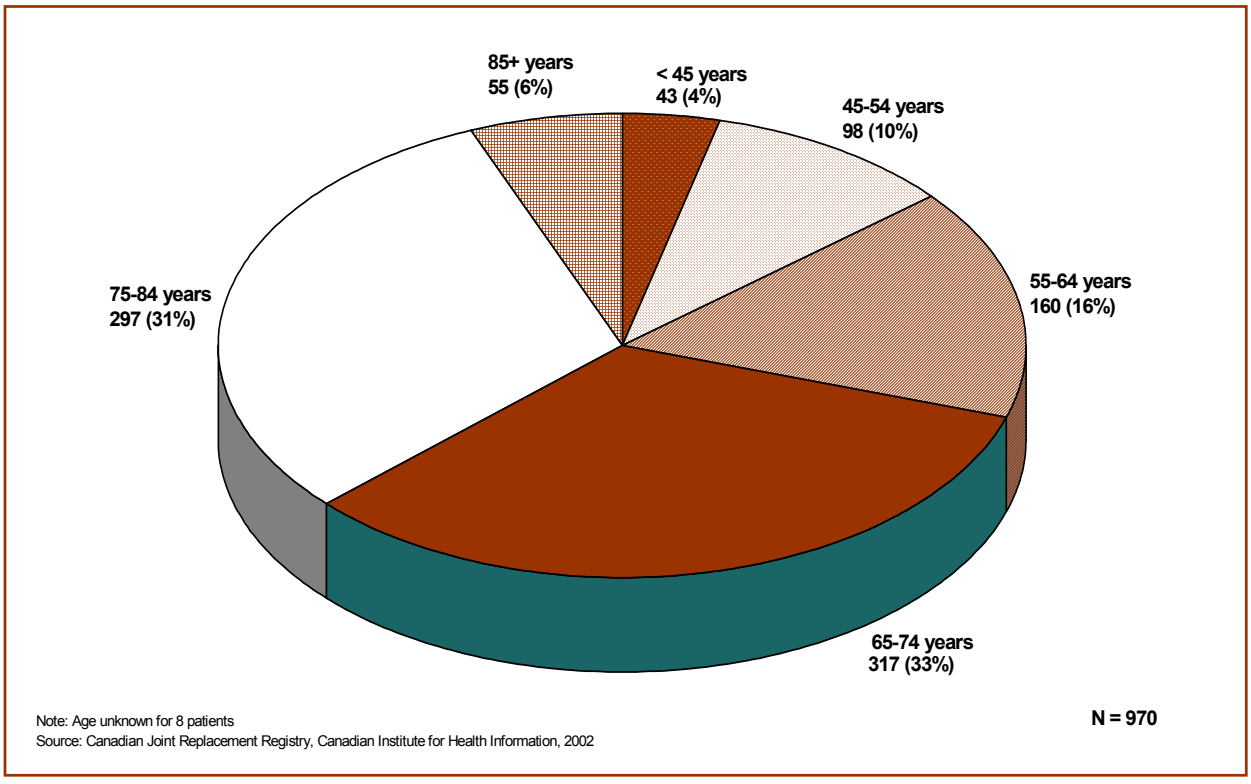


Figure 2. Distribution of Total Hip Replacement Procedures by Patient Age

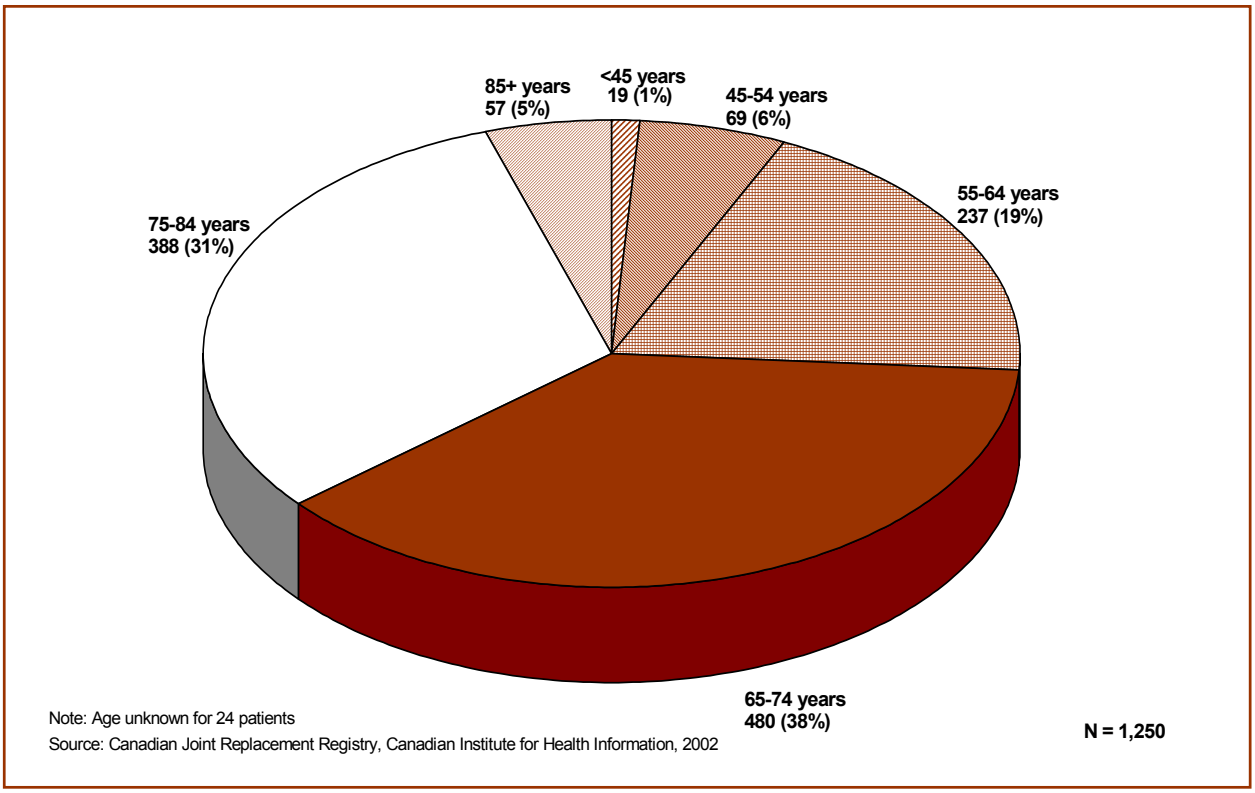


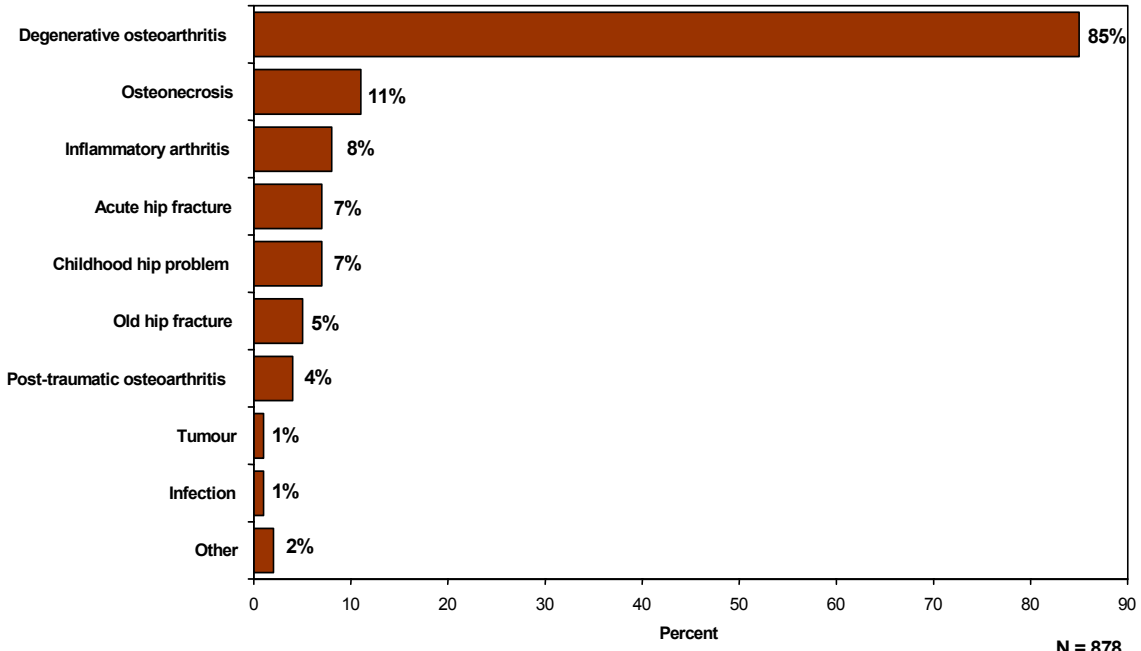
Figure 3. Distribution of Total Knee Replacement Procedures by Patient Age

Figure 2 and Figure 3 depict the age distribution, categorized into 6 distinct age groups, of total hip and total knee replacement recipients, respectively. Total hip replacement recipients were somewhat younger than total knee replacement recipients as observed by the higher proportion of patients below 55 years of age among those receiving a total hip replacement (14%) compared to those receiving a total knee replacement (7%). Conversely, the proportion of patients aged 65 years or older was higher among total knee replacement recipients (74%) than among total hip replacement recipients (70%).

Clinical Characteristics of Joint Replacement Recipients

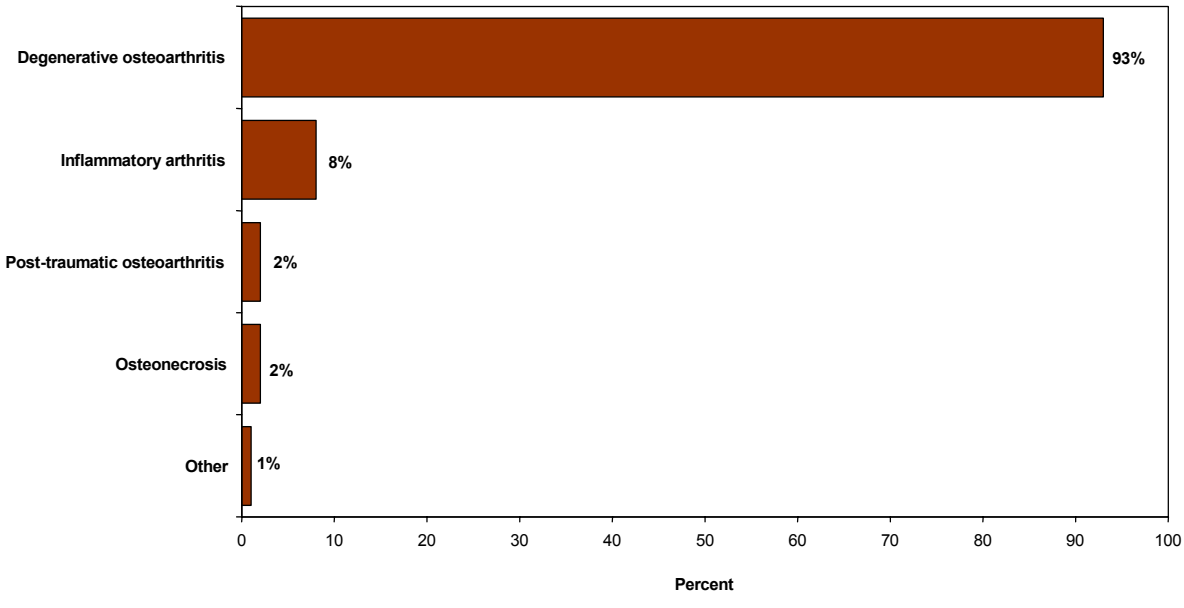
Indications for Surgery

Degenerative osteoarthritis is the most common diagnosis grouping for a primary total hip (85%) and a primary total knee replacement (93%). The second and third most common indications for a total hip replacement are osteonecrosis (11%) and inflammatory arthritis (8%), respectively. In the case of a total knee replacement, inflammatory arthritis (8%) and post-traumatic osteoarthritis (2%) make up the second and third most common indication for surgery, respectively. It is noted that diagnosis groupings are not mutually exclusive. Figure 4 and Figure 5 provide a breakdown of the most common diagnosis groupings for a primary total hip and primary total knee replacement respectively.



[1] Percentages do not add up to 100% because diagnosis groupings are not mutually exclusive
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Figure 4. Primary Total Hip Replacement Procedures by Diagnosis Grouping[1]

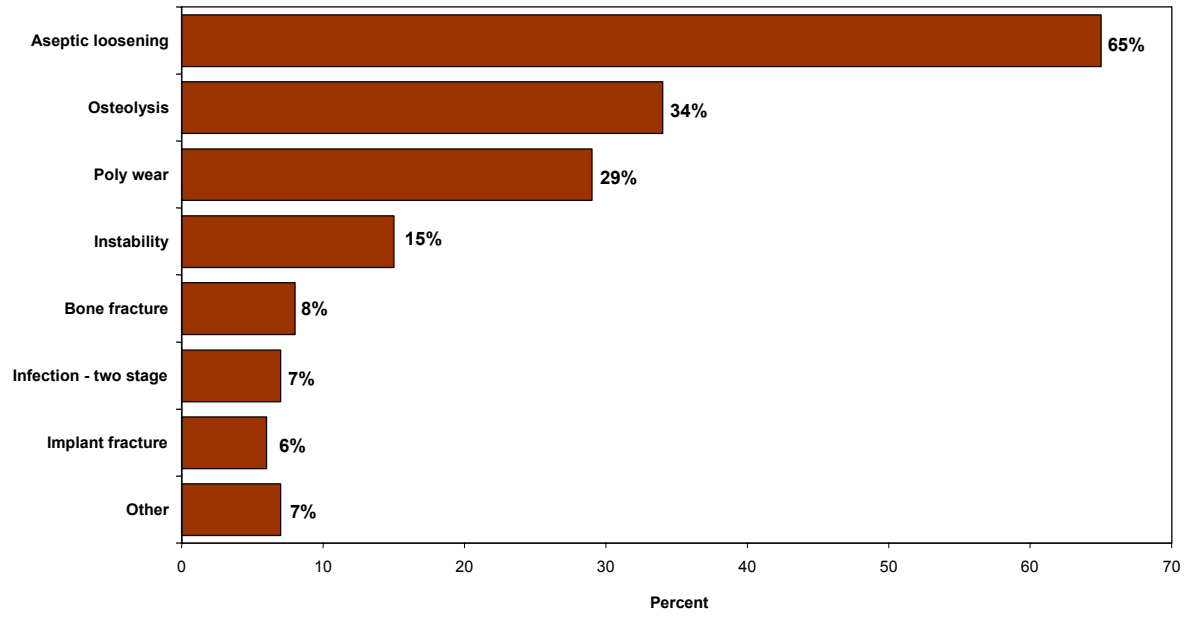


[1] Percentages do not add up to 100% because diagnosis groupings are not mutually exclusive
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Figure 5. Primary Total Knee Replacement Procedures by Diagnosis Grouping[1]

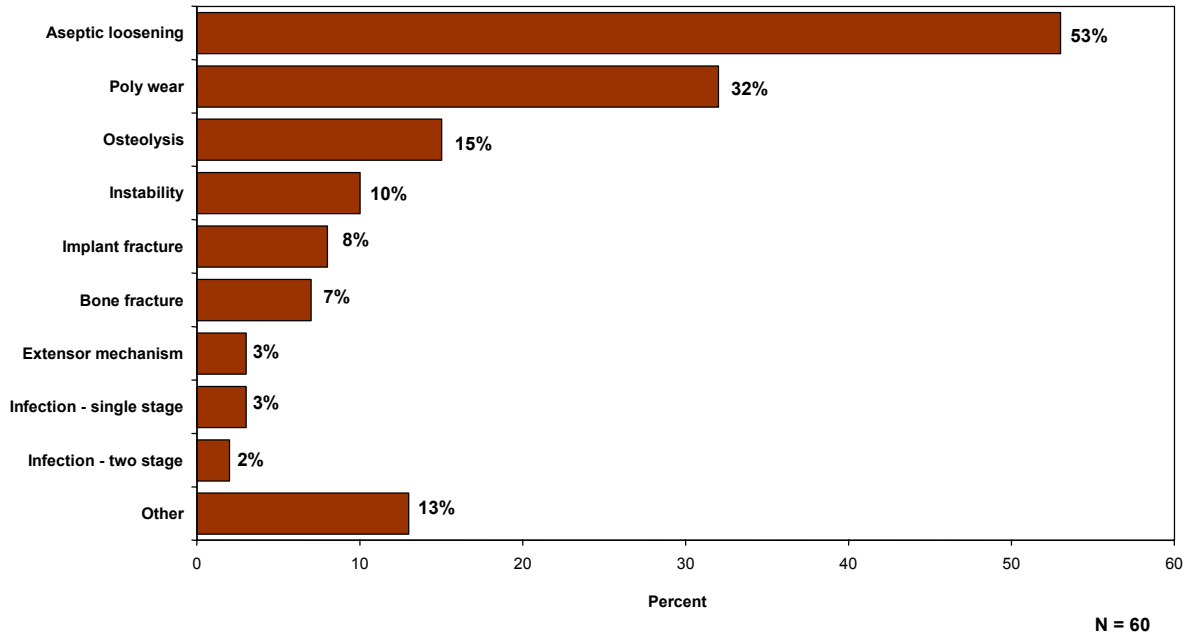
Reasons for Revision

The most common reasons for revising a total hip replacement are shown in Figure 6. The top four indications for revising a total hip replacement (N = 113) are aseptic loosening (65%), osteolysis (34%), poly wear (29%) and instability (15%). The same 4 reasons for revisions are observed in the case of total knee replacements as seen in Figure 7. Among the 60 revised knee replacements, the 4 most common reasons for the revision are aseptic loosening (53%), poly wear (32%), osteolysis (15%) and instability (10%). Percentages do not add up to 100% because diagnosis groupings are not mutually exclusive.



[1] Percentages do not add up to 100% because reasons for revision are not mutually exclusive
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Informaiton, 2002

Figure 6. Revised Total Hip Replacement Procedures by Reason for Revision[1]

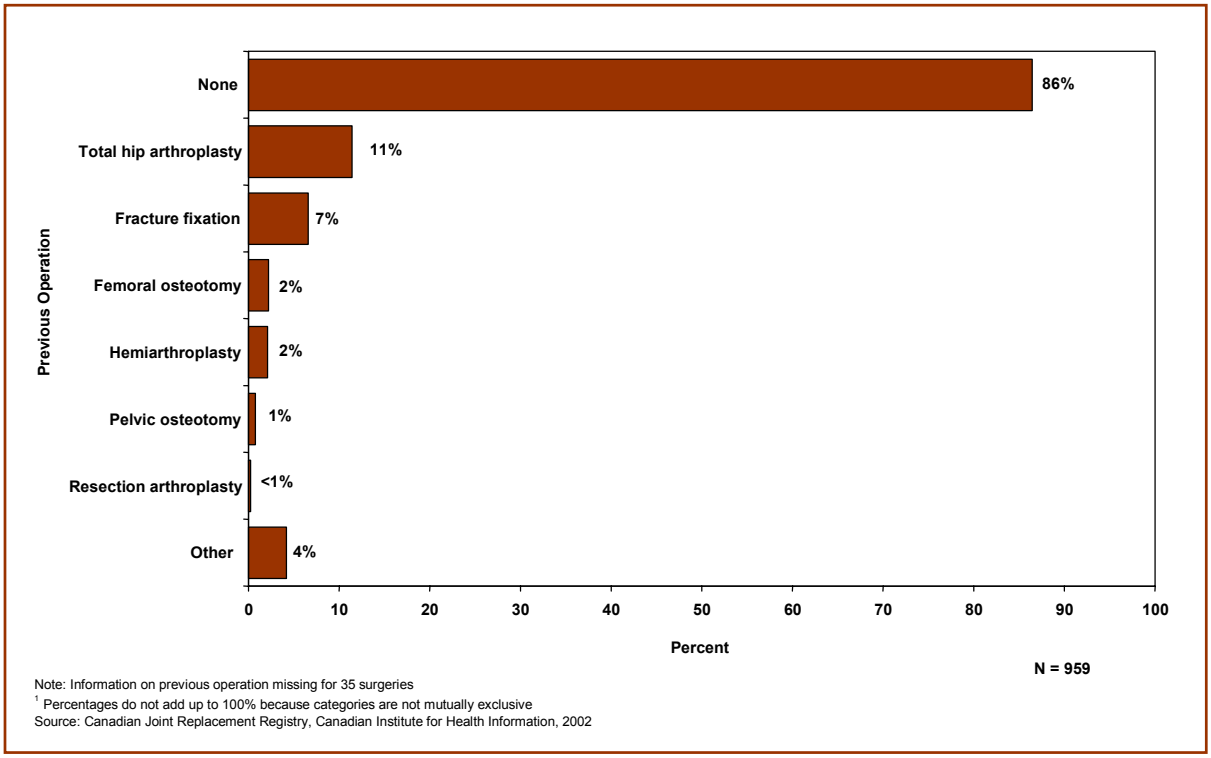


[1] Percentages do not add up to 100% because reasons for revision are not mutually exclusive
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Figure 7. Revised Total Knee Replacement Procedures by Diagnosis Grouping[1]

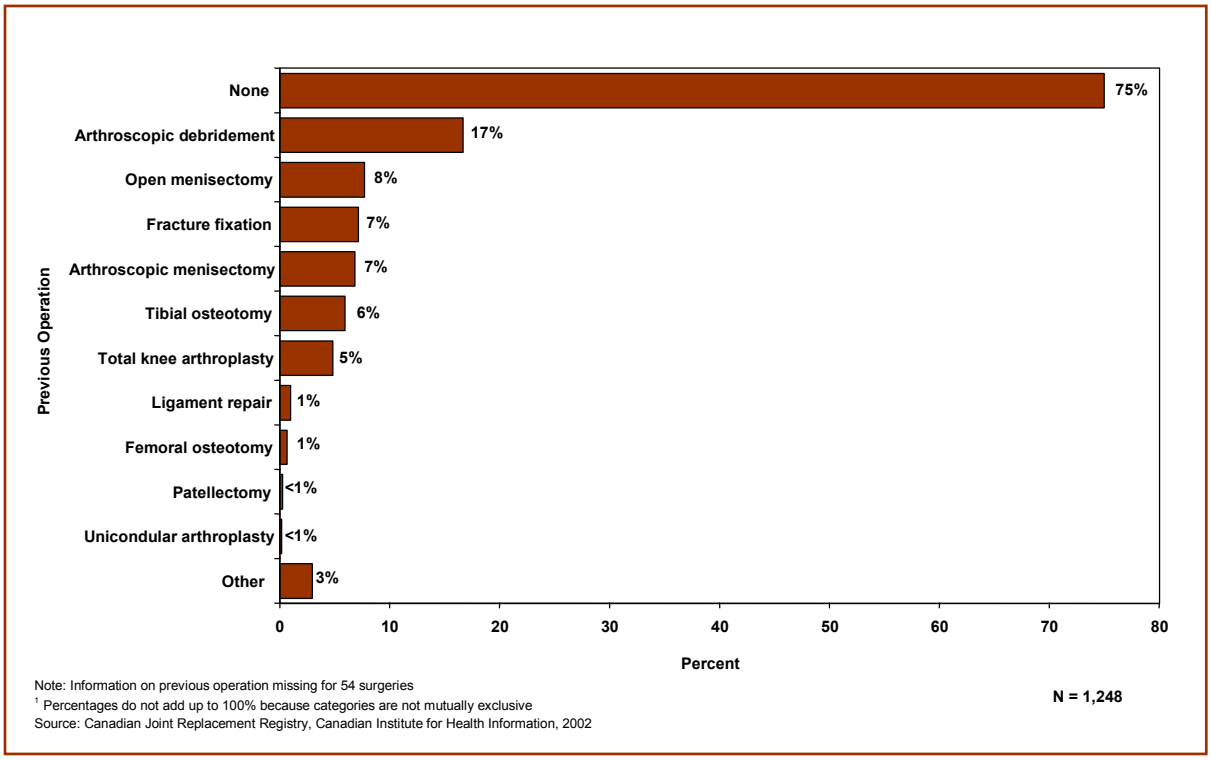
Previous Operations

The majority of total hip (86%) and total knee (75%) replacement recipients had no relevant previous operation. As shown in Figure 8, the three most common previous operation for total hip replacement recipients was total hip arthroplasty (11%) followed by fracture fixation (7%), femoral osteotomy (2%) and hemiarthroplasty (2%). In the case of total knee replacement recipients, the three most common previous operations were arthroscopic debridement (17%) followed by open menisectomy (8%), fracture fixation (7%), arthroscopic menisectomy (7%) and tibial osteotomy (6%) (Figure 9).



Note: Information on previous operation missing for 35 surgeries
[1] Percentages do not add up to 100% because categories are not mutually exclusive
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Figure 8. Distribution of Total Hip Replacement Procedures by Previous Operation[1]



Note: Information on previous operation missing for 54 surgeries
[1] Percentages do not add up to 100% because categories are not mutually exclusive
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

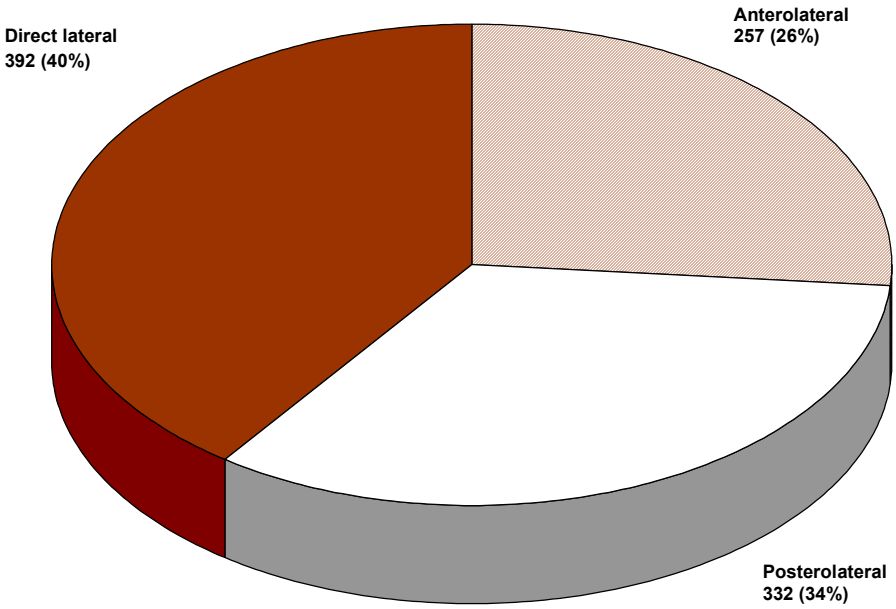
Figure 9. Distribution of Total Knee Replacement Procedures by Previous Operation[1]

Surgical Characteristics of Joint Replacement Procedures

Surgical Approach

The distribution of total hip replacement procedures by surgical approach is shown in Figure 10. The direct lateral approach (40%) and the posterolateral (34%) approach are the most commonly used techniques in total hip replacement surgeries. While the anterolateral approach was used in 26% of procedures in this sample, the Smith/Peterson approach was used in less than 1% of surgeries.

The medial approach was used in the majority (80%) of total knee replacement procedures, followed by the intravastus (13%) and subvastus (3%) approaches. The lateral approach is the least common surgical approach (1%) used in this sample (Figure 11).



Note: Information on surgical approach missing for 12 surgeries. The Smith/Peterson method is used in <1% (N=1) of surgeries.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Figure 10. Distribution of Total Hip Replacement Procedures by Surgical Approach

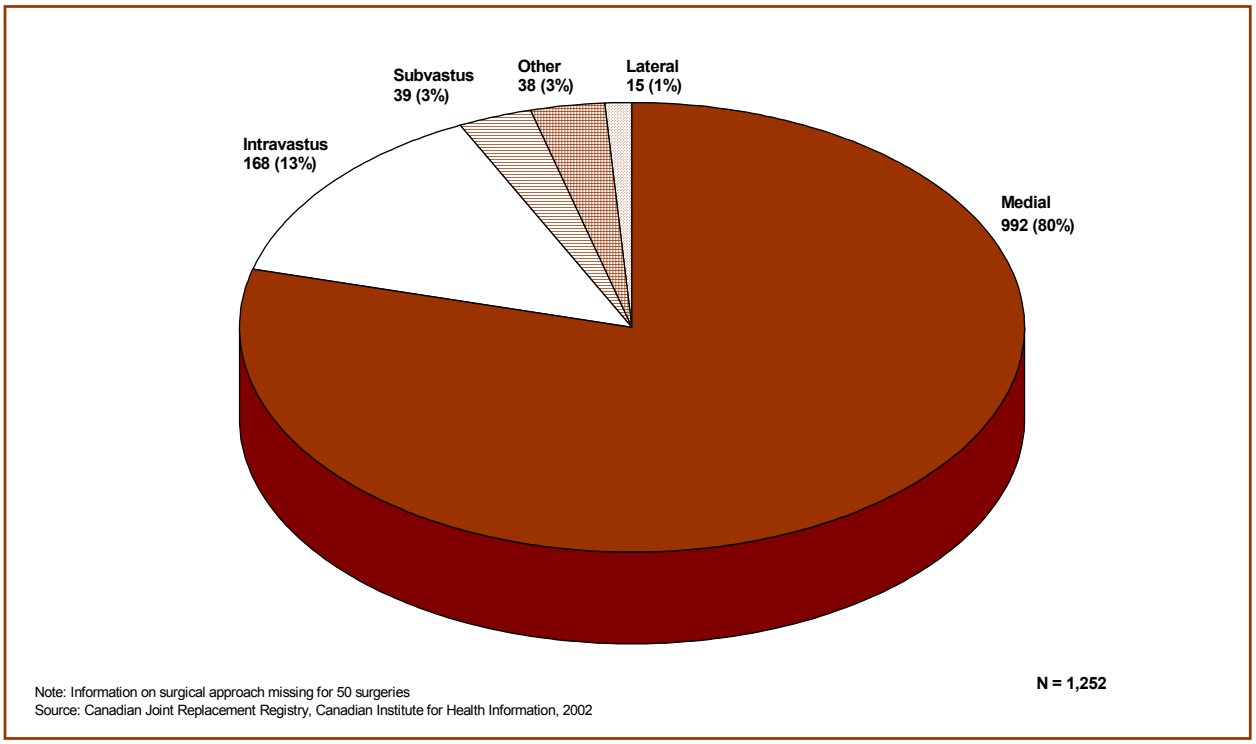


Figure 11. Distribution of Total Knee Replacement Procedures by Surgical Approach

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 standard practice among Canadian orthopaedic surgeons. As seen in Table 4, 99.3% of total hip replacement patients and 98.8% of total knee replacement patients were given antibiotics prophylactically.

Table 4. Antibiotic Use in Total Hip and Total Knee Replacement Procedures

Antibiotic Use	Total Hip Replacements Number (%)	Total Knee Replacements Number (%)	All replacements Number (%)
Yes	987 (99.3%)	1,287 (98.8%)	2,274 (99.0%)
No	7 (0.7%)	15 (1.2%)	22 (1.0%)
TOTAL	**994 (100.0%)**	**1,302 (100.0%)**	**2,296 (100.0%)**

Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table 5. Duration of Antibiotic Prophylaxis in Total Hip and Total Knee Replacement Procedures

Duration	Total Hip Replacements Number (%)	Total Knee Replacements Number (%)	All replacements Number (%)
≤ 24 hours	528 (54.2%)	730 (57.3%)	1,258 (56.0%)
>24 hours	446 (45.8%)	543 (42.7%)	989 (44.0%)
Subtotal	***974 (100.0%)***	***1,273 (100.0%)***	***2,247 (100.0%)***
Unknown	13	14	27
TOTAL	**987**	**1,287**	**2,274**

Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

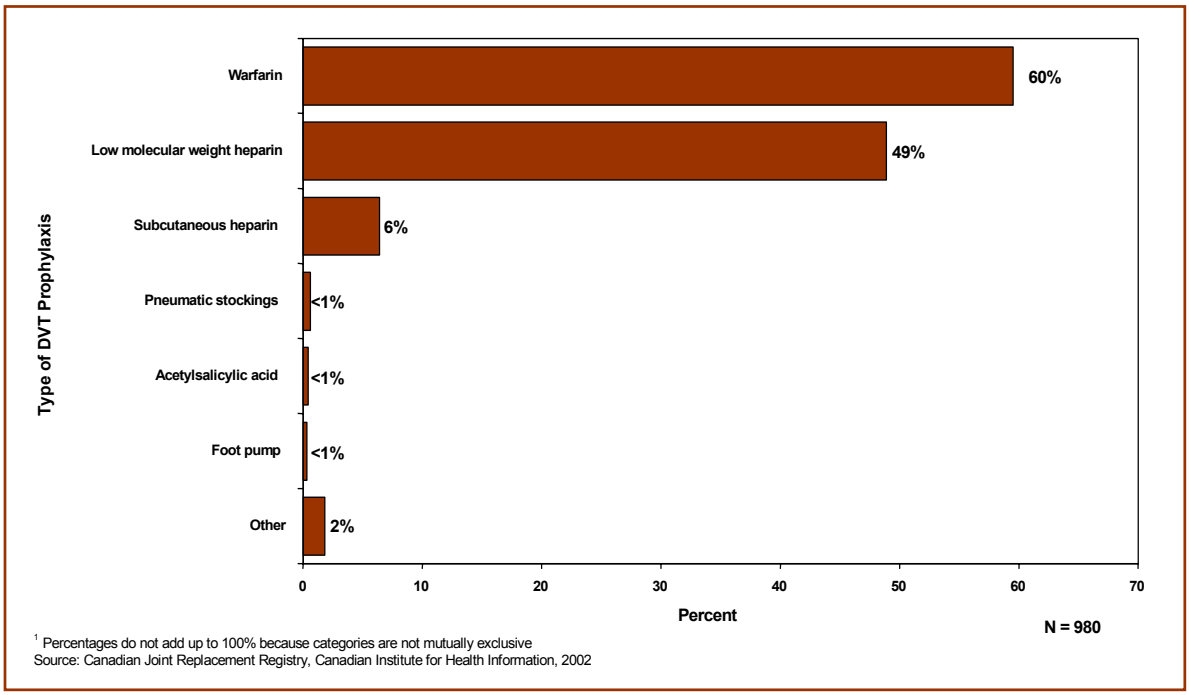
Antibiotics were administered for a period of 24 hours or less to over half (56.0%) of joint replacement recipients (Table 5) while the remaining 44.0% of patients received antibiotic therapy for greater than 24 hours.

Table 6. Deep Vein Thrombosis (DVT) Prevention in Total Hip and Total Knee Replacement Procedures

DVT Prevention	Total Hip Replacements Number (%)	Total Knee Replacements Number (%)	All replacements Number (%)
Yes	980 (98.6%)	1,284 (98.6%)	2,264 (98.6%)
No	14 (1.4%)	18 (1.4%)	32 (1.4%)
TOTAL	**994 (100.0%)**	**1,302 (100.0%)**	**2,296 (100.0%)**

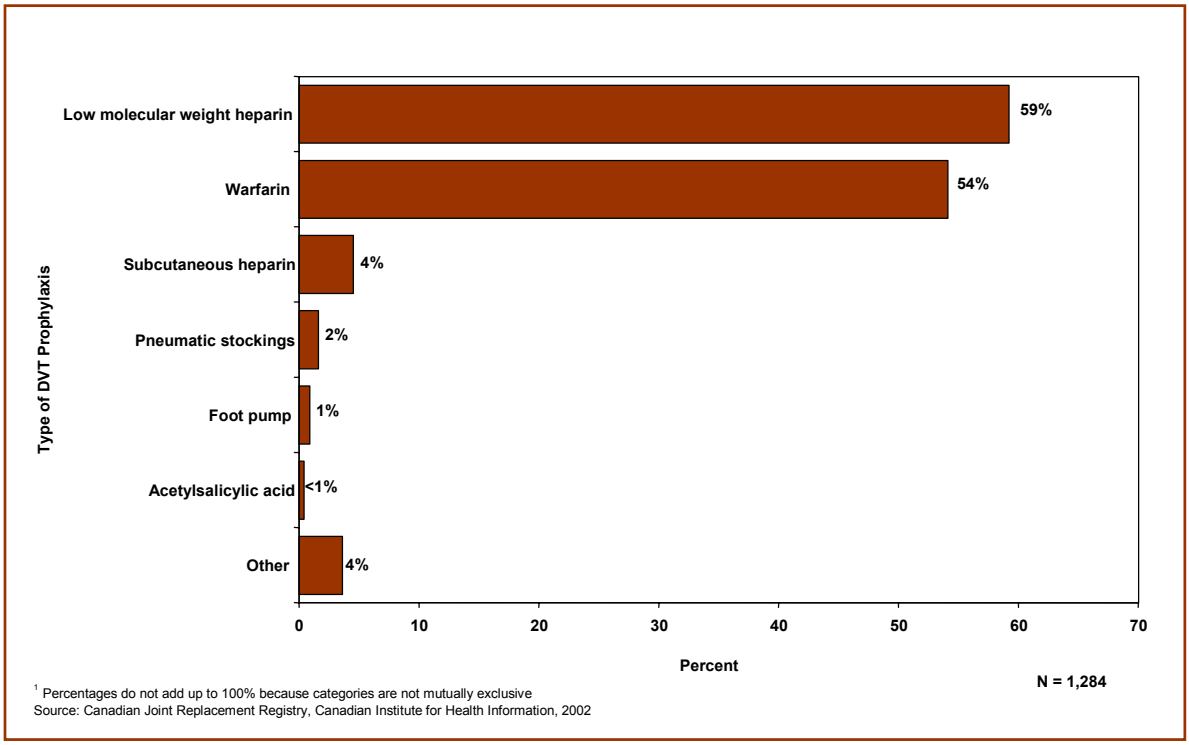
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Deep vein thrombosis (DVT) prevention was employed in 98.6% of all total hip and total knee replacement procedures in this sample (Table 6). The type of DVT prophylaxis given is similar for both hip and knee surgeries. The three most common DVT prophylactic agents used in total hip replacement procedures are warfarin (60%), low molecular weight heparin (49%) and subcutaneous heparin (6%) (Figure 12). Although the same three agents are also the most commonly used agents in total knee replacements, low molecular weight heparin (59%) is the most common type of DVT prophylaxis in knee replacement surgeries followed by warfarin (54%) and subcutaneous heparin (4%) (Figure 13).



[1] Percentages do not add up to 100% because categories are not mutually exclusive
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Figure 12. Type of Deep Vein Thrombosis Prophylaxis[1] Used in Total Hip Replacement Surgery

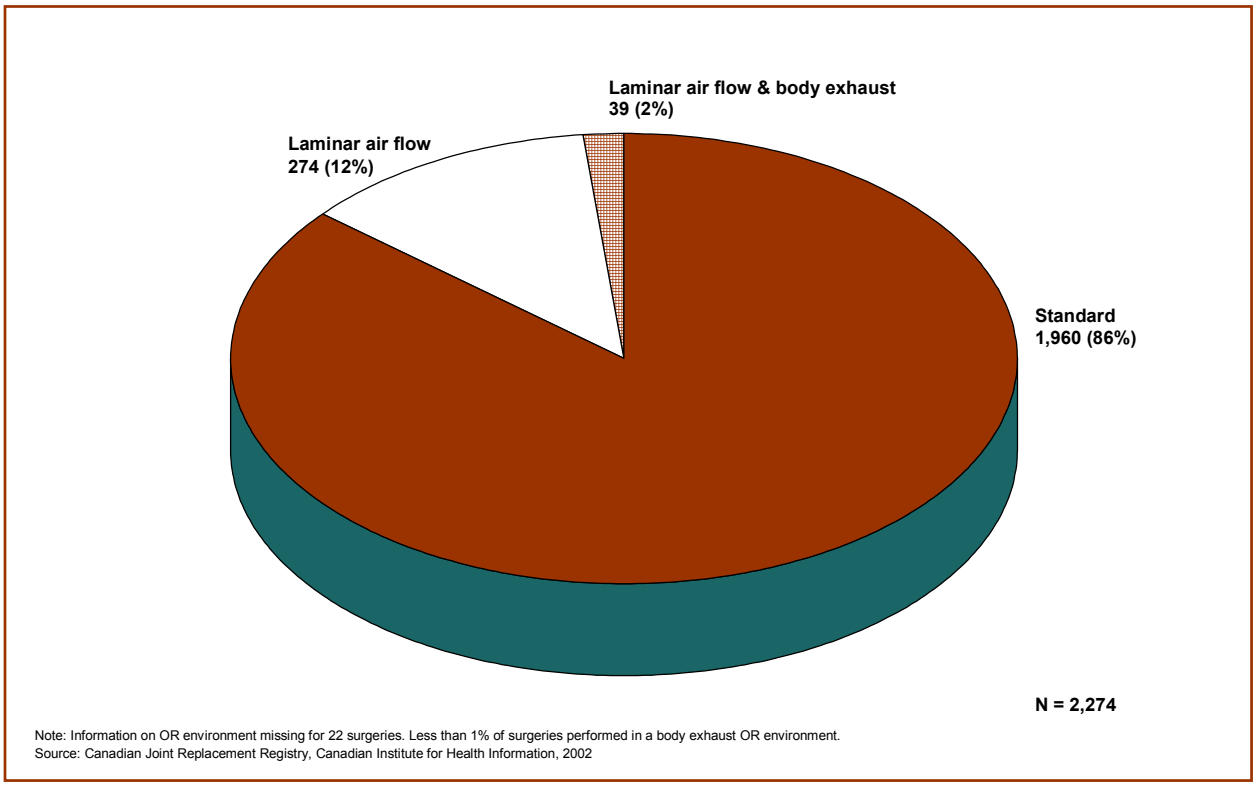


[1] Percentages do not add up to 100% because categories are not mutually exclusive
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Figure 13. Type of Deep Vein Thrombosis Prophylaxis[1] Used in Total Knee Replacement Surgery

Operating Room (OR) Environment

The types of OR environments where total hip and total knee replacement procedures are performed are depicted in Figure 14. The standard OR environment is the most widespread OR environment (86%) followed by laminar air flow (12%) and a combination of laminar air flow and body exhaust (2%). Less than 1% of surgeries were performed in a body exhaust OR environment and no surgeries were performed in an ultraviolet OR setting.



Note: Information on OR environment missing for 22 surgeries. Less than 1% of surgeries performed in a body exhaust OR environment.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Figure 14. Total Hip and Total Knee Replacement Surgeries by Operating Room Environment

Regional Movement of Total Joint Replacement Recipients

Inter-provincial/territorial movement of total joint replacement recipients was reported in the first annual CJRR report. With the exception of residents of Nunavut and Yukon—where total arthroplasties are not performed—very few patients had to relocate to another province have their surgeries done (Table A.3 and Table A.4 in the Appendix). Based on feedback from the orthopaedic community, the last section of this report provides information on the intra-provincial or regional movement of total hip and total knee replacement recipients. As expected, regional movement of patients is more common than inter-provincial movement of patients as shown in Table A.5 to Table A.13 in the Appendix.

Regional rates for fiscal year 1999/2000 for the provinces are also shown in Tables A.14 through A.22 in the Appendix. Rates are reported only for regions with a population of at least 100,000.

Discussion

It is important to note that the current data cannot be used for determining revision rates, but over time CJRR will be able to measure and monitor revisions rates for these surgeries. By tracking individual patients who have had a primary total hip and total knee replacement and subsequently undergo a revision operation, the registry will be able to determine a true revision rate.

Following hip and knee replacement recipients over time will also enable the registry to determine which implants are least likely to be replaced. Providing a mechanism for post-market surveillance of orthopaedic implants is one of the goals of CJRR. Although implant-specific analysis was not included in this report, the registry will release such information in the near future.

It is also noteworthy that the mean age of total hip and total knee replacement recipients in the CJRR sample (68.2 years and 69.5 years, respectively) is very similar to the mean age of all patients who had undergone a total hip (mean age: 67.8 years) and total knee replacement (mean age: 69.2 years) in Canada in 2000/2001. Furthermore, the age distribution of total hip and total knee replacement recipients in the CJRR sample is very similar to the age distribution of all patients who had undergone these surgeries in Canada in 2000/2001. These similarities suggest that the data in the CJRR sample are representative of all total hip and total knee replacements performed in Canada, despite some differences in proportion of revisions. As participation in the CJRR increases and more data are submitted, it is expected that such differences will be minimized.

In the future, the CJRR may also be expanded to include data on wait times, patient prioritization, illness severity, patient functioning at follow-up and patient satisfaction. The addition of any of these data modules would greatly increase the number of policy relevant questions that can be addressed using registry data.

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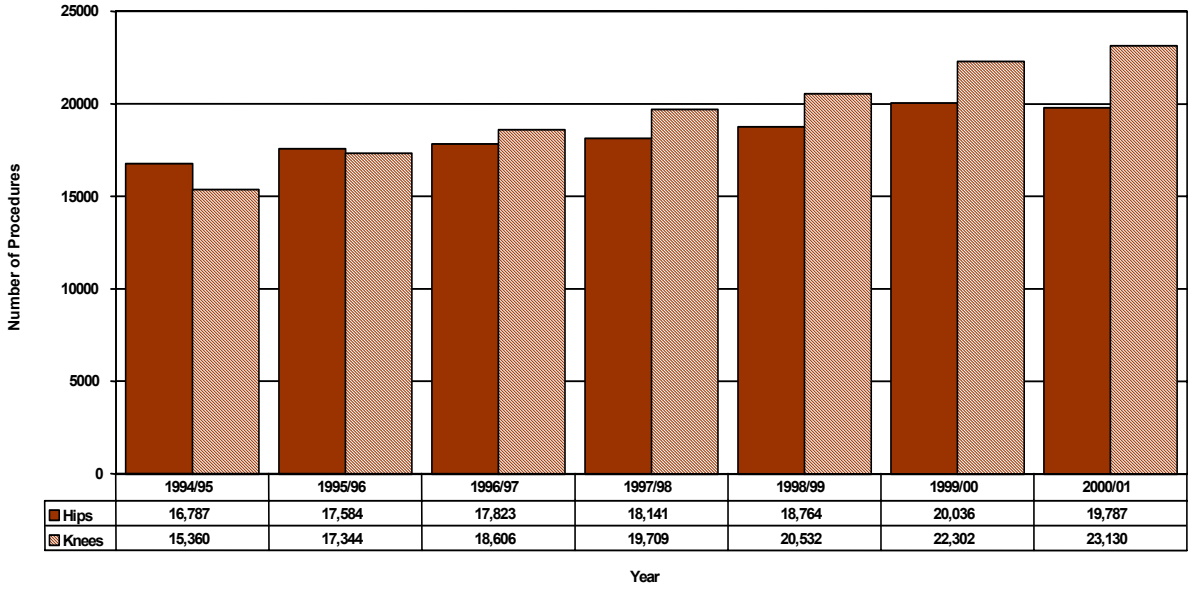
Appendix A

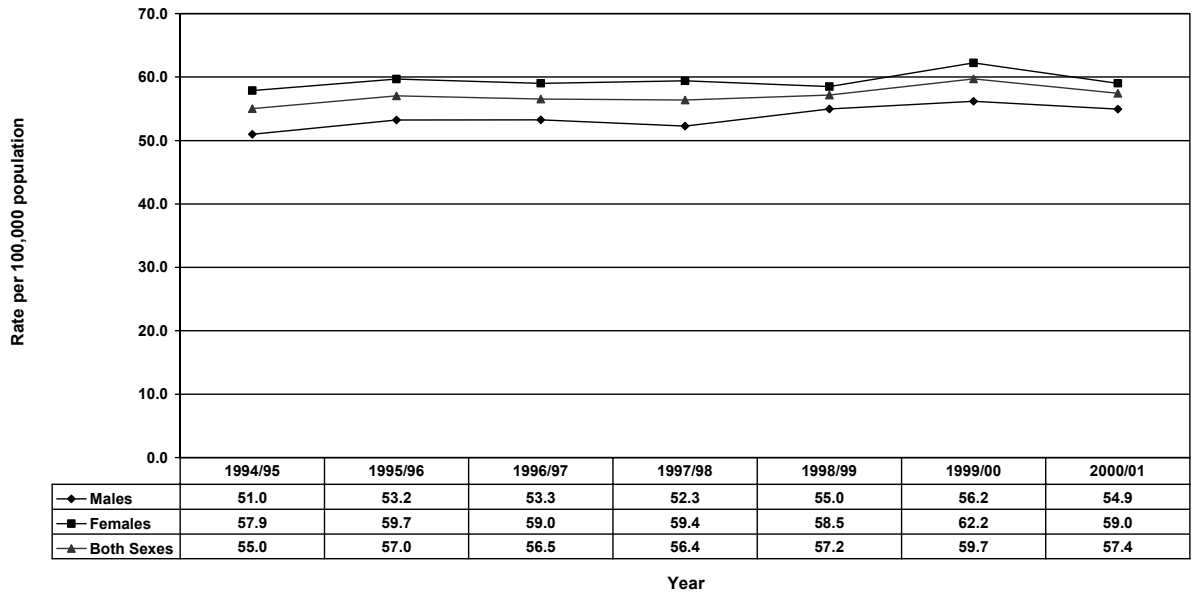
Additional Figures and Tables



	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Hips	16,787	17,584	17,823	18,141	18,764	20,036	19,787
Knees	15,360	17,344	18,606	19,709	20,532	22,302	23,130

Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

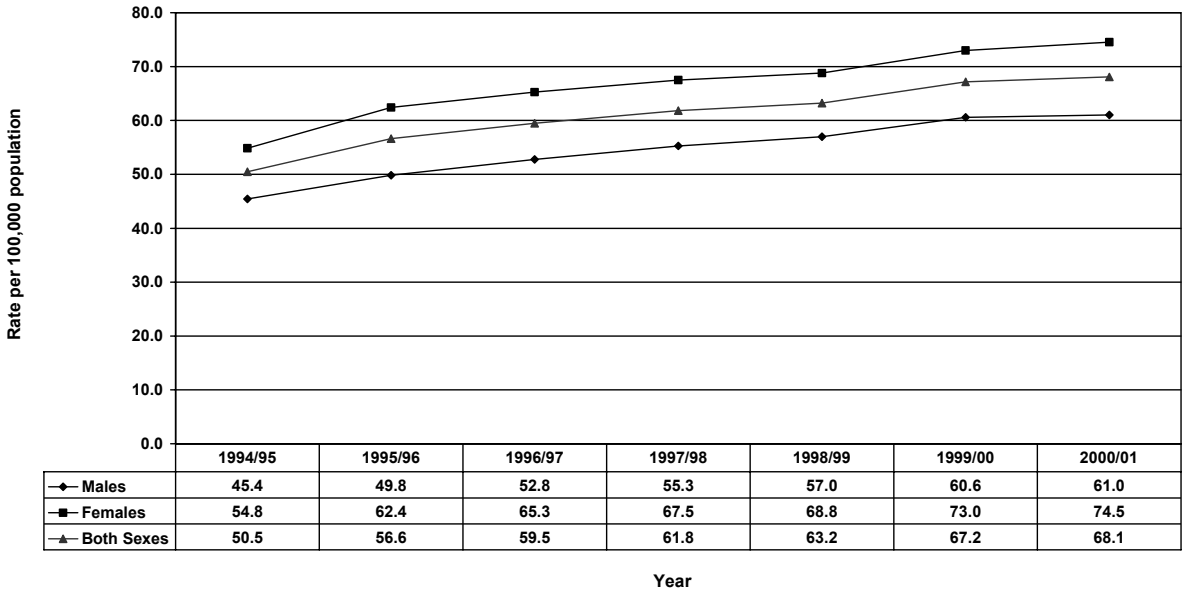
Figure A.1. Number of Total Hip and Total Knee Replacement Procedures Performed in Canada, 1994/1995 to 2000/2001



	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Males	51.0	53.2	53.3	52.3	55.0	56.2	54.9
Females	57.9	59.7	59.0	59.4	58.5	62.2	59.0
Both Sexes	55.0	57.0	56.5	56.4	57.2	59.7	57.4

Rates calculated based on patients' residence. Patients with unknown residence excluded.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

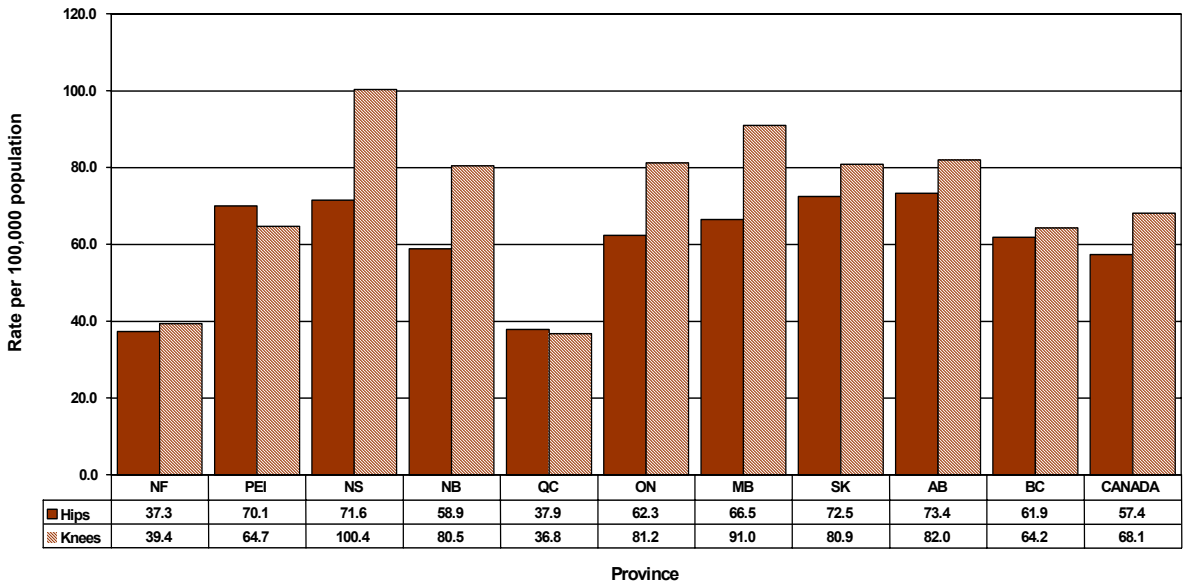
Figure A.2. Age-Standardized Rates (per 100,000 population) by Sex for Total Hip Replacement Procedures, Canada, 1994/1995 to 2000/2001



	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
Males	45.4	49.8	52.8	55.3	57.0	60.6	61.0
Females	54.8	62.4	65.3	67.5	68.8	73.0	74.5
Both Sexes	50.5	56.6	59.5	61.8	63.2	67.2	68.1

Rates calculated based on patients' residence. Patients with unknown residence excluded.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Figure A.3. **Age-Standardized Rates (per 100,000 population) by Sex for Total Knee Replacement Procedures, Canada, 1994/1995 to 2000/2001**



	NF	PEI	NS	NB	QC	ON	MB	SK	AB	BC	CANADA
Hips	37.3	70.1	71.6	58.9	37.9	62.3	66.5	72.5	73.4	61.9	57.4
Knees	39.4	64.7	100.4	80.5	36.8	81.2	91.0	80.9	82.0	64.2	68.1

Yukon, Northwest Territories and Nunavut rates suppressed due to small numbers but included in
Rates calculated based on patients' residence. Patients with unknown residence excluded (N=378).
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Figure A.4. **Age-Standardized Rates (per 100,000 population) of Total Hip and Total Knee Replacement Procedures by Province, 2000/2001**

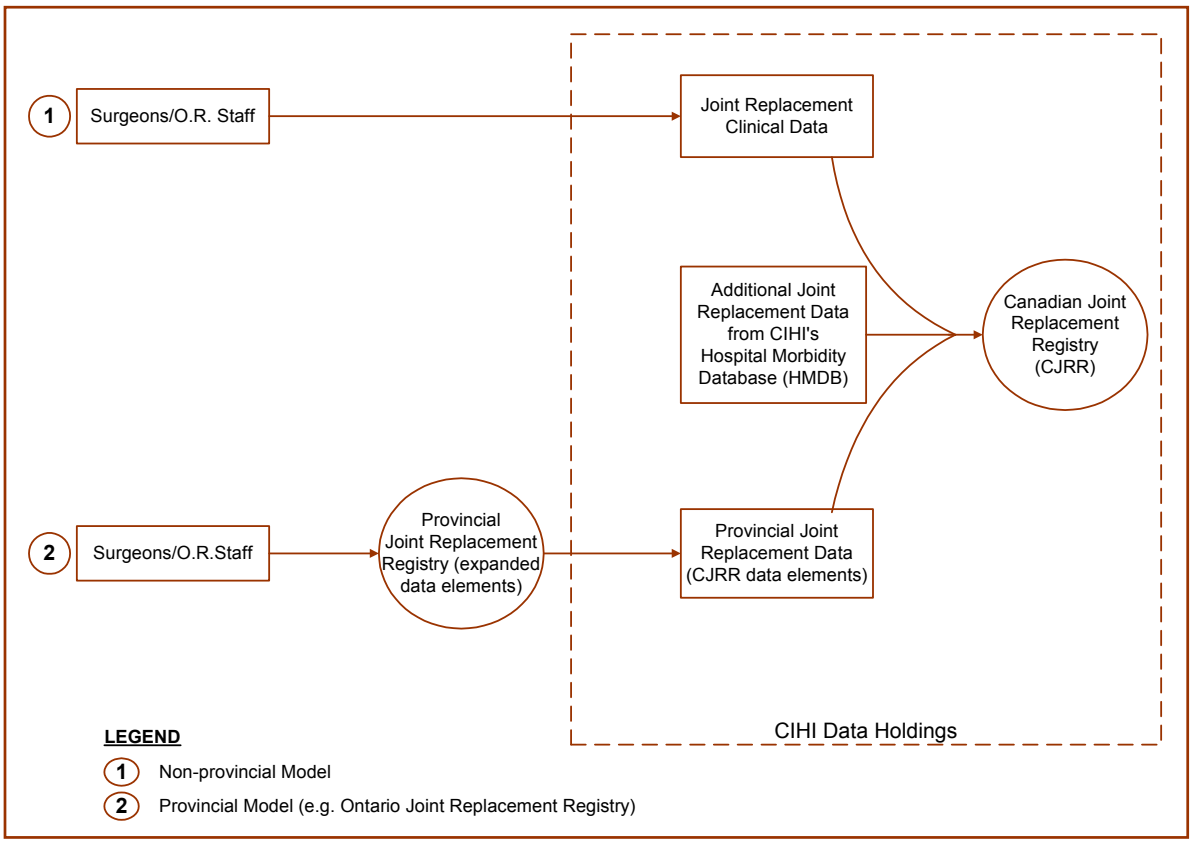


Figure A.5. Canadian Joint Replacement Registry (CJRR) Data Flow

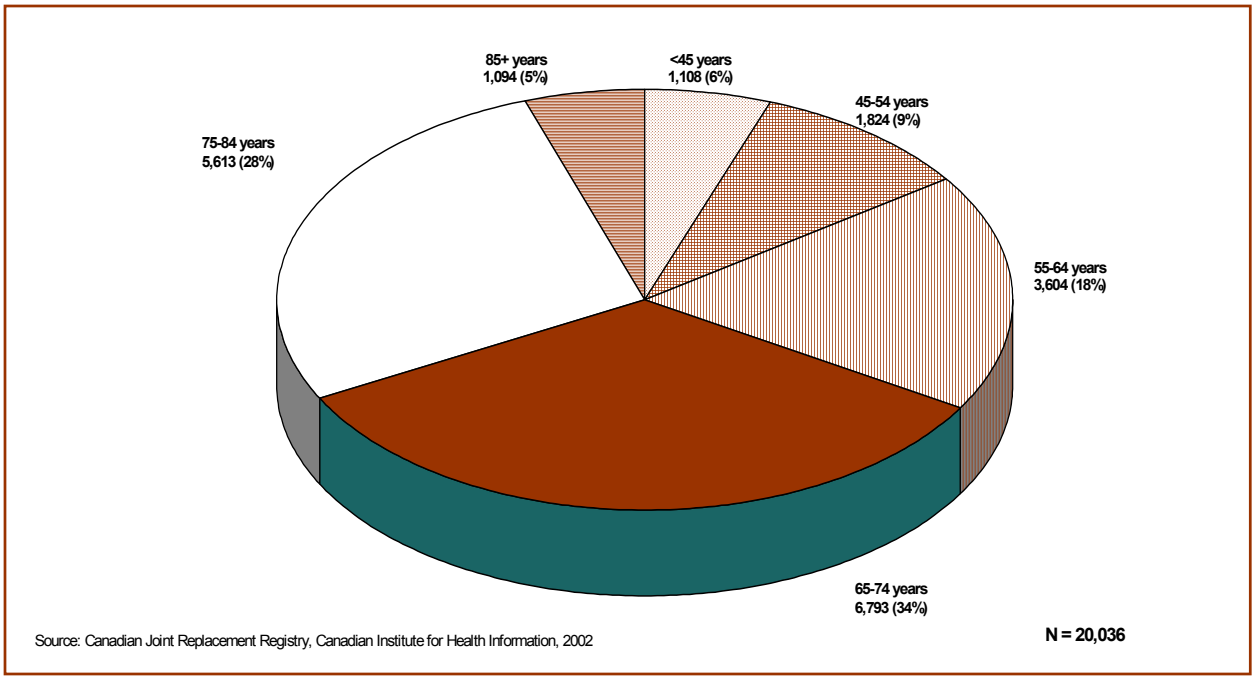


Figure A.6. Distribution of Total Hip Replacement Procedures by Age Groups, Canada, 2000/2001

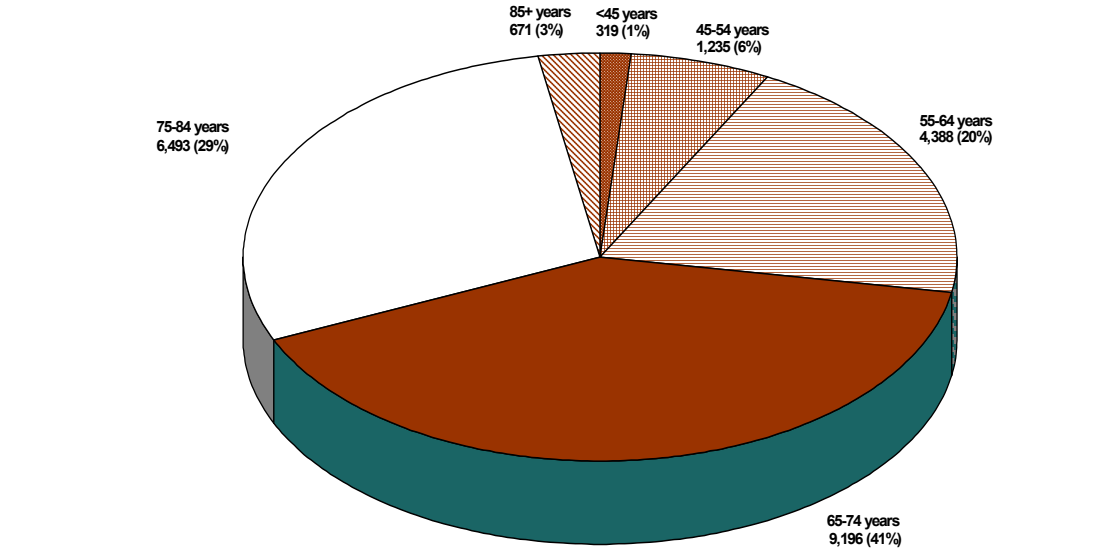


Figure A.7. Distribution of Total Knee Replacement Procedures by Age Group, Canada, 2000/2001

Table A.1. History of the 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 Bulletin	May 2002
8. CJRR Surgeon Participation Rate Exceeds 50%	July 2002
9. Supplemental CJRR Report	October 2002

Table A.2. Number and Total Hip and Total Knee Replacements Submitted to CJRR Relative to the Total Number of these Procedures Performed in Canada in 2000/2001

Province	Total number of replacement submitted to CJRR[1] (% of total)	Total number of replacements performed in 2000/2001 (% of total)
British Columbia	397 (17.3%)	5,835 (13.6%)
Alberta	109 (4.7%)	4,408 (10.3%)
Saskatchewan	151 (6.6%)	1,851 (4.3%)
Manitoba	223 (9.7%)	2,090 (4.9%)
Ontario[2]	N/A	18,748 (43.7%)
Quebec	446 (19.4%)	6,209 (14.5%)
Nova Scotia	371 (16.2%)	1,833 (4.3%)
Newfoundland	90 (3.9%)	445 (1.0%)
Prince Edward Island	0 (0.0%)	193 (0.4%)
New Brunswick	509 (22.2%)	1,276 (3.0%)
Northwest Territories	0 (0.0%)	29 (0.1%)
TOTAL	**2,296 (100.0%)**	**42,917 (100.0%)**

[1]Based on data received between May 1, 2001 and March 31, 2002
[2]Ontario surgeons submit directly to the Ontario Joint Replacement Registry (OJRR). OJRR data were not available for this report
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.3. Movement of Total Hip Replacement Patients Across Provinces, 1999/2000

Province	Number of patients who had their total hip replacement done in another province	Number out of province total hip replacement patients performed in this province
Alberta	7 (0.3%)	106 (5.1%)
British Columbia	63 (2.2%)	20 (0.7%)
Manitoba	24 (2.5%)	52 (5.3%)
New Brunswick	6 (1.2%)	30 (5.7)
Newfoundland	2 (1.0%)	1 (0.5%)
Nova Scotia	18 (2.2%)	36 (4.3%)
Northwest Territories	3 (21.4%)	**
Nunavut	1 (100%)*	*
Ontario	5 (0.1%)	127 (1.5%)
Prince Edward Island	17 (16.5%)	2 (2.3%)
Quebec	36 (1.2%)	16 (0.5%)
Saskatchewan	21 (2.4%)	28 (3.2%)
Yukon	12 (100%)*	*

* No joint replacements performed in Nunavut and the Yukon
** Numbers are suppressed.
Note: Columns 2 and 3 have different totals because Northwest Territories numbers are suppressed and patients with unknown geography codes are not accounted for in the second column.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.4. Movement of Total Knee Replacement Patients Across Provinces, 1999/2000

Province	Number of patients who had their total knee replacement done in another province	Number out of province total knee replacement patients performed in this province
Alberta	7 (0.4%)	79 (3.9%)
British Columbia	32 (1.1%)	30 (1.0%)
Manitoba	19 (1.6%)	57 (4.6%)
New Brunswick	3 (0.5%)	48 (7.2%)
Newfoundland	3 (1.5%)	6 (3.0%)
Nova Scotia	27 (2.6%)	18 (1.8%)
Northwest Territories	0	**
Nunavut	8 (100%)*	*
Ontario	3 (<0.1%)	135 (1.4%)
Prince Edward Island	4 (3.9%)	1 (1.0%)
Quebec	51 (1.8%)	5 (0.2%)
Saskatchewan	32 (3.7%)	29 (3.4%)
Yukon	22 (100%)*	*

* No joint replacements performed in Nunavut and the Yukon
** Numbers are suppressed.
Note: Columns 2 and 3 have different totals because Northwest Territories numbers are suppressed and patients with unknown geography codes are not accounted for in the second column.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.5. Movement of Joint Replacement Patients Across Newfoundland Regions, 2000/2001

Region	Number of patients who had their joint replacement done in another region	Number of out of region patients who had their joint replacement done in this region[1]
St. John's	0 (0.0%)	122 (45.3%)
Eastern	93 (100.0%)*	*
Central	14 (15.0%)	5 (5.9%)
Western	7 (8.5%)	10 (11.8%)
Grenfell	7 (63.6)**	2 (33.3%)**
Labrador	10 (100.0%)	*

[1]Includes out-of-province patients: Newfoundland received 2 out-of-province patients for a total joint replacement in 2000/2001.

* No joint replacements performed in this region

** Interpret with caution since percent based on small numbers

Note: Columns 2 and 3 have different totals because patients with unknown geography codes and patients who went to another province for their total joint replacement are not accounted for in the second column.

Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.6. Movement of Joint Replacement Patients Across Nova Scotia Regions, 2000/2001

Region	Number of patients who had their joint replacement done in another region	Number of out of region patients who had their joint replacement done in this region[1]
Zone 1	252 (100.0%)*	*
Zone 2	34 (18.8%)	170 (53.6%)
Zone 3	194 (100.0%)	*
Zone 4	111 (59.0%)	1 (1.3%)
Zone 5	24 (6.5%)	24 (6.5%)
Zone 6	29 (4.9%)	494 (46.6%)

[1] Includes out-of-province patients: Nova Scotia received 42 out-of-province patients for a total joint replacement in 2000/2001.
* No joint replacements performed in this region
Note: Columns 2 and 3 have different totals because patients with unknown geography codes and patients who went to another province for their total joint replacement are not accounted for in the second column.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.7. Movement of Joint Replacement Patients Across New Brunswick Regions, 2000/2001

Region	Number of patients who had their joint replacement done in another region	Number of out of region patients who had their joint replacement done in this region[1]
Region 1—Moncton area	7 (2.3%)	96 (24.8%)
Region 2—St. John area	23 (7.6%)	15 (5.1%)
Region 3—Fredericton area	5 (1.5%)	33 (9.4%)
Region 4	6 (10.9%)	7 (12.5%)
Region 5	13 (26.0%)	13 (26.0%)
Region 6	11 (17.5%)	11 (11.5%)
Region 7	25 (35.7%)	1 (2.2%)

[1] Includes out-of-province patients: New Brunswick received 77 out-of-province patients for a total joint replacement in 2000/2001.
Note: Columns 2 and 3 have different totals because patients with unknown geography codes and patients who went to another province for their total joint replacement are not accounted for in the second column.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.8. Movement of Joint Replacement Patients Across Quebec Regions, 2000/2001

Region	Number of patients who had their joint replacement done in another region	Number of out of region patients who had their joint replacement done in this region[1]
Bas-Saint-Laurent	39 (19.1%)	17 (9.3%)
Saguenay Lac-Saint-Jean	27 (10.8%)	23 (9.3%)
Québec (QC)	9 (1.7%)	226 (30.8%)
Mauricie et Centre-du-QC	60 (12.8%)	64 (13.5%)
Estrie	104 (36.9%)	21 (10.5%)
Montréal-Centre	64 (4.4%)	751 (34.8%)
Outaouais	11 (4.7%)	8 (3.5%)
Abitibi-Témiscamingue	9 (8.9%)	16 (14.8%)
Côte-Nord	29 (44.6%)	1 (2.7%)
Gaspésie-Îles-de-la-Madeleine	40 (45.4%)	0 (0.0%)
Chaudière-Appalaches	117 (28.1%)	63 (17.4%)
Laval	177 (54.1%)	79 (34.5%)
Lanaudière	111 (39.9%)	22 (11.6%)
Laurentides	146 (42.9%)	39 (16.7%)
Montérégie	361 (34.6%)	35 (4.9%)
Nord-du-QC, Nunavik & Cries-de-la-Baie-James	32 (100.0%)	*

[1] Includes out-of-province patients: Quebec received no out-of-province patients for a total joint replacement in 2000/2001.

* No joint replacements performed in these regions

Note: Columns 2 and 3 have different totals because patients with unknown geography codes and patients who went to another province for their total joint replacement are not accounted for in the second column.

Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.9. Movement of Joint Replacement Patients Across Ontario Regions, 2000/2001

Region—District Health Councils	Number of patients who had their joint replacement done in another region	Number of out of region patients who had their joint replacement done in this region[1]
Champlain	42 (2.9%)	172 (10.8%)
Quinte-Kingston & Rideau	154 (14.4%)	93 (9.2%)
Durham-Haliburton-Kawartha & Pine Ridge	803 (53.3%)	34 (4.6%)
Toronto	156 (4.9%)	2,233 (42.3%)
Simcoe-York	585 (42.8%)	264 (25.3%)
Halton-Peel	466 (27.4%)	351 (22.2%)
Waterloo-Wellington-Dufferin	279 (26.6%)	96 (11.1%)
HHamiHH	92 (10.3%)	375 (31.9%)
Niagara	227 (24.4%)	33 (4.5%)
Grand River	268 (68.2%)	4 (3.1%)
Thames Valley	60 (6.8%)	474 (36.5%)
Essex-Kent & Lambton	167 (14.1%)	34 (3.2%)
Grey-Bruce-Huron & Perth	299 (43.3%)	73 (15.7%)
Muskoka-Nipissing & Perry Sound	316 (71.5%)	7 (5.3%)
Algoma-Cochrane-Manitoulin & Sudbury	128 (18.1%)	46 (7.4%)
Northwest Ontario	14 (2.7%)	6 (1.2%)

[1] Includes out-of-province patients: Ontario received 86 out-of-province patients for a total joint replacement in 2000/2001.
Note: Columns 2 and 3 have different totals because patients with unknown geography codes and patients who went to another province for their total joint replacement are not accounted for in the second column.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.10. Movement of Joint Replacement Patients Across Manitoba Regions, 2000/2001

Region	Number of patients who had their joint replacement done in another region	Number of out of region patients who had their joint replacement done in this region[1]
Winnipeg	1 (0.1%)	793 (40.7%)
Brandon	22 (35.5%)	78 (66.1%)
North Eastman	81 (100.0%)	*
South Eastman	81 (100.0%)	*
Interlake	149 (100.0%)	*
Central	156 (88.6%)	3 (13.0%)
Marquette	71 (100.0%)	*
South Westman	84 (100.0%)	*
Parkland	74 (100.0%)	*
Norman	19 (100.0%)	*
Burntwood	45 (100.0%)	*
Churchill	7 (100.0%)	*

[1]Includes out-of-province patients: Manitoba received no out-of-province patients for a total joint replacement in 2000/2001.

* No joint replacements are performed in these regions.

Note: Columns 2 and 3 have different totals because patients with unknown geography codes and patients who went to another province for their total joint replacement are not accounted for in the second column.

Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.11. Movement of Joint Replacement Patients Across Saskatchewan Regions, 2000/2001

Region—Service Areas	Number of patients who had their joint replacement done in another region	Number of out of region patients who had their joint replacement done in this region[1]
Weyburn	120 (100.0%)	*
Moose Jaw	55 (46.6%)	16 (20.2%)
Swift Current	84 (100.0%)	*
Regina	26 (6.3%)	227 (37.0%)
Yorkton	57 (46.7%)	42 (39.2%)
Saskatoon	17 (3.4%)	435 (47.1%)
Rosetown	103 (100.0%)	*
Melfort	88 (100.0%)	*
Prince Albert	36 (34.0%)	23 (24.7%)
North Battleford	102 (100.0%)	*
Northern Health Services Branch	16 (100.0%)	*

[1]Includes out-of-province patients: Saskatchewan received 39 out-of-province patients for a total joint replacement in 2000/2001.
* No joint replacements are performed in these regions.
Note: Columns 2 and 3 have different totals because patients with unknown geography codes and patients who went to another province for their total joint replacement are not accounted for in the second column.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.12. Movement of Joint Replacement Patients Across British Columbia Regions, 2000/2001

Region	Number of patients who had their joint replacement done in another region	Number of out of region patients who had their joint replacement done in this region[1]
East Kootenay	32 (23.0%)	5 (4.5%)
West Kootenay-Boundary	33 (25.0%)	41 (29.3%)
North Okanagan	80 (33.2%)	26 (13.9%)
S. Okanagan Similkameen	39 (6.1%)	122 (16.8%)
Thompson	50 (18.8%)	42 (16.3%)
Fraser Valley	75 (17.9%)	41 (10.7%)
South Fraser Valley	323 (45.2%)	40 (9.3%)
Coast Garibaldi	120 (100.0%)	*
Central Vancouver Island	126 (26.2%)	24 (6.3%)
Upper Island/Central Coast	19 (12.3%)	79 (36.9%)
Cariboo	87 (100.0%)	*
North West	33 (50.8%)	3 (8.6%)
Peace Liard	7 (41.2%)**	0 (0.0%)
Northern Interior	68 (48.2%)	14 (16.1%)
North Shore	75 (26.5%)	66 (24.1%)
Capital	48 (7.8%)	51 (8.3%)
Vancouver/Richmond	57 (9.8%)	762 (59.1%)
Simon Fraser/Burnaby	152 (25.7%)	187 (29.9%)

[1]Includes out-of-province patients: British Columbia received 31 out-of-province patients for a total joint replacement in 2000/2001.

* No joint replacements are performed in these regions.

** Interpret with caution since percent based on small numbers

Note: Columns 2 and 3 have different totals because patients with unknown geography codes and patients who went to another province for their total joint replacement are not accounted for in the second column.

Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.13. Movement of Joint Replacement Patients Across Alberta Regions, 2000/2001

Region—Health Authority	Number of patients who had their joint replacement done in another region	Number of out of region patients who had their joint replacement done in this region[1]
Chinook	25 (8.6%)	61 (18.6%)
Palliser	42 (29.2%)	40 (28.2%)
Headwaters	123 (100.0%)	*
Calgary Region	13 (1.3%)	312 (24.1%)
Health Authority #5	108 (94.7%)	0 (0.0%)
David Thompson Region	65 (18.2%)	58 (16.5%)
East Central	107 (53.0%)	59 (38.3%)
West View Region	129 (100.0%)	*
Crossroads	74 (100.0%)	*
Capital	16 (1.3%)	695 (36.7%)
Aspen Region	135 (100.0%)	*
Lakeland	197 (100.0%)	*
Mistahia	18 (13.1%)	86 (41.9%)
Peace Region	31 (100.0%)	*
Keeweetinok Lakes Region	25 (100.0%)	*
Northern Lights Region	19 (100.0%)	*
Northwest Region	12 (100.0%)	*

[1]Includes out-of-province patients: Alberta received 141 out-of-province patients for a total joint replacement in 2000/2001.

* No joint replacements are performed in these regions.

Note: Columns 2 and 3 have different totals because patients with unknown geography codes and patients who went to another province for their total joint replacement are not accounted for in the second column.

Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.14. Age Standardized Rates[1] (per 100,000 population) of Total Hip and Total Knee Replacement Procedures in Newfoundland Regions, 1999/2000

Regions[2]	Total Hip Replacements	Total Knee Replacements
Central	44.6	43.0
Eastern	31.1	33.4
St. John's	34.9	27.5
NEWFOUNDLAND	**35.5**	**35.4**

[1]Rates calculated based on patients' residence. Patients with unknown residents excluded
[2]Rates reported only for those regions with a population of at least 100,000 residents
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.15. Age Standardized Rates[1] (per 100,000 population) of Total Hip and Total Knee Replacement Procedures in Nova Scotia Regions, 1999/2000

Regions[2]	Total Hip Replacements	Total Knee Replacements
Zone 1	61.8	92.3
Zone 3	73.8	107.3
Zone 5	73.1	132.0
Zone 6	81.1	84.5
NOVA SCOTIA	**76.4**	**98.7**

[1]Rates calculated based on patients' residence. Patients with unknown residents excluded
[2]Rates reported only for those regions with a population of at least 100,000 residents
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.16. Age Standardized Rates[1] (per 100,000 population) of Total Hip and Total Knee Replacement Procedures in New Brunswick Regions, 1999/2000

Regions[2]	Total Hip Replacements	Total Knee Replacements
Region 1	61.8	79.3
Region 2	71.1	94.6
Region 3	65.8	92.1
NEW BRUNSWICK	**60.6**	**77.3**

[1]Rates calculated based on patients' residence. Patients with unknown residents excluded
[2]Rates reported only for those regions with a population of at least 100,000 residents
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.17. Age Standardized Rates[1] (per 100,000 population) of Total Hip and Total Knee Replacement Procedures in Quebec Regions, 1999/2000

Regions[2]	Total Hip Replacements	Total Knee Replacements
Lanaudière	32.3	32.6
Laval	37.3	36.9
Montréal-Centre	34.3	28.0
Région de Québec	31.0	26.4
Abitibi-Témiscamingue	42.5	43.5
Estrie	36.6	25.9
Outaouais	34.0	46.4
Chaudière-Appalaches	51.5	39.7
Côte-Nord	24.6	28.9
Gaspésie-Îles-de-la-Madeleine	31.2	54.5
Mauricie et Centre-du-Québec	36.1	38.8
Montérégie	35.6	39.3
Laurentides	44.1	33.5
Bas-Saint-Laurent	43.1	39.5
Saguenay—Lac-Saint-Jean	33.8	42.5
QUEBEC	**36.3**	**34.4**

[1]Rates calculated based on patients' residence. Patients with unknown residents excluded
[2]Rates reported only for those regions with a population of at least 100,000 residents
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.18. Age Standardized Rates[1] (per 100,000 population) of Total Hip and Total Knee Replacement Procedures in Ontario Regions, 1999/2000

Regions—District Health Councils[2]	Total Hip Replacements	Total Knee Replacements
Algoma-Cochrane-Manitoulin-Sudbury	61.5	84.4
Champlain	59.9	67.4
Durham-Haliburton-Kawartha-Pine Ridge	78.7	101.2
Essex-Kent and Lambton	75.7	92.6
Grand River	69.7	98.3
Grey-Bruce-Huron and Perth	73.1	102.7
Halton-Peel	68.1	78.5
Hamilton-Wentworth	74.1	102.8
Muskoka-Nipissing and Parry Sound	66.2	86.6
Niagara	68.5	92.3
Northwest Ontario	92.3	107.8
Qinte-Kingston and Rideau	79.6	95.0
Simcoe-York	61.8	74.4
Thames Valley	72.6	84.2
Toronto	55.3	64.2
Waterloo-Wellington-Dufferin	70.6	77.2
ONTARIO	**67.0**	**81.7**

[1]Rates calculated based on patients' residence. Patients with unknown residents excluded
[2]Rates reported only for those regions with a population of at least 100,000 residents
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.19. Age Standardized Rates[1] (per 100,000 population) of Total Hip and Total Knee Replacement Procedures in Manitoba Regions, 1999/2000

Regions[2]	Total Hip Replacements	Total Knee Replacements
Winnipeg	76.0	98.6
MANITOBA	**74.9**	**94.8**

[1]Rates calculated based on patients' residence. Patients with unknown residents excluded
[2]Rates reported only for those regions with a population of at least 100,000 residents
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.20. Age Standardized Rates[1] (per 100,000 population) of Total Hip and Total Knee Replacement Procedures in Saskatchewan Regions, 1999/2000

Regions[2]	Total Hip Replacements	Total Knee Replacements
Regina	68.7	51.4
Saskatoon	81.0	78.8
SASKATCHEWAN	**70.3**	**71.8**

[1]Rates calculated based on patients' residence. Patients with unknown residents excluded
[2]Rates reported only for those regions with a population of at least 100,000 residents
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.21. Age Standardized Rates[1] (per 100,000 population) of Total Hip and Total Knee Replacement Procedures in Alberta Regions, 1999/2000

Regions—Regional Health Authority[2]	Total Hip Replacements	Total Knee Replacements
Calgary	61.7	55.7
Edmonton	76.2	75.4
Chinook	82.6	88.5
David Thompson	84.8	80.0
East Central	78.6	98.5
Lakeland	107.3	93.4
ALBERTA	**74.3**	**75.8**

[1]Rates calculated based on patients' residence. Patients with unknown residents excluded
[2]Rates reported only for those regions with a population of at least 100,000 residents
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.22. Age Standardized Rates[1] (per 100,000 population) of Total Hip and Total Knee Replacement Procedures in British Columbia Regions, 1999/2000

Regions[2]	Total Hip Replacements	Total Knee Replacements
Victoria	70.7	60.1
Central Vancouver Island	64.7	74.8
Simon Fraser/Burnaby	47.7	53.7
Vancouver/Richmond	43.5	39.3
Fraser Valley	61.3	83.2
North Okanagan	91.4	90.0
North Shore	88.7	50.8
Northern Interior	59.4	86.3
South Fraser Valley	59.7	59.8
South Okanagan Similkameen	76.8	88.3
Thompson	87.7	90.7
Upper Island/Central Coast	72.3	93.1
BRITISH COLUMBIA	**64.6**	**66.0**

[1]Rates calculated based on patients' residence. Patients with unknown residents excluded
[2]Rates reported only for those regions with a population of at least 100,000 residents
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.23. Number of Primary and Revision Total Hip Replacements Performed in Canada by Province, 2000/2001

Province	Number of Primary Replacements	Number of Revision Replacements	Total Number of Replacements	Percent Revisions
Alberta	1,873	227	2,100	10.8
British Columbia	2,507	378	2,885	13.1
Manitoba	754	135	889	15.2
New Brunswick	463	82	545	15.0
Newfoundland	197	25	222	11.3
Northwest Territories	**	**	**	**
Nova Scotia	671	112	783	14.3
Ontario	7,474	733	8,207	8.9
Prince Edward Island	85	7	92	7.6
Quebec*	3,165	N/A	3,165	N/A
Saskatchewan	818	70	888	7.9
CANADA	**18,017**	**1,770**	**19,787**	**10.6**

* Revision procedures are not coded separately from primary procedures in Quebec
** Numbers from Northwest Territories suppressed due to small cell sizes
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.24. Number of Primary and Revision Total Knee Replacements Performed in Canada by Province, 2000/2001

Province	Number of Primary Replacements	Number of Revision Replacements	Total Number of Replacements	Percent Revisions
Alberta	2,132	176	2,308	7.6
British Columbia	2,748	202	2,950	6.8
Manitoba	1,099	102	1,201	8.5
New Brunswick	636	95	731	13.0
Newfoundland	201	22	223	9.9
Northwest Territories	**	**	**	**
Nova Scotia	949	101	1,050	9.6
Ontario	9,741	800	10,541	7.6
Prince Edward Island	95	6	101	5.9
Quebec*	3,044*	N/A	3,044	N/A
Saskatchewan	890	73	963	7.6
CANADA	**21,551**	**1,579**	**23,130**	**7.9**

* Revision procedures are not coded separately from primary procedures in Quebec
** Numbers from Northwest Territories suppressed due to small cell sizes
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.25. Number and Age-Standardized Rates of Total Hip Replacement Procedures Performed in Canada Based on Patient Residence, 1999/2000 and 2000/2001

Province	1999/2000		2000/2001	
	Number of Procedures	Rate per 100,000 population	Number of Procedures	Rate per 100,000 population
Newfoundland	201	35.5	218	37.3
Prince Edward Island	104	64.2	110	70.1
Nova Scotia	825	76.4	781	71.6
New Brunswick	511	60.6	514	58.9
Quebec	2,979	36.3	3,188	37.9
Ontario	8,433	67.0	8,078	62.3
Manitoba	967	74.9	867	66.5
Saskatchewan	861	70.3	885	72.5
Alberta	1,992	74.3	2,036	73.4
British Columbia	2,931	64.6	2,892	61.9
Northwest Territories	14	*	10	*
Yukon	12	*	15	*
Nunavut	1	*	4	*
Unknown	205	N/A	189	N/A
CANADA*	**20,036**	**59.7**	**19,787**	**57.4**

*Patients with unknown residence are excluded. Yukon, Northwest Territories and Nunavut rates are suppressed due to small numbers but included in the national average.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002

Table A.26. Number and Age-Standardized Rates of Total Knee Replacement Procedures Performed in Canada Based on Patient Residence, 1999/2000 and 2000/2001

Province	1999/2000		2000/2001	
	Number of Procedures	Rate per 100,000 population	Number of Procedures	Rate per 100,000 population
Newfoundland	198	35.5	226	39.4
Prince Edward Island	104	67.0	101	64.7
Nova Scotia	1,039	98.7	1,077	100.4
New Brunswick	643	77.3	685	80.5
Quebec	2,796	34.4	3,069	36.8
Ontario	10,220	81.7	10,426	81.2
Manitoba	1,217	94.8	1,178	91.0
Saskatchewan	870	71.8	975	80.9
Alberta	1,984	75.8	2,223	82.0
British Columbia	2,970	66.0	2,946	64.2
Northwest Territories	17	*	15	*
Yukon	22	*	10	*
Nunavut	8	*	10	*
Unknown	214	N/A	189	N/A
CANADA*	**22,302**	**67.2**	**23,130**	**68.1**

*Rates for the Northwest Territories, Yukon, Territories and Nunavut rates are suppressed due to small numbers but included in the national average.
Source: Canadian Joint Replacement Registry, Canadian Institute for Health Information, 2002