



Manitoba Centre for Health Policy

Orthopedic and Ophthalmology Surgical Projection Models

Autumn 2022

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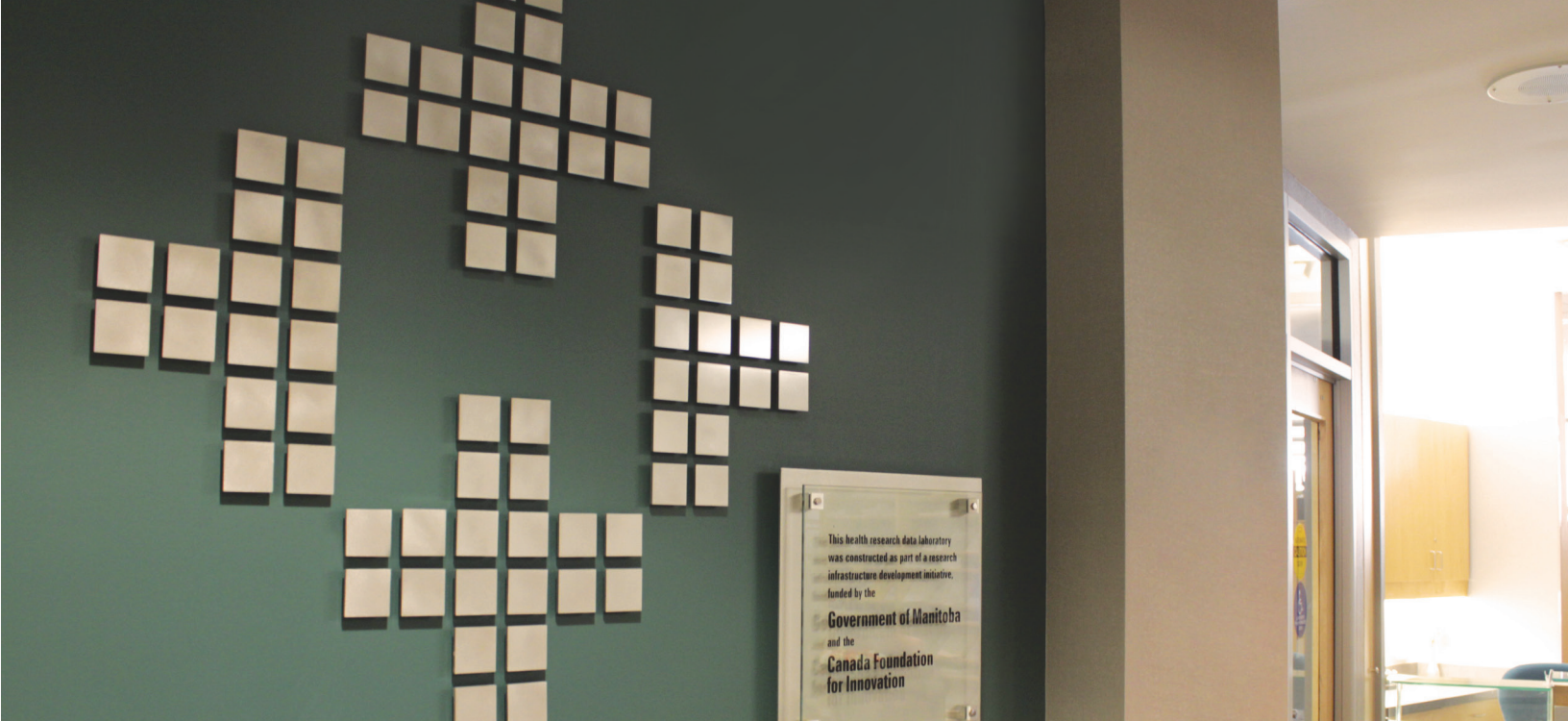
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This report was prepared at the request of Manitoba Health, a department within the Government of Manitoba, as part of the contract between the University of Manitoba and Manitoba Health. It was supported through funding provided by Manitoba Health to the University of Manitoba (HIPC/PHRPC 2021/2022-36). The results and conclusions are those of the authors and no official endorsement by Manitoba Health was intended or should be inferred. Data used in this study are from the Manitoba Population Research Data Repository housed at the Manitoba Centre for Health Policy, University of Manitoba, and were derived from data provided by Manitoba Health. Strict policies and procedures were followed in producing this report to protect the privacy and security of the Repository data.



About the Manitoba Centre for Health Policy

The Manitoba Centre for Health Policy (MCHP) is located within the Department of Community Health Sciences, Max Rady College of Medicine, Rady Faculty of Health Sciences, University of Manitoba. The mission of MCHP is to provide accurate and timely information to healthcare decision-makers, analysts and providers, so they can offer services that are effective and efficient in maintaining and improving the health of Manitobans.

Our researchers rely upon the unique Manitoba Population Research Data Repository (Repository) to describe and explain patterns of care and profiles of illness and to explore other factors that influence health, including income, education, employment, and social status. This Repository is unique in terms of its comprehensiveness, degree of integration, and orientation around an anonymized population registry.

Members of MCHP consult extensively with government officials, healthcare administrators, and clinicians to develop a research agenda that is topical and

relevant. This strength, along with its rigorous academic standards, enables MCHP to contribute to the health policy process. MCHP undertakes several major research projects, such as this one, every year under contract to Manitoba Health. In addition, our researchers secure external funding by competing for research grants. We are widely published and internationally recognized. Further, our researchers collaborate with a number of highly respected scientists from Canada, the United States, Europe, and Australia.

We thank the Research Ethics Board on the Bannatyne Campus at the University of Manitoba for their review of this project. MCHP complies with all legislative acts and regulations governing the protection and use of sensitive information. We implement strict policies and procedures to protect the privacy and security of anonymized data used to produce this report and we keep the Provincial Health Research Privacy Committee (PHRPC) informed of all work undertaken for Manitoba Health.

The Manitoba Centre for Health Policy

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This report is the result of the contributions of many people. The team relied on the guidance of both Manitoba Health leadership and representatives of the ministry and Shared Health who provided their time and expertise to an advisory group. In particular, we thank Bill Ayers, Bronwyn Butler-Jones, Janie Peterson Watt, and Mike Ocko from Manitoba Health, as well as Aaron Suggitt from Shared Health.

We appreciate the research scientists, staff and students at MCHP who supported the research team and provided feedback and guidance throughout the process, including useful comments on the draft report. The Manitoba Population Research Data Repository is a complex resource that requires constant “maintenance and feeding.” We recognize this ongoing work, which contributes to the foundation of all research that uses the Repository.

We acknowledge the University of Manitoba Health Research Ethics Board for their review of the proposed research project. The Provincial Health Research Privacy Committee (which replaced the Health Information Privacy Committee (HIPC)) is kept informed of all MCHP deliverables. The HIPC/PHRPC number for this project is 2021/2022-36. We also acknowledge Manitoba Health for the use of their data.

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Background and Introduction

The Manitoba Centre for Health Policy (MCHP) developed projection models for orthopedic and ophthalmology surgical procedures in Manitoba, as requested by Manitoba Health. The Manitoba healthcare system has been plagued by longstanding surgical wait times which preceded the COVID-19 pandemic. The reasons for these wait times are beyond the scope of this report. The exacerbation of wait times during the pandemic are also not addressed in the report.

Many resources are required to perform surgical procedures, including providers (e.g., Surgeons to perform the procedures, anesthetists), other clinical staff such as nurses, surgical equipment including artificial joints, and necessary medical facilities. Some procedures can be performed in emergency departments or other facilities outside of hospitals while more complex procedures require specialized surgical facilities.

The focus of this study is on orthopedic and ophthalmology surgical procedures, which includes the resources described above and the patients who require the procedures.

The approach we have taken is to model previous orthopedic and ophthalmology service provision which includes key population characteristics, but these models are under-estimates of the true need due to waiting lists.

Research Objectives

1. Explore the delivery of orthopedic and ophthalmology surgical procedures between April 2004 and March 2020 in relation to population demographics.
2. Build models to predict surgical procedure requirements based on past use.

Report Approach

This report includes three distinct products:

1. First, this narrative report which describes the approach and methods of the study while providing context for the other components.
2. Second, the results are presented using interactive data visualization software (Power BI) to enhance the user experience.
3. Third, the analytic SAS code is being made available to Manitoba Health to facilitate running of new models over time.



Methods

Data sources and study years

All the data included in the study are housed at the Manitoba Centre for Health Policy in the Manitoba Population Research Data Repository (Repository). Procedure codes (CCI codes) from the hospital discharge abstracts (DAD) were used to identify in-hospital surgical procedures, the medical claims database provided physician billings (tariff codes) for procedures (usually minor procedures) performed either outside hospitals or for procedures that do not result in a hospital discharge abstract. Additionally, the Manitoba Health Insurance Registry provided the eligible population and postal codes to determine area of residence, and The Provider registry provided the physician specialty to determine which physician billings to include. More details about these datasets are available on the MCHP website at: <https://umanitoba.ca/manitoba-centre-for-health-policy/data-repository>.

The data from April 1, 2004 to March 31, 2018 were used to develop the models and data from April 1, 2018 to March 31, 2020 were used to validate the models. The period of the COVID-19 pandemic was excluded in the model development, but the projections for this period are included and reflect the decreased services provided during this period.

Out-of-province procedures (amounting to less than 1% of each category) were excluded.

Procedures and codes

Please see Appendix 1 (in the online supplement at <http://mchp-appserv.cpe.umanitoba.ca/deliverable.php?referencePaperID=88448>) for all CCI and tariff codes used as well as details on how procedures were counted.

Projection Models

After an exploration of the potential modelling approaches, SARIMA (Seasonal Autoregressive Integrated Moving Average) models were chosen to predict the number of orthopedic and ophthalmology surgical procedures expected for the period April 1, 2020 to March 31, 2027. We chose these models because the number of surgical procedures showed some seasonality and trends over time. We developed the predictive models by dividing the data into a training dataset (from April 1, 2004 to March 31, 2018) and a validation dataset (from April 1, 2018 to March 31, 2020) – all before the pandemic. Model selection

was based on measures of model fit. The technical details are presented in Appendix 3 online. To account for future population structural changes in older age groups (ages 60 and over), we adjusted the projections by multiplying by a constant that represents the most recent trend in the population growth in older adults.

Limitations

All projection modelling is just an estimate based on the data used in the models.

The most significant limitation of the projections presented in this report is that the models **do not include the actual population need** for procedures but reflect the volume of

services provided in the past. For years, Manitoba has had wait lists for many surgical procedures included in the study. The Repository does not include wait list data and the wait list data that are available are not of sufficient quality for inclusion in projections. This means that the services included in the development of the models represent the minimum number of services to meet the population demand. It is reasonable to expect that provision of the services projected by the model would result in ongoing wait lists. Addressing the backlog of services that existed prior to the pandemic would require providing an even greater number of services than what the models suggest.

The reduction in surgical procedures during the COVID-19 pandemic from March 18, 2020 to April 1, 2022 has increased the backlog of surgical procedures. This additional backlog is not addressed in this report.



Findings

Orthopedic Surgical Procedures

We identified 349,171 orthopedic procedures from hospital abstracts with orthopedic CCI codes (See Appendix Tables 1.1 and 1.2 online) including both in-patient and day procedures, while 151,561 procedures were identified from physician billing not found in the hospital discharge abstracts bringing the total to 500,732. The procedures identified from hospital abstracts are major procedures such as joint replacement surgeries, while the procedures identified from physician billing codes are minor procedures such as joint injections and casting of fractures. More than one third of hospital-based surgical procedures were one of three procedures: hip replacement, knee replacements and knee repairs.

Annual counts and adjusted rates are presented in Appendix 2 and in interactive graphs online.

Ophthalmology Surgical Procedures

Out of the total of 660,127 procedures, less than half (230,717) of the procedures were identified in hospital abstracts with CCI codes, including both in-patient and day procedures (See Appendix Tables 1.3 and 1.4 online). Eighty-four percent of hospital-based procedures were cataract surgeries. The Medical Claims File provided 429,410 additional clinic-based procedures which were included in the models.

Projected Surgical Procedures to 2027

The detailed projections are presented via the Power BI visualization which includes dynamic interactive graphic presentations of the models and the underlying data. Appendix 2 presents the projected counts. Figure 1 shows the pattern of orthopedic procedures from 2005 to 2020 (observations from procedures provided) and projections to 2027.

The observed service counts (2005-2020) and model projections for ophthalmology are shown in Figure 2. This figure reflects a continual increase in service provision that steepens slightly in later years of the projection. This appears to be due to the projected rise in clinic-based procedures.

Figure 1: Orthopedic Surgical Procedures, 2005 to 2027

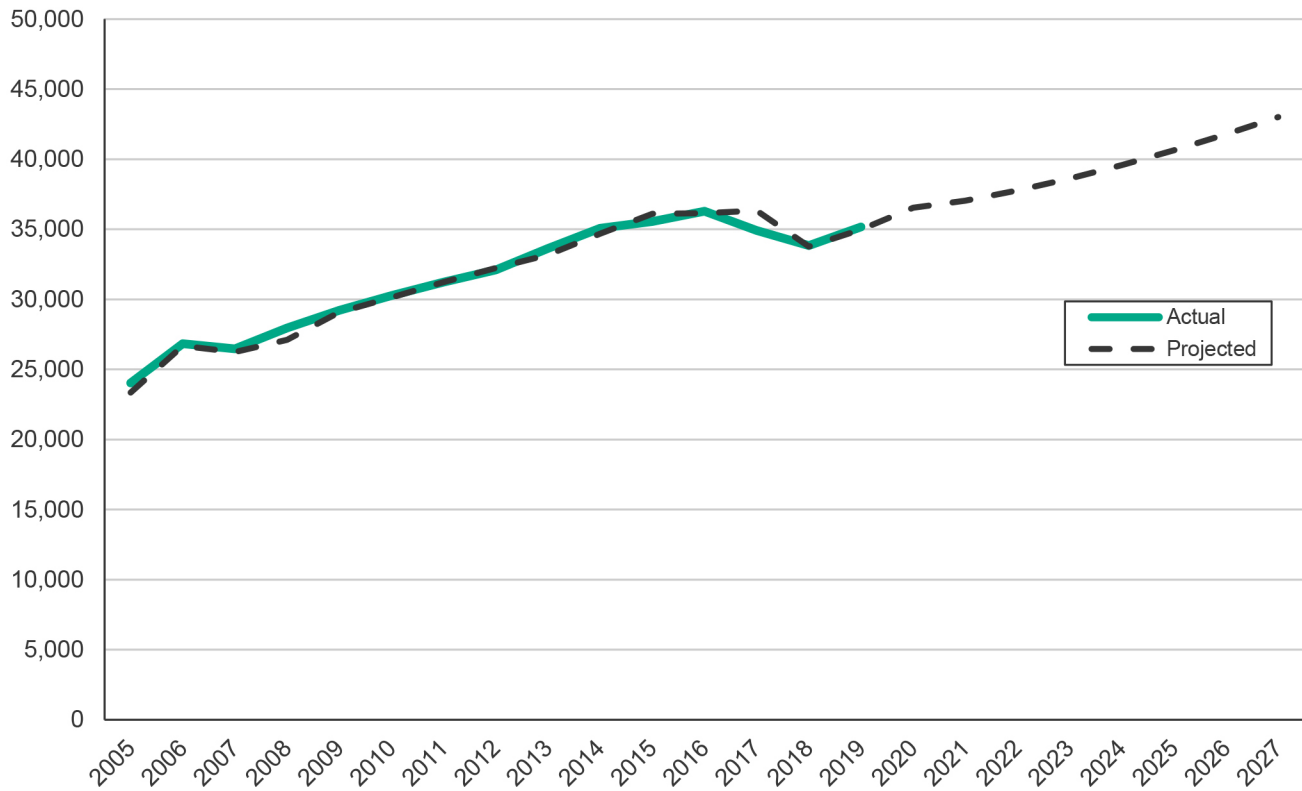
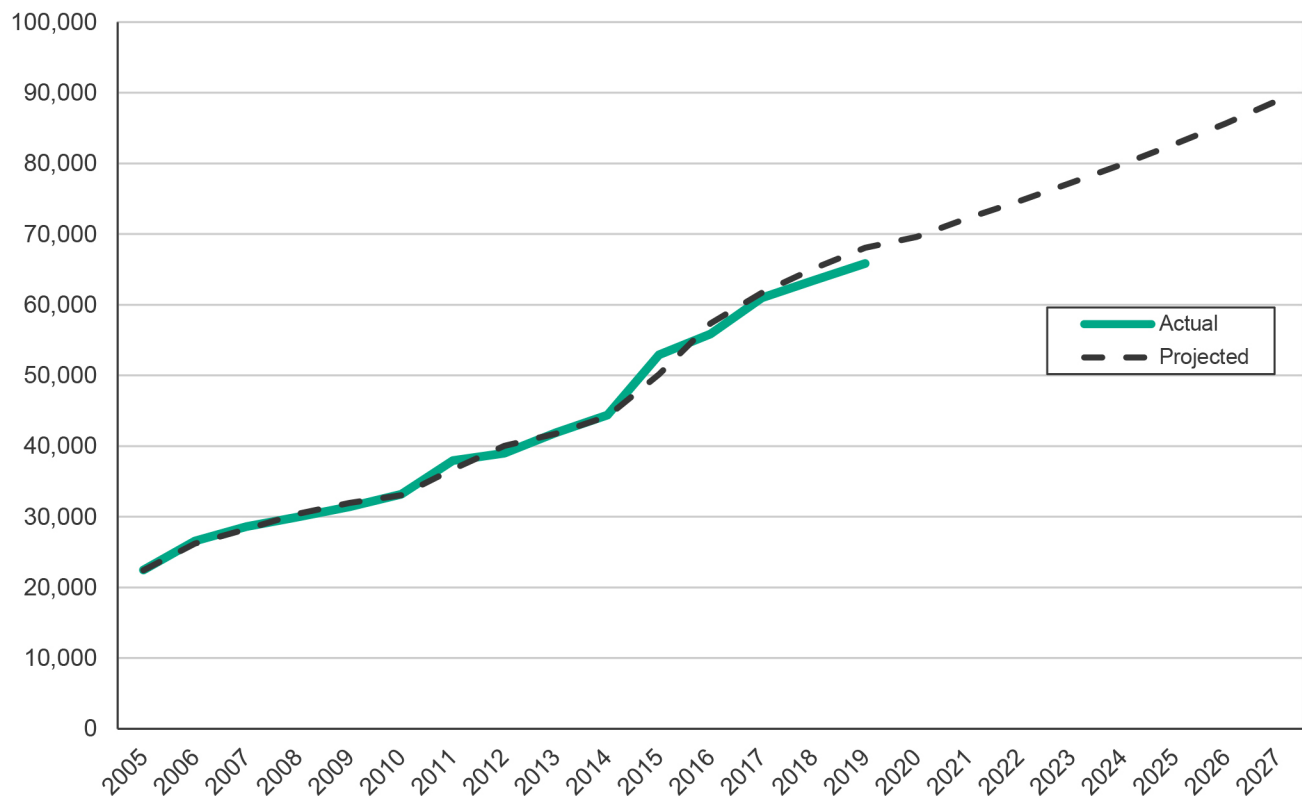


Figure 2: Ophthalmology Surgical Procedures, 2005 to 2027





Conclusion

Service provision for both orthopedic and ophthalmology surgical procedures has steadily grown over the 15 years prior to the COVID-19 pandemic. There was a significant drop in service provision during the pandemic, but the population demand for these procedures continued. As a result, the reduction in services provided during this period has added significantly to the surgical backlog. This report, however, does not address surgical procedure need, as it is based on service provision prior to the pandemic. Projection modelling science is a rapidly evolving field with the development of multiple modelling options from machine learning, a branch of artificial intelligence. The projections presented in this report are based on models with a very high degree of predictive accuracy. The model “fit” (a reflection of the degree of accuracy of the model) is over 90% for all the models.

The projections presented do not provide the detail needed to understand the limiting factors that will need to be addressed to meet the projected service increases. These limiting factors will depend on the type of procedure as some surgical procedures require post-surgical intensive care or hospital stays and others only depend on the availability of a qualified provider (e.g., joint injection).

The material included in the appendices of this report helps to address these details. Moreover, the SAS code provided to Manitoba Health includes guidance on adjusting the cohort to include specific procedures like joint replacement surgery, which can then be used to address the projected numbers of those procedures with their resource impact (including surgical and nursing personnel, anesthesia, joint hardware, operating facilities, post operative care). There will be a reduced impact on the healthcare system for less complex procedures, such as cataract surgeries.

Finally, it is crucial to understand that these projections will not meet the expected population need for orthopedic and ophthalmology surgical procedures. Modelling is based on past usage rather than need, so any attempt to address population demands should include wait list and backlog information.



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