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An Evaluation of the Primary-to-Specialist Referral System for Elective Hip and Knee Replacements in Alberta

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by

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Abstract

Introduction: Long waiting times for elective surgical procedures in the Canadian healthcare system are a concern for patients, physicians, and governments.

Objective: To measure how changes in elective hip and knee arthroplasty referral processing for primary-to-specialist surgical consultations may impact accessibility, referral appropriateness, and efficiency.

Methods: I documented current referral practices by conducting semi-structured interviews with clinical staff at three Alberta hip and knee musculoskeletal clinics, determined accessibility and referral appropriateness outcomes by reviewing 218 patient charts, and efficiency outcomes by conducting time studies at each clinic. Using scenario analyses, I estimated expected system-related improvements from implementing an electronic referral tool.

Results: 20-54% of received referrals were incomplete or incorrectly directed, with involuntary waits accounting for 11-15% of waiting times. Implementing electronic referral could reduce inappropriate referrals, waiting time, and reduce staff time to process referrals by 20-25%.

Conclusion: An electronic referral tool may reduce waiting times through streamlined referral practices.

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Chapter One: **Introduction**

1.1 The current situation around waiting time in Canada

Long waiting times for elective procedures in the Canadian healthcare system are a main concern for patients, physicians, and hospital administrators.[2] The First Ministers of Canada declared five specializations to be priority areas with the aim to reduce waiting times for surgeries to occur.[3] When discussing waiting times, two time periods for waiting are often discussed, consisting of 1) time spent waiting for an initial surgical consultation (the area of focus for this thesis), which is commonly denoted as the T0-T1 wait, and 2) time spent awaiting surgery, commonly denoted as the T1-T2 wait. Time spent waiting for an initial surgical consultation starts when a referring provider sends a referral to a specialist, and ends when a surgical consultation occurs. Time spent awaiting surgery starts when a patient is medically ready and chooses to have surgery, and ends when surgery actually occurs. The time spent on these waiting lists by a patient could last for many months.[4,5] Snider et al., for instance, found that for total hip and knee joint arthroplasty (TJA) in Ontario, the mean wait time for a consultation was 2.6 months (~79 days), while the mean wait time for surgery was 8.9 months (~268 days).[5] Performance measurements for 2011/2012 indicate that Alberta waiting times from the decision date for surgery to surgery are high: 9.2 months (39.8 weeks, 279 days) for 90th percentile hip replacements and 11 months (48 weeks, 336 days) for 90th percentile knee replacements.[6] Current waiting times will be compounded in the future by a larger patient population waiting for treatment, with longer wait times from ailments relating to age-related diseases.[7] Without any changes to how patients are managed, or to system variables such as the number of specialists or hospitals, longer waiting times will result, decreasing public confidence in the quality of the Canadian healthcare system, and potentially causing negative impacts on patient care.

Some medical conditions require referral by general physicians such as general practitioners (GPs), physiotherapists (PTs) and other primary care providers, leading to the need for patients to be sent to specialists for follow-up care for the condition. These conditions can be considered emergent, in which the patient needs to be routed immediately to a surgeon or hospital. The patient is treated immediately with minimal delay.

Other medical conditions are considered elective, in which a patient chooses to seek treatment at a given time for a specific condition. The demand for these procedures is usually higher than the supply available, leading to increased waiting times for patients to see a specialist and to have surgery if necessary. To manage these patients *referrals* are sent from primary care providers (henceforth called *referring providers*) to specialists. Referrals ideally contain information on the patient, reason for referral, and supporting documentation and evidence that the specialist should see the patient. To manage the flow of patients between the primary and specialist care, waiting lists are one of many approaches used to match specialist time with the correct level of patients. Acute patients are triaged and seen first by a specialist while less acute patients are put lower on waiting lists and are seen later.

Most literature to date has examined waiting time period at the end of treatment: the time spent by a patient awaiting surgery.[8,9] Measuring the whole waiting time and differentiating these waiting times and their causes is important to inform interventions aimed at improving healthcare system performance. Waiting times from the perspective of patients is the most important measure. Several other process outcomes which impact patient waiting time also need to be measured concurrently to provide a broad assessment of overall quality of care for patients. Without knowing where waits occur in the referral process, the sources of waiting times cannot

be determined. This reduces the chances of developing effective interventions to reduce waiting times for a surgical consultation.

Efforts have been made both in other jurisdictions and in Alberta to reduce waiting times for surgeries. This thesis will explore the first waiting period – T0-T1, from the time of a referral through to surgical consultation – and look at different events and processes occurring in this period. The pathway a referral takes from referring provider to specialist, defined by Wait Times Rules, is generalized in Marshall et al. (Chapter 5 and Figure 1). Each box represents a specific time point, with specific criteria for an event being deemed completed with a datestamp upon completion. The period of waiting for these events to occur can be broken into two types: voluntary, patient-related waiting time; and involuntary, system-related waiting time. Voluntary waiting time should be excluded from performance measures of healthcare system outcomes: patient choice is not something that should be limited or dictated by a healthcare system. Involuntary waiting time is instead the area of focus where policymakers can direct initiatives to reduce surgical consultation waiting times.

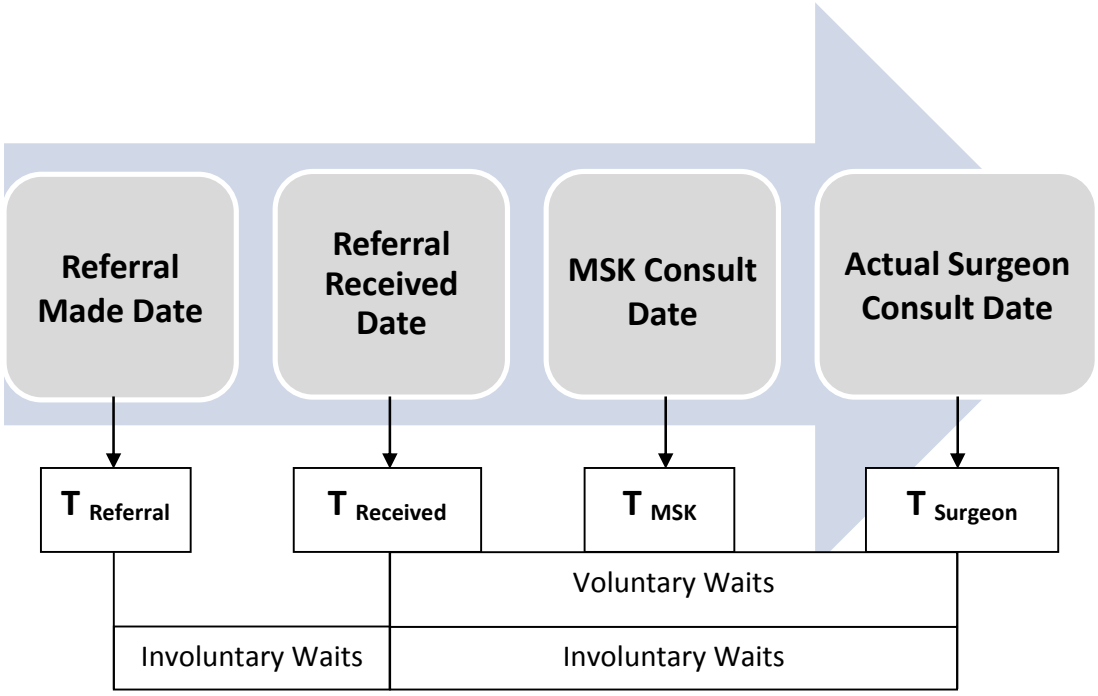

Figure 1: Wait times rules with voluntary and involuntary waiting times (adapted from Marshall et al. 2012 (Chapter 5))[1]

There are many reasons contributing to long waiting times for elective procedures. Many of these are involuntary system-related reasons. In the interaction between primary care providers and specialists, information gets exchanged. In some jurisdictions such as Alberta, a referral must be made by a primary care provider for a patient to receive specialist care. The referral should give enough information for the specialist to make a determination on whether a patient is suitable to be seen. Whether a patient is suitable for a consultation, which will be defined as referral appropriateness, is determined differently across specialists. If complete information is not given to a specialist to make this determination, delays occur. In turn, the quality of a referral is determined by office-specific processing procedures. These have not been

previously evaluated formally in the health services literature. While specific processing procedures differ between specialists, general steps are similar among all specialists and will be noted in the results. In addition, some specialists provide additional options to a patient before a specialist consult occurs. The combination of these informs the amount of office resources for processing patients, which is a useful metric for measuring across different specialists. Once resource use is determined, a healthcare policymaker can then decide whether to apply more resources to allow for increased throughput of patients through a specific speciality (technical efficiency), or reallocate resources to other specialties that maximize gains to society from limited resources (allocative efficiency). The system delays listed above are areas in which improvements to a referral system can reduce waiting times.

Involuntary reasons for delaying surgical consultations can also include the lack of resources to schedule or reschedule a patient promptly for a consultation with the orthopaedic surgeon, or if further care is needed, with another specialist for conditions that need treatment in addition to orthopaedic ailments. Visits to another specialist are a non-hip and knee medical reason for involuntary delays, even though they are not necessarily system-related, should not be counted and as a voluntary delay, and separated into a subcategory of clinical delays within total involuntary waiting time.

Waiting times are also caused by patient-related voluntary reasons, which occur when the patient chooses to delay a step for the hip and knee treatment. There is currently limited patient choice, both with regard to how specialists are chosen and the time when specialist care is sought. Information on how long a patient has to wait for a consult after choosing a specific surgeon and being scheduled compared to selecting a next available surgeon is not publicly available. Lack of information or lack of knowledge about the next available option may lead

patients to choose a specific surgeon, thereby increasing waiting time. Even after being scheduled, delays may arise. Voluntary reasons include patients choosing to postpone surgical consultations because they are not ready and willing to continue with further treatment. Voluntary delays are currently included in waiting time calculations, and have not been differentiated in publicly reported waiting times or previous studies. This thesis, while attempting to quantify voluntary and involuntary delays, instead found that information for these variables was missing, and through estimation shows that the delays should be tracked separately for accurate waiting time reporting.

Measuring successes (the throughput of patients, for instance), or even measuring the outcomes and rates of different referral processing schemes, is another topic that has been neglected in previous reviews. Previous papers have looked at a variety of metrics to measure healthcare system performance, such as costs (see, for example, Tuominen et al.[10]), waiting times (see, for example, Willcox et al.[11]), or patient satisfaction (see, for example, Kinnersley et al.[12]). However, these outcomes cannot be measured without looking at specific processes that occur in the treatment of patients who seek referrals. Outcome measures must also be defined in detail to properly value any changes or interventions to the referral system, and to be measured consistently across different types of clinics. This thesis will extend the literature by defining several outcome measures, and the process used, to develop these measures consistently across a variety of specialist clinics.

Three outcome measures – accessibility, referral appropriateness and efficiency – are defined using the Health Quality Council of Alberta [HQCA] Quality Matrix for Healthcare.[13] These definitions are used in this thesis to assess the primary-to-specialist referral process as described below:

- Accessibility was defined by the Alberta Quality Matrix as "health services [which] are obtained in the most suitable setting in a reasonable time and distance."[13] This can be improved by reducing wait times – system-related and patient-related – in the referral process, specifically by improving referral appropriateness and efficiency in processing referrals to specialists.
- Appropriateness in the Alberta Quality Matrix was defined as providing "health services… relevant to user needs and… based on accepted or evidence-based practice."[13] Specifically relating to referrals, appropriateness can be improved by increasing the percentage of complete and correct referrals to minimize involuntary, system-related waiting time for patients referred to an orthopaedic surgeon. The goal is not to reduce the number of total referrals to orthopaedic clinics, but to correctly treat patients in an efficient way once the referral has been received by the clinic, and to have patients routed to a qualified specialist for correct treatment in a timely manner.
- Efficiency was defined by the Alberta Quality Matrix as "using resources optimally to treat patients."[13] This can be improved by reducing the need for clinical resources to process referrals. With eventual implementation of an electronic referral tool which combines measures focused upon improving these system outcomes, resource use to track and schedule referrals should decrease compared to the current system.

These outcome measures will be discussed further in the methodology (Chapter 3).

1.2 Total joint arthroplasty referral issues

The literature has focused primarily on reducing the waiting time for surgery – but not significantly on the waiting time for a surgical consultation and potential reductions in waiting

times from changes in the processes to get a patient to a surgical consultation. This thesis will focus on hip and knee TJA and efforts to reduce surgical consultation waiting times. The consultation process starts for elective hip and knee arthroplasty when evidence of osteoarthritis is noted by a referring provider, and treatment could not be initiated or continued by the provider in a way that improves patient wellbeing. Referrals were sent by the referring provider to either orthopaedic surgeons or a centralized hip and knee MSK (musculoskeletal) intake clinic. Referrals were evaluated by staff – either for the surgeon or the clinic – and resources such as MSK screenings and consultations were then used for triaging patients.

The referral and triaging process, with the interchange between referring providers, surgeons, and centralized intake clinics, faces issues of timely patient treatment, the appropriateness of incoming referrals, and staff time required to process and complete referrals. This thesis will address gaps in the literature by:

- Measuring waiting times from the time of referral through to surgical consultation;
- Determining the reason and rate of initially unacceptable referrals and which elements are required to deem a referral acceptable;
- Calculating the staff time at specialist clinics needed to process referrals;

With the three quality of care outcome measures defined above, an evaluation of referral processing procedures at pilot MSK clinics with varying patient, specialist and clinical characteristics was completed. A mixed-methods study evaluating these outcomes and procedures was informed by semi-structured interviews, clinical visits, anonymized retrospective patient data and time studies, providing evidence regarding the effectiveness of the current referral system for hip and knee pain. Based on the analyses completed in Chapters 4-6, key scenarios were defined, characterizing potential elements of the referral system for hip and knee

arthroplasty that could be enhanced. The impact of implementing these scenarios on the quality of care outcome measures was then estimated. The scenario analyses aimed to assess whether four policy initiatives that change the referral system could potentially improve system outcomes by providing evidence regarding the possible effectiveness of a future electronic referral tool.

1.3 Research questions

The overall purpose of this thesis was to evaluate current referral practices and processing from referring providers to specialists. It was intended to serve as a first step in a proof of concept demonstration to show the potential impact and value of implementing changes to referral processing and system process outcomes in the future.

The primary research question was to explore whether implementing an electronic referral tool could positively impact referral processing for elective hip and knee arthroplasty from a primary care provider to an orthopaedic surgeon. An electronic referral tool could potentially incorporate processing elements such as standardized referral forms, application of specific Wait Times Rules to track referrals, the option to select a next available surgeon, a requirement to complete all referral form elements, consistent MSK triaging options, and separation of voluntary and involuntary surgical waiting times. This thesis explored whether these processing elements could positively affect patient outcomes as measured by accessibility, appropriateness, and efficiency. Specifically, this thesis seeks to answer:

- 1) How long were waiting times for elective hip and knee arthroplasty patients between when a referral was made by a referring provider and a surgical consultation, and how these times were distributed between:

    - Voluntary, patient-related causes such as personal and social reasons that lead the patient to choose to delay treatment for hip or knee pain,
    - Involuntary, healthcare system-related causes, where the patient is not choosing to delay treatment for hip or knee pain, for example caused by:
        - System delays: where a referral was incorrectly directed to a specialist office which cannot treat the patient, or a referral was sent from a referring provider to a specialist unnecessarily,
        - Clinical delays: where a patient could not proceed with a surgical consultation for hip or knee pain due to the need for a patient to first receive treatment from other clinicians.
- 2) What was the estimate of complete – based on a gold standard referral template – and correctly directed referrals that were accepted as a percentage of all referrals received?
- 3) What was the time spent per referral and time spent per task processing each referral within a specialist office?

These questions were answered using the following methods:

- Semi-structured interviews at three Alberta hip and knee MSK clinics to inform current referral practices;
- A chart review of de-identified referral information from the clinics, determining waiting times for a surgical consultation and options that a patient received before a consultation;
- Time tracking of clinical staff to determine the time needed to process referrals at different steps before a surgical consultation.

Next, the thesis examined referral system elements that, if improved, could impact accessibility, referral appropriateness, and efficiency. Changes in referrals were measured using

scenario analyses informed by extrapolating clinic data to Alberta. These scenarios are, with reference to their numbers in Chapter 7:

- Scenario 1) Next available surgeon option: How would waiting times change if the option of next available surgeon for a consultation were chosen in a larger percentage of referrals?
- Scenario 2) Full completion of standardized referral forms: How would waiting times change if a new referral tool increased the percentage of complete and correctly directed referrals received by orthopaedic surgeons?
- Scenario 3) MSK screening of patients for triaging: How would waiting times change if more patients received specialist triaging by a clinical practitioner?
- Scenario 4) Voluntary versus involuntary waiting time: How would reported waiting times change if voluntary, patient-related delays were separated from involuntary, system-related delays?

1.4 The importance of research into referral processing

There are several reasons why the analysis of referral processing in this thesis, from referral by the referring provider to surgical consultation, would enhance current understanding of surgical consultation delay and provide benefit to stakeholders in the healthcare system who are seeking to reduce waiting times for elective hip and knee arthroplasty surgical consultations. First, this thesis defines specific outcomes which incorporate multiple aims – reducing waiting time and improving referral processing. Projects evaluating the referral process have often looked at only one of the three outcomes at a time: accessibility, appropriateness, and efficiency. It is not seen in the literature, however, that all three outcomes have been evaluated concurrently. Nor has it

been mentioned *why* these outcomes have been chosen. This thesis, in an effort to provide a generalized framework for evaluating changes to referral systems, will describe how, and why, specific outcomes were chosen for analysis.

Second, a detailed description of what currently occurs in referral processing will be described and reported. Outcomes for patients awaiting surgical consultations have been reported in a few previous studies. The specific steps completed by specialist clinics to process referrals are still generally undocumented in the literature. By looking at these steps, reasons for delays, or reasons for rejecting referrals at a specific step can be noted. Noting these delays will help to inform best practices that can be adopted by specialists evaluating primary care provider referrals. The effects from a more timely and accurate referral will then lead to better outcomes for the patient receiving treatment. This explains the focus on system-related outcomes, as mentioned above, opposed to patient-based outcomes such as safety.

Third, this thesis aims to provide a foundation for future research. Reviews of referral processing satisfaction have occurred elsewhere, such as Bourguet et al.[14] and Gandhi et al.[15] This thesis will use a dataset that describes, in detail, current referral practices and observations, that can inform estimates as to whether electronic interventions have the potential to improve referral system outcomes. This thesis is intended to serve as the first step in a proof of concept demonstration to show the potential impact and value of implementing changes to referral processing and system process outcomes in the future.

1.5 Thesis overview

The thesis will progress as follows:

- Chapter 2 is a background review of areas related to hip and knee care, referrals from primary care to specialist care, waiting time, and the economics behind these areas as well as proposed interventions to the referral system. This chapter also notes that several projects have taken place elsewhere in Canada to improve referral system outcomes. Primary care interactions with specialists and surgical waiting times have been described thoroughly in previous literature. Waiting times for consultations, and the role clinic variations play in staff efficiency and referral appropriateness, have not been explored thoroughly.
- Chapter 3 will describe the methodology behind this project, including:
    - The population under study: patients with hip and knee pain seeking an orthopaedic consultation from a primary care practitioner, at one of three pilot musculoskeletal (MSK) clinics in Alberta,
    - The intervention (evaluation of the current process and potential enhancements from an electronic referral tool),
    - The outcomes (related to accessibility, appropriateness, and efficiency),
- Chapter 4 will outline current referral processing at the three MSK clinics. This details the results found from the chart reviews, semi-structured interviews, and time studies at each of the pilot MSK clinics.
- Chapter 5 provides background to how one referral element enhancement was developed: wait times rules, which standardize the measures used to determine accessibility to hip

and knee TJA services. This chapter is courtesy of Longwoods Publishing, and is published in the journal *Healthcare Quarterly*, Volume 15, Issue 3, pages 37-42.

- Chapter 6 will provide further analysis of referral processing, including descriptive data, and comparisons between different types of clinics, highlighting that clinical rules contribute to waiting times, which vary from two to eight months for a consultation.
- Chapter 7 describes the four scenario analyses that potentially can improve referral system outcomes. These analyses are 1) including next available surgeon consultations, 2) completion of all referral form requirements, 3) MSK screening, and 4) separating voluntary and involuntary waiting time.
- Chapter 8 is a detailed discussion of the results and potential impact an electronic referral tool could have on referral processing.
- Chapter 9 concludes the thesis by summarizing current referral processes and describing results from scenario analyses.

Chapter Two: **Literature Review**

2.1 Literature review overview

The primary aim of the literature review was to explore issues surrounding referrals, with a specific focus on hip and knee related pain and waiting time resulting from referral processing. This chapter provides a detailed background for both the clinical analyses (Chapter 4 and 6) and initiatives to improve referral processing (Chapters 5 and 7). Due to the many different subject areas, this review was not intended to be a systematic review. The goal was not to include every article in these fields. Rather, the goal was to find articles that were either seminal to each subject field, or provided a synthesis across fields. Areas were chosen based upon broad topic headings that were relevant for the thesis. Articles that were included came from multiple sources, including Web of Science, EconLit, MedLine, and expert opinion (specifically, for determining other referral systems used across Canada). Search terms related to each subsection heading were used, and then a snowball approach was used to review the abstracts of recent, and highly cited, articles. These abstracts were then evaluated by the author, who determined if the articles were either relevant for the heading, or related to hip and knee pain. Articles matching these criteria were included in the review.

The literature review is broken down as follows:

- Section 2.2: An overview of health services research, the foundation for research in the operation of medical sciences.
- Section 2.3: An overview of literature surrounding outcomes research, highlighting strategies for deciding on outcomes when evaluating projects.
- Section 2.4: A description of waiting lists is given, with an economic emphasis on how they develop and why they continue to exist.

- Section 2.5: Strategies for treatment of hip and knee pain, and why hip and knee pain is such as problem.
- Section 2.6-2.7: How long patients actually have to wait, and different strategies for measuring waiting time.
- Section 2.8: Analysis of patient choice in dealing with long waiting times
- Section 2.9-2.10: How triaging options work for patients sent to a specialist environment.
- Section 2.11: Whether referrals arriving to specialists are appropriate, and for the cases in which the referrals not appropriate, what problems exist in the referrals.
- Section 2.12: An overview of previous evaluations of electronic referral tools implemented worldwide.
- Section 2.13: A select sample of literature regarding simulation modelling and scenario analyses as related to health outcomes.
- Section 2.14: A description of specific Canadian referral enhancement initiatives.

2.2 Health services research

The theme encompassing this thesis is health services research. Health services research has been defined as "the study of the organization, use and outcomes of healthcare delivery" – using system outcome metrics.[16] Other areas of medicine look at the use of therapies that are actually used in healthcare delivery, and the outcomes of these therapies. These are patient-centred metrics. Patient and system-centred metrics have been measured using broad categories, as listed in the Alberta Health Quality Matrix.[13] The Health Quality Matrix was derived from an effort in the United States to measure medical outcomes.[17] This effort was to improve the quality of healthcare in the United States to deliver high-quality medical care to everyone. This

led to several dimensions of healthcare quality being developed, which will be used as outcomes in this thesis (Chapter 3). For a healthcare system that is limited by binding constraints such as the number of doctors, amount of hospital capacity, and budgets, looking just at patient-centred metrics will not lead to a complete, and sustainable, picture of healthcare. Health services research provides techniques and a structure to analyze how healthcare systems provide medical care, including aspects that are never seen by the patient.

There is not a single unifying strategy for analyzing healthcare operations or organizations that deliver healthcare to patients. Many approaches can be taken, with positives and negatives to each. One strategy is qualitative research. This strategy involves in-depth understanding of a topic or group of individuals, which is useful in areas where descriptive data can best analyze a research question. Interviews of individuals involved in a topic area are a main component of qualitative research. Information from those interviews can then be processed and analyzed. Britten gave a summary of qualitative interviews, with regards to medical research.[18] Britten noted that by being interactive and having a core set of questions from which the interview can be initiated could provide answers to areas that are difficult to investigate. This may be good for determining what people wish to have occur (a 'best case' scenario), but may not accurately reflect what people, especially given constrained resources, would like to do. For referral processing, there is a scarcity of data. Specific individuals who process referrals have not been interviewed thoroughly in previous literature. As a result, who sees what at a given stage, and what implicit guidelines exist to accept or reject referrals is unknown. Qualitative interviewing is a necessary component to any study looking at referral processing. This will be incorporated into the project methodology, as mentioned in Chapter 3. An example of this is Crabtree et al., who detailed how they qualitatively reviewed eighteen

family practices in Nebraska, evaluated competing programs and diagrammed relations between stakeholders within each practice.[19]

A different approach from the qualitative study of individual medical practitioners is the analysis of clinical pathways. Clinical pathways are informed by qualitative research, and describe a process that is occurring. Kim et al. described clinical pathways as "specified guidelines or outlines for care that describe patient treatment goals and define a sequence and timing of interventions to meet these goals efficiently."[20] While evaluation of these can be conducted quantitatively (as described below), the production of these pathways is often initiated qualitatively to determine sequences and timing. This helps to inform this thesis by providing a structure for deciding how referral processing occurs within specialist clinics. These pathways, which will also be called *maps*, will be informed by data collected both qualitatively and quantitatively. Pathways help to inform and differentiate clinical processes, which in this thesis are the steps a referral goes through from being made to resulting in a surgical consultation.

Quantitative techniques take a different approach than qualitative research. This approach takes data recorded from events and uses it to analyze a system (see, for instance, CIHI wait times tables[21]). These data are then applied to health services research, answering questions related to the operating of healthcare systems. Most studies, as listed elsewhere in Chapter 2, focused on descriptive quantitative data. These studies often provided summary statistics, and recommendations for interventions based on those summary statistics.

2.3 Outcomes research

Most previous studies mention relatively little on how outcomes of interest were chosen, which ties into questions regarding: a) determination of a quantifiable metric that describes current

system performance and can be used for future comparison, and b) the effectiveness measure in any cost-effectiveness analysis. As a result, it is important to have a framework for determining which outcomes should be the foci of research. A recently developed field, outcomes research, aims to assist with this goal.

Outcomes research was first noted by Ellwood.[22] He noted that patients, physicians, executives, and healthcare payers needed a common language when deciding how best to answer pressures put upon the healthcare system, such as increased costs. Outcomes management would be a technology to "help [stakeholders] make rational medical care-related choices based on better insight into the effect of these choices on the patient's life." It has also been defined as "a domain in which the convergence of multiple disciplines is applied to generate knowledge... [of] the delivery and organization of health care".[23] Outcomes management would require data to be collected routinely in a standardized way by physicians, then pooled into aggregated datasets, and then analyzed from the perspective of a relevant decision maker. The outcome Ellwood focused upon was patient quality-of-life (and is fleshed out by Clancy and Eisenberg in further detail[24]). The choice of outcomes is subject to the caveat that most analyses occur with outcomes dependent upon the perspective of a relevant decision maker. Specific research outcomes as a result might not be considered by a decision maker with a different incentive set.

These other factors have been the subject of much discussion in many articles. Smith focuses upon performance measures, and the history of adopting performance measures by the NHS in the United Kingdom.[25] Smith's perspective is that performance measures can be used by decision makers to provide accountability and improvement for the healthcare system. Poolman et al., from an orthopaedic clinical perspective, highlights how outcome measures can be constructed.[26] Using a standard epidemiological approach, as noted in Rothman et al.[27],

Poolman highlights several validity measures, ensuring the outcome measures minimize potential biases. Careful construction of outcome measures, such as face validity with experts (ensuring experts agree with the variable), will also help to minimize biases, and are used in constructing outcome metrics in this thesis. An example of developing new outcome measures is given in Ohman-Strickland in the context of primary care providers.[28]

2.4 Economics of waiting times

In the healthcare system, why do waiting times and waiting lists arise in the first place? At first glance, it would appear to be a supply versus demand imbalance – the number of physicians practicing is lower than the demand for a medical therapy. Supply consists of elements such as the amount of hospital operating time available for surgeries and the number of physicians. Demand consists of the number of individuals, influenced by factors such as age, genetics, and weight and level of their pain. Physicians can change supply by speeding up or reducing the number of patient consults, and patients may seek alternative therapies. Waiting times can influence both supply (by serving as a signal to increase resources spent providing a service) and demand (by serving as a signal to patients to seek alternative treatments that may result in receiving therapy quicker). Knowing what shifts supply and demand – hence the intersection of the two – will be important to answer questions of accessibility and efficiency.

This role was fleshed out in the health services literature by articles which first looked at waiting queues in the United Kingdom NHS. Lindsay and Feigenbaum extend Barzel to incorporate a waiting list instead of queueing.[29] They note a delay in receiving a service will lower its value, which is a questionable assumption in terms of health, as a delay may instead increase pain and increase the willingness-to-pay to receive a therapy. To answer these ethical

worries, prioritization was developed, which is explored later in this review. In the Lindsay and Feigenbaum framework, individuals join as long as their present value from the service outweighs the cost of joining the list – receiving a (delayed) treatment outweighs the cost of being referred to a specialist. This implies as the expected delay increases, less people will join a waiting list. The present value from receiving a service – multiplied by the discount (interest) rate and by the timing of the delivering the service – produces variation in the sizes of waiting lists. They also note that, if individuals are responsive to joining a waiting list, an increase in supply will produce an *increase* in the size of wait lists – not necessarily the result of surgeon-induced demand. Subsequent work by Cullis and Jones emphasizes that waiting lists are unreliable due to patient turnover, and welfare costs from waiting are significant.[30] This has been a concern with waiting lists in Alberta, as they are self-reported by each specialist, with no cross-province check for individuals waiting for the same procedure across multiple specialists.

Theories of waiting lists, especially for hospital treatment, have since been expanded in several articles. Iversen adopts a political science viewpoint of supply-side considerations, noting that waiting lists are tied to budgets for hospitals, and longer waiting lists could result in political pressure for a higher operating budget, with no long-run decrease in waiting times.[31] Iversen recommends a focus on surgical volumes, as opposed to explicit, enforced, decreases in waiting times, to disentangle the perverse incentives on physicians and hospitals to receive increased funds.

2.5 Orthopaedic treatment for hip and knee pain

Orthopaedic care is concerned with treatment of musculoskeletal ailments. One specific component of orthopaedics is bone and joint care of degenerative conditions. Bone and joint

care which is urgent, such as fractures, is treated as such by hospitals and MSK clinics. Within MSK clinics, specific clinics just for hip and knee ailments may reside. Degenerative diseases of the musculoskeletal system, such as rheumatoid arthritis and osteoarthritis, are conditions that can't be treated the same across all individuals, and as a result have different treatment pathways. The National Collaborating Centre for Chronic Conditions in the United Kingdom defines osteoarthritis as "a clinical syndrome of joint pain accompanied by varying degrees of functional limitation and reduced quality of life."[32] Opposed to rheumatoid arthritis, which can be controlled using medication, osteoarthritis cannot be controlled medically – only the symptoms can be controlled.

Prevalence of osteoarthritis varies depending on the study noted. For *total* osteoarthritis cases, a study from British Columbia using an administrative database estimated a prevalence of 107.8 per 1,000 people above the age of 19, with an incidence of 11.7 per 1,000 people, for the year ending in March 2001.[7] This, however, includes all joints with osteoarthritis, and doesn't separate cases where osteoarthritis is severe enough for a specialist visit or for eventual joint replacement. Of patients with osteoarthritis, a study from England noted that 41% of patients had osteoarthritis of the knee, 30% had hand OA, and 19% had hip OA, with remaining osteoarthritic cases occurring in ankles, shoulders, elbows, and wrists.[33] For hip osteoarthritis, estimates range around 15 per 1,000 people whom have hip scores – a measure used to evaluate hip function – poor enough that require total hip replacement, with an incidence of 2.23 per 1,000 people per year.[34]

Treatment, as will be explored further below, is often delayed for a variety of reasons. This treatment delay, if not by patient choice, causes patient dissatisfaction, due to the potential for lower quality-of-life from living with hip or knee joint pain. Research is divided as to

whether pain while waiting for surgery should be a significant concern. One systematic review of 15 studies of hip and knee OA patients indicated that pain (for hip and knee OA) and functioning (for hip OA) does not deteriorate in patients who wait less than 180 days for a joint replacement.[35] This finding has been confirmed in other studies.[36] Some studies, for instance one involving hip patients at a clinic in England, found waiting times were correlated with increased pain, with a decrease in the Harris hip score of 8.9 points.[37] A Swedish study showed decreased quality-of-life indicators across several EuroQoL dimensions between baseline and preoperative measurements, though no breakdown by length of time waiting were made available.[38] Longer term waiting time was found to cause worse outcomes, in terms of mobility and quality-of-life, in one prospective study.[39]

The association of waiting time and postoperative outcomes also differ depending on the study. Waiting time does not cause worse postoperative quality-of-life or mobility outcomes, but less than six months of waiting for joint replacement results in greater postoperative gains in quality-of-life and mobility.[39] A randomized prospective study in Finland found that there were no statistically significant differences in quality of life (15D) and physical function between a lengthy waiting group and a quicker waiting group of knee OA patients.[10] One English study found that postsurgical outcomes for hip or knee OA were maximized after one year, with improvements maintained for five years after surgery.[40]

Gains in patient quality-of-life noted above are combined with economic concerns in highlighting hip and knee replacement as a critical area for the medical system. Economic evaluations of hip and knee replacement have been completed, but have been of relatively poor quality.[41] There is evidence from higher quality studies that hip and knee replacements are a cost

effective procedure for increasing quality of life at an affordable cost, with less than $80,000 per QALY for the worst age category noted.[42]

A retrospective cohort study in Alberta found that post-surgery, patients who received hip and knee replacement saw a decline in physician costs of 23%.[43] Waiting for surgery did not result in increased costs before or after surgery. Costs for hip and knee replacement were higher than other comparison procedures, which were cholecystectomy, discectomy, and hysterectomy. A Finnish study found that patient-incurred costs were not associated with quality-of-life.[44] Tying into the results above, if quality-of-life changes little as waits increase, then costs will not necessarily increase for the patient. However, a prospective cohort study in New Zealand found that costs increase (and quality of life decreases) in patients who wait longer than 6 months for a replacement.[45] Though medical costs were similar (25%), societal (37%) and personal costs (171%) showed the greatest gains as a patient waited.

In summary, for short waiting times, it is inconclusive whether patient outcomes are worsened by waiting for hip or knee TJA. For waiting times longer than 6 months, there is evidence that functional health decreases, and for waiting times longer than 12 months, post-operative outcomes in terms of functionality are worse after TJA.[46] TJA is a medically-effective, cost-effective remedy for OA.

2.6 Empirical evidence of waiting time

Waiting times have been a metric used in a variety of research for all medical procedures. This ties into the Health Quality Matrix of Alberta's accessibility guidelines, in which timely service should be received by patients awaiting care.[13] Increased waiting times, magnified by an increased incidence over time, is why access to orthopaedic care has been deemed a priority area

for Canadian First Ministers.[3] Several issues have arisen around waiting times, both in measurement and usage as a system performance metric, that are explored in this section.

The times a patient must wait for surgery vary, both across countries, procedures, and urgency.[47] Willcox et al. provides an overview of several Commonwealth countries, including Canada, and the strategies used to reduce waiting times.[11] Canada is highlighted as a jurisdiction which uses specific governmental funds to reduce waiting times, from both the federal and provincial levels. The two main strategies are for benchmarks are to be established, including for hip and knee replacement at 26 weeks, and improved access to services. These goals have increased dramatically since Coyte et al. published their findings of knee replacement waiting time in the U.S. and Ontario in 1994.[4] Median waiting times to consultation were 2 weeks in the U.S. and 4 weeks in Ontario, with median waiting times to replacement of 3 and 8 weeks, respectively. By the mid-1990s, Williams et al. found for Ontario that only 16% of patients had surgery within 3 months of waiting, with 34.1% waiting more than a year.[48] Despite being a priority area for reduction in waiting times, as of 2009 in Alberta, only half of patients received hip replacements within 13 weeks, and knee replacements within 18 weeks.[49] For Canada, primary hip replacement waiting times between 2007/08 and 2009/10 decreased by 11% and knee replacement waiting times by 15%, to 88 median days and 120 median days respectively.[50] Alberta met hip replacement Pan-Canadian benchmarks of 182 days for 80% of patients, and knee replacement benchmarks of 182 days for 70% of patients.[21] The Ontario and Alberta times, as well, are only from when a decision is made to have surgery to the surgical date – excluding initial surgical consultations. These waits, as will be noted in the analyses, are a significant duration for most patients.

Combining all patients in every region into one waiting time hides substantial heterogeneity, which is not accounted for by the benchmarks. For instance, Snider et al. analyzed waiting times between rural Ontario and urban Ontario for hip and knee arthroplasty.[5] They found that while the wait for surgery was not significantly different between the two regions (8.45 months mean/9.39 months median for rural; 9.32 months mean/10.50 months median for urban), the wait for a consultation was significantly different between the two: 1.10 months mean (1.13 months median) for rural, versus 3.40 months mean (3.47 months median) for urban clinics. Clinical characteristics between the two locations differed slightly, with the implication that the patient population between the two clinics might be different. If so, interpreting results that combine highly urbanized regions which serve as a wide intake for highly acute patients with rural locations may produce errant conclusions. Other factors which should be taken into consideration when accounting (and stratifying) for waiting times include age and the urgency of a patient.[51] Aggregate waiting times mask the differences these covariates could create. This thesis will account for these variables by looking at urban versus rural clinics in the analyses (Chapters 3-4).

Several strategies have been used to try and reduce waiting time for patients. Waiting lists are a natural tool to sort all patients in an effort to efficiently manage and triage all patients. Waiting lists have been used elsewhere besides surgical consultations, most notably as queues to receive surgery. The waiting time for surgery when on a waiting list depends on the number of patients on the waiting list at entry, the number of new patients, the service rate of patients who have entered the queue, and the number of patients who are urgent and bypass the waiting list.[52] These factors will be noted for waiting list behaviour for patients awaiting a specialist

consultation. Even for urgent procedures, such as hip fractures, queueing is used, with little negative impact upon patient outcomes.[53]

With waiting lists, pressures to see patients quickly result in some jurisdictions to promise patients access to a service – either a specialist consultation or a surgery – within a given period of time. Waiting time guarantees are one method used to guarantee service, in which a healthcare system signals to patients that all seeking a certain treatment (or a percentage, such as 90% in Alberta) will be seen within a certain period of time. For orthopaedics, Alberta set a benchmark to have hip and knee replacements completed within 26 weeks, with 90% of patients having hip replacements between 26-30 weeks, and knee replacements between 26-45 weeks.[49] These benchmarks have recently been reduced, with a goal of 14 weeks for surgical treatment by 2015.[54]

Waiting time guarantees in several European countries were abandoned after several years of implementation.[55] Unconditional guarantees, implemented in England and Sweden, guaranteed treatment by a certain time for all patients. All of the ones noted by Siciliani and Hurst were not successful in full, in part due to changes on prioritization of patients, which will be discussed later in this review. Conditional guarantees, implemented in Norway, New Zealand, Netherlands, Italy and Denmark, guaranteed a share of patients (or patients with "higher need") treatment within a certain timeframe. They note that clear criteria must be established to guarantee treatment, and if this does not occur, conditional guarantees might not result in reducing waiting times. Prioritization efforts help to create consistent criteria for treatment, and as a result will be explored in clinical analyses.

Lundström et al. evaluates whether patients, deemed as priority or not, receive care quickly for cataract conditions in Sweden.[56] The proportion of patients who were deemed a

priority, and as a result are bound by waiting time guarantees, increased over two years, from 66% to 70%. Approximately 4% of patients in each year who were priority received slower treatment, due to wanting a clinic closer to their home – this option of patient choice will be explored further in the literature review and in the analyses.

2.7 Issues with waiting times

The measurement of waiting times, in the context of health delivery or for wait time guarantees, is an area subject to variation. Waiting times have not been defined on a consistent basis across different jurisdictions. As a result, waiting time calculations are non-standardized upon initial aggregation and inconsistent in the timeframes measured. Sanmartin et al. noted similarities between three specialities – general surgery, cataract surgery, and hip and knee replacement.[57] A unified framework, highlighting specific points defining events either starting or ending a wait time, was defined in the paper. Their framework is established from a first contact with a primary care provider, through to surgery. The framework is defined at a high level, and aggregates all steps between the primary care consultation and the first specialist consultation (excepting any diagnostic tests in between) into one waiting time. This thesis will highlight that changes in system outcomes can be made when the steps of referral processing are delineated, measured, and changes to a referral system are made.

Part of the benefit from calculating waiting times using a standardized measurement framework is consistency among definitions, and identifying which waiting times arise that are avoidable by changing the referral system, versus the result of patient choices. An example of the former would be waiting for a diagnostic test, while an example of the latter would be a patient willingly choosing a later date for surgery. The surgical side of waiting times, from the

decision-to-treat a patient (also known as a ready date) to surgery has been highlighted, and is often used as the waiting time given to patients. Examples of this include Alberta and Ontario waiting time trackers.[58,59] Some Canadian efforts have been made to define specific waiting intervals, as noted in Table 1.

Table 1: Canadian studies on defining waiting time intervals

Author	Field	Mandate	Specific Definitions
Cancer Care Ontario[58]	Cancer	Defining waiting times, with a focus on the decision-to-treat to surgery. No data given.	An appendix (Appendix E) in a provincial report gives detailed wait time definitions for: 1) specialist referral date 2) specialist consult date 3) decision-to-treat date 4) ready-to-treat date 5) start of treatment date
Munt et al.[60]	Cardiovascular surgery	Develop waiting time definitions and present rationale. Data from 2,237 patients in British Columbia.	Defined several wait times for comparison in an academic manuscript: 1) Booking to surgery 2) Procedure to booking 3) Internist to testing 4) Primary care physician to internist 5) Primary care physician to surgery The author's proposed definition for the wait list time: first contact with a medical care provider to date of surgery

Author	Field	Mandate	Specific Definitions
Saint-Jacques et al.[61]	Breast cancer	Defining stages of breast cancer detection, comparing newly defined intervals with more aggregated measures. Data from 637 patients in Nova Scotia.	Defined data elements for defining time intervals: 1) Detection 2) Biopsy 3) Surgery 4) Referral 5) Patient contact 6) Oncology consultation 7) First adjuvant
Alberta Bone and Joint Health Institute, endorsed by the Alberta Bone and Joint Strategic Clinical Network (BJSCN)[62]	Hip and knee joint arthroplasty	Defining waiting times, with a focus on the time a referral was made to the time surgery occurred. No data given. Some options (such as the time a next available option was given) were not included.	Defined data elements that would populate wait times: 1) Referral date 2) Referral received date 3) MSK consult date 4) Surgeon consult date 5) Surgical decision date 6) Patient ready for surgery date 7) Surgery date

Other efforts have occurred in the UK, where National Clock Rules define what exactly starts a referral, what pauses a wait time clock, and what ends the wait time clock.[63,64] A brief summation of the rules states that the clock begins when a referral is made to a consultant or assessment service which will treat or evaluate the patient before returning the patient back to the referring provider (a general practitioner). The clock pauses after two appointments are declined by the patient for a consultation. The clock stops when treatment begins, a clinical decision has been made and the patient is informed, or treatment is ended by consultant or patient (through the patient not attending a referring provider or specialist appointment) choice.

Patient acceptability of waiting times, as highlighted below, varies depending upon the individual. As a result, there may be reasons in which a patient may choose to wait versus a patient who seeks treatment immediately. No existing framework has been found to differentiate the effects of voluntary waiting versus involuntary waiting, which are described further below. As a result, it cannot be determined ex ante whether a specific type of wait (involuntary or voluntary) creates problems for recording waiting times or influences accessibility issues, with respect to a referral system. Information for this is lacking, and this gap will be noted in the thesis.

Potential reasons for delays have been explored previously. De Coster explored quantitative aspects that caused delays for cataract surgery (a similar, elective procedure) in Manitoba.[65] She found that significant predictors for delays included age, sex, and hospitalization during the wait – females, 65 and older patients, and being hospitalized all resulted in increased waiting times. For old age and female patients, one hypothesis put forward was due to the loss of driving (and potentially employment) which would potentially impact men more than women and impact urgency scores. The most significant factor was the specific surgeon of a patient, which explained 29.5% of the variance in waiting times. This was due to large variation in the waiting lists of each surgeon. Central registries with prioritization tools were noted as one potential tool to reduce waiting time.

Hilkhuysen et al. developed a conceptual framework which qualitatively explored the reasons for waiting for elective surgery.[66] A group of individuals, with more surgeons than patients, were interviewed about the factors influencing patient treatment, and the consequences of those actions. Hilkhuysen et al. broke the consequences into three factors: physical, social, and psychological. Physical consequences included mortality and disability, and the potential for

further deterioration of a patient. Social consequences included whether a patient could continue normal activities, and the impact upon work. Psychological consequences included prolonged time with a treatment (i.e. while waiting) and the emotional distress from that wait, as well as uncertainty and stress resulting during the wait. These criteria, though able to highlight how patients and medical staff qualitatively judge patients, cannot provide a quantitative guide directly for prioritization of patients. The questions did not ask about the relative well-being of a patient compared to others, meaning the impact of deeming one patient highly urgent relative to another patient was not analyzed.

Lofvendahl et al. completed a retrospective study on orthopaedic patients in Sweden, including hip replacement, back surgery and knee arthroscopy. [67] Quantitative reasons for waiting, and patient perceptions, were explored. Hip replacement had the longest waiting time, in terms of time from referral to time of surgical consult and time of surgical consult to time of surgery. Men waited longer for all procedures except knee arthroscopy compared to women, and local hospitals had significantly lower waiting times than university hospitals for all procedures. For hip replacement, those age 44 and less and 60-71 waited longer than individuals between 45-59 and 72 and higher, though not significantly – the other two operations had longer waits for older individuals, matching De Coster.[65] Better EQ-5D results were also associated with a longer wait, significantly for hip replacement and knee arthroscopy. The specific reasons for waits, beyond the associations, were not explored in further detail.

Further classification of waiting times for specialist visits have not been highlighted in the literature. Provinces such as Ontario and Alberta report *surgical* waiting times, which generally are similar to Ontario's definition of "the time... surgery or exam is booked until the

time [one] receive[s] it."[68] Amoko et al. list several factors in affecting surgical waiting lists, which can be used to help classify waiting times into categories.[69] These include:

- Patient preferences (season, facility, physician, cultural beliefs),
- Type of procedure and urgency,
- Admission thresholds for hospitals,
- Referring physician's preferences,
- Personal preferences and other considerations of individual referring physicians.

Manitoba highlights several different categorized factors affecting waiting times.[70] In addition to monthly variability and the influence of volumes at a specific site, these include:

- Patient choice (delaying treatment for personal or family reasons),
- Patient condition (treatment delayed until a patient's condition improves),
- Follow-up care (pre-booked for follow-up treatment to monitor status),
- Treatment complexity (procedure delayed until specific resources are available).

As noted above, these are related to *surgical* waiting times, not *specialist consultation* waiting times. The literature for specialist consultation waiting times has not gone into depth regarding reasons for waiting. These surgical waiting time classifications will help to inform what categories will exist, and how delays will be classified, for hip and knee patients awaiting specialist surgical consultation visits. These times – involuntary, system-related waits, and voluntary, patient-related waits, are described in Chapters 3 and 5, with results in Chapters 6-8. When waiting times are explored through this perspective, this thesis will provide evidence that these waiting times should be separated in any effort to track waiting times more accurately, and determine steps where referral enhancements can be provided.

2.8 Interventions to reduce waiting time: for surgeries and consultations

Several policies surrounding waiting time and waiting lists should be noted at this point. One main concern, the contents of a referral which communicate information from a primary care provider to a specialist, will be explored later in this review. Kreindler presents a thorough overview of these policies.[71] She breaks these policies down into supply-side and demand-side policies. Supply-side policies have the aim of increasing the ability of the medical system to provide a service, which reduces waiting lists. These provide the only two successful strategies for dealing with waits: pay directly for the activity in the short-run, and increase investment for the capacity in the long-run. Targets for waiting times and market incentives can work as a global strategy, but only together. All other strategies either work in certain circumstances, or are limited or not effective at all. Kreindler notes that direct strategies are the ones that work, which would include certain aspects of an electronic referral-type intervention, such as explicit prioritization and patient choice. For the latter option, Kreindler did not find enough data to make judgment upon whether it was an effective strategy for reducing waiting times. These strategies are summarized in Table 2.

Table 2: Interventions for reducing waiting times

(adapted from Kreindler[71])

Intervention	Direct or indirect; supply or demand-side	Proposed Alberta referral process element enhancement?	Effectiveness
Pay for increased procedures, such as targeted funding or fee-for-service	Direct supply-side intervention	Not incorporated	Consistently effective

Intervention	Direct or indirect; supply or demand-side	Proposed Alberta referral process element enhancement?	Effectiveness
Increased public capacity	Direct supply-side intervention	Not incorporated	Consistently effective
Buying capacity from elsewhere – other countries or private providers	Indirect supply-side intervention	Not incorporated	Limited effectiveness (services from the private sector are effective under certain conditions)
Increased usage of private health insurance	Indirect supply-side intervention	Not incorporated	Limited effectiveness
Patient choice	Indirect supply-side intervention	Incorporated	Few studies available to judge
Develop better-designed treatment systems	Indirect supply-side intervention	Incorporated	Effective under certain conditions
Prevent illness	Direct demand-side intervention	Not incorporated	Few studies available to judge
Prioritize patients	Direct demand-side intervention	Incorporated	Effective under certain conditions
Eliminate inappropriate tests	Indirect demand-side intervention	Incorporated	Not categorized
Set mandatory targets (wait times) with incentives to meet them	Global intervention	Indirectly incorporated	Limited effectiveness if done separately; consistently effective if done together
Use market mechanisms to promote shorter waits	Global intervention	Not incorporated	Few studies available to judge
Data collection to monitor and evaluate system performance	Global intervention	Incorporated	Not catergorized

A cynical view towards these initiatives is that none will work, because as designed, the initiatives mentioned do not take into account the behaviour of decisionmakers and physicians expected to enact the changes. This is the view of Kenis, evaluating an initiative involving increased funds and more detailed waiting list calculations in the Netherlands.[72] Kenis' opinion

is to remove interdependencies between agents in the medical system, rather than focus on waiting lists *per se*. While managing complexities and de-centralized decision making may be important, it still is important to focus on waiting lists as metrics which can be measured, and which patients and the public will focus upon, regardless of any organizational changes.

Putting aside management issues within the health system, some specific interventions are now explored, specifically upon those that are included in a proposed electronic referral tool for Alberta (described further in Chapters 3 and 7). An electronic referral tool would incorporate multiple elements which would result in a better designed referral system, such as better triaging of patients, which Kreindler noted is effective under certain conditions. As a result of this focus on referral system enhancements, items such as the direct supply-side interventions (paying physicians money to spend more time on orthopaedic patients) will not be explored here in order to limit and focus the scope of this thesis.

Better designed treatment systems are designed to produce better patient outcomes by changing the way a patient is treated by the health system. The scope of these changes may vary – treatment guidelines assist physicians and surgeons in determining how a patient should be treated, and what resources should be used in treatment. Care pathways look more broadly at the system, in which multidisciplinary teams combine specific outcome measures and algorithms for treatment of patients.[73] Gooch et al. took advice from orthopaedic specialists and developed a new care pathway for hip and knee replacements in Alberta.

Bridgman et al. developed a slot system to address long waiting lists for first surgical consultations in England.[74] Slots were installed which forced the number of incoming patients to equal the number of consultations available for different orthopaedic surgeons. Locally developed guidelines and a central intake officer were also included in the plan, making it more

of a complete program overhaul. Referral rates from GPs to the surgeons decreased by 2.2 referrals per 10,000 people, with the decrease maintained for an additional year. Control groups experienced an increase in referral rates over the two years. This study only measured referral rates from GPs before and after the slot intervention, so no determination could be made about whether bottlenecks were created elsewhere in the system. Using referral rates is not an ideal outcome, as patients who desire to seek a specialist should have their choices accounted for. This chapter does show that by including referrals and the system to process them – central intake, and guidelines for referral – changes in the healthcare system can occur.

Patient choice is an indirect patient intervention that, as noted above, has few studies judging effectiveness. The main metric used in most patient choice studies is waiting times. García-Lacalle notes that for hospital choice, two factors: a human factor, and a facilities factor, explain patient assessment of hospital quality, and the resulting choice of a hospital.[75] Human factors included how patients are treated in a hospital by front-line staff, while facility factors included how patients react towards the hospital surroundings. Those two measures explain approximately two-thirds of perceived hospital quality. This decreases to less than one-half when explaining whether a patient would recommend a hospital. García-Lacalle finds that reputation of a hospital might account for this difference, though it remains an unexplained factor in the study.

Dawson et al. explore patient choice in London, England.[76,77] A total of 66% took advantage of patient choice, in which a patient was offered a choice of another provider with shorter waiting times, with 63% of orthopaedic patients choosing another surgeon. Waiting times decreased compared to areas with no patient choice, specifically one week for orthopaedic care. This decrease was statistically significant, but clinically insignificant. Convergence of

waiting times between surgeons who participated in the program occurred, resulting in better equity of patient care. For surgical waiting lists, Siciliani finds that if hospitals provide similar services, and receive fixed budgets for those services, wait lists could increase.[78] Similar services would imply high degrees of patient choice available. Siciliani analyzes the problem only from the supply-side perspective, ignoring patient choices when encountering a wait list of a given time. An implication, though, is that funding must be increased in order to prevent wait lists from increasing dramatically due to the lack of an increased supply of surgeries.

The acceptability of patient choice by patients is also subject to disagreement. An initial study done in 1994 by Ho et al. found that waiting times for consultation and surgery for knee replacement patients in Ontario were acceptable to 93% and 88% of patients.[79] The dividing point between satisfaction and dissatisfaction for waiting was 34 weeks, implying that patient choice was not a critical issue, since patients in Ontario could be seen in a timely manner. Conner-Spady et al. explored maximum acceptable waiting times for patients who either had hip or knee replacement within 3-12 months or were awaiting surgery in Saskatchewan.[80] While the maximum acceptable waiting time was 4 months, with an ideal of 2 months, patients ended up waiting 8 months. Most patients surveyed – 51% – gave pain, and the effects of living in pain, as the reason for choosing their maximum acceptable waiting time. Longer maximum acceptable times were associated with younger patients, whether the patient was waiting or already had the replacement (those waiting had a longer maximum time), a longer self-reported waiting time, better EQ-5D, an acceptable waiting time, and the idea that patients were being treated fairly and those with most severe conditions would receive quicker treatment. Results were not broken down between the group that had had surgery and the group that was awaiting surgery, so differences between the groups for gender, EQ-5D, and the other factors cannot be quantified.

As waiting times have approached the benchmark, and studies such as Dawson et al. show that 34% of patients do not choose a lower waiting time when given the opportunity, several factors have been explored to explain this discrepancy.[77] Conner-Spady et al. explored factors associated with patients not choosing a surgeon for joint arthroplasty patients in Saskatchewan.[81] They found that 63% of patients were not willing to change surgeons. Men, those with higher education, and those who'd already undergone a surgery were more likely to switch compared to women, those with lower education, and those undergoing initial primary surgery. Better EQ-5D scores, perceived treatment, perception of acceptable waiting times, and having a preference for a surgeon were less likely to switch. One limitation may be the specific population of Saskatchewan, as distance to a site was not raised as a factor. Birk and Henriksen included this factor when looking at Danish hip and knee replacements.[82] They found that 40% of patients did not choose a re-referral to another surgeon, with 90% of patients who chose this option having no regrets about their choice four years later. The primary reasons stated for declining re-referral were distance, transport time and ease of access, with 65%, 63% and 51% of patients declining re-referral selecting these as reasons. A prior relationship with the original surgeon was selected by 61%. Of patients seeking a re-referral to another surgeon, 91% chose waiting time as a reason. This suggests that in rural areas, having a next available surgeon option, especially for a medically intensive procedure such as joint replacements, may have a role in producing shorter waiting times for patients who have no current relationship with a physician.

2.9 Referral appropriateness: correctly directing patients to specialists

Patient choice, as noted above, is a factor in determining waiting times for elective surgeries such as joint arthroplasty. The impact of patient choice, as noted above, is mixed, with few studies existing to determine the effects. The structure of the system is instead an area that, as noted above, could lead to better system outcomes under certain conditions. This structure is analyzed in this section, with regards to how referrals communicate information between different parts of this system.

One line of thought is that primary care providers should not serve as gatekeepers to the medical system, but as coordinators of care.[83] While dealing with who is responsible for a patient, an improvement in the system structure, defining *who* is in charge of the patient at *any* given time, would serve the same purpose. A diagram showing referrals and (approximately) who is responsible for what input regarding the referral is given in Figure 2. As is noted in the figure, there are many branches where patients may be lost to both medical providers – patient status unknown – increasing patient waiting time unnecessarily.

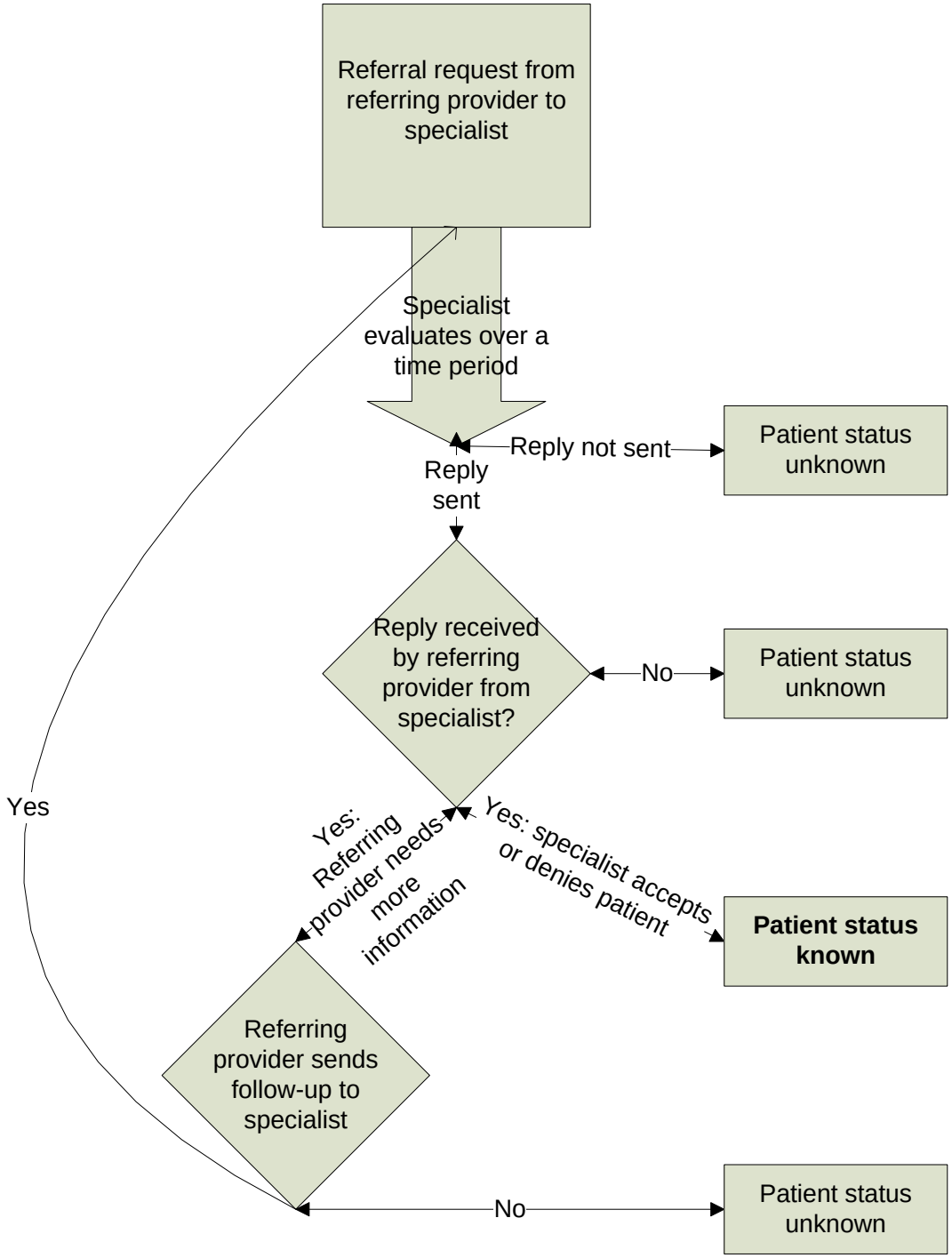

Figure 2: Generalized referral model from a referring provider to a specialist (adapted from Wootton et al.[84])

An initial question from Figure 2 raises the issue of what happens at GPs offices, specifically regarding referrals to specialists. Stange et al. asked GPs at family practices in Ohio to track what was done during their meetings with patients.[85] They found that the average visit takes 10 minutes. Asking what actions were taken during any 15 second interval (multiple answers could be given), 56% of time was spent primarily on history taking of a patient and 32% primarily on planning treatment. In addition to 19% spent on health education, the latter two options would be assisted by clear guidelines for treatment and referral. No breakdown was given between patients who were referred and those who were not, and timing of referrals was not completed. The total number of visits resulting in a referral was 11.6 per 100 visits, with 7.6 per 100 visits to another physician and 4 per 100 visits to a non-physician. Most of the visit was spent taking the history of a patient and designing a treatment plan, both of which must be communicated to other practitioners if a patient is referred. A referral tool as a result must be setup for ease of use, given only one in ten patients will have records sent through such a tool.

For more details on referrals, Bourguet et al. conducted a survey with physicians in Ohio in family physician residency programs.[14] They found that 5.97 visits per 100 resulted in a referral being made, with 1.06 of those to non-physicians.[1] Of those patients being referred, 27% were for treatment and/or surgery, 22% for a diagnosis, 15% for a specialist to take over treatment, 15% for an investigation, and 13% for advice on management of a patient. Clear referral and treatment guidelines would assist in lowering some of the referral rates, as physicians would know exactly what to refer for, and could perhaps complete more treatment before asking a specialist for management advice. Another key finding was that for 23% of

visits, primary care physicians did not know whether a patient saw a specialist. This lack of feedback hampers efforts for the GP to serve as a coordinator of care, and may result in duplication of services. A focus on feedback and improvements in the primary care-specialist care interface will be the focus of the next several sections.

One of the areas where the system structure could be improved is with referral forms. Referrals are meant to direct information from a primary care provider to a surgical specialist. These package together a note from a primary care provider or specialist re-referring a patient giving the cause of the referral, a background of the patient, and necessary lab tests and imaging. Alternatively, a template may include some or all of this information. If referrals are not well done, they can cause waiting time increases in addition to extra MSK clinic resources to process. Not being well done includes referrals that are not routed to the correct specialist, and referrals that arrive incomplete, which precludes a specialist making decisions on how to screen or treat a patient.

Two systematic reviews have been completed looking at referrals as well as referral forms for primary care to specialist consultations. Faulkner et al. divided studies into professional interventions in primary care, and organizational interventions.[87] The former included referral guidelines and education and information; the latter included primary care and specialist care interventions, along with GP fundholding in the UK and open access schemes. They found that clinical behaviour changed when guidelines are used, though not necessarily referral rates. Organizational interventions tended to see nonzero reductions in referrals from interventions. Similar small reductions in referral rates were seen with the fundholding studies

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[1] The consensus in the literature appears to be between 6 and 12 per 100 primary care visits resulting in a referral,

and open access schemes. Most studies, however, were underpowered, and Faulkner et al. recommended caution with implementing any intervention.

A Cochrane Review on interventions designed to reduce referral rates and increase referral appropriateness was completed by Akbari et al.[88] Effective findings included giving guidelines to referring providers with training, educating referring providers with consultants, and organizational interventions. Passive interventions, such as locally developed guidelines given to referring providers without further aid, were not effective. As a result, they noted local dissemination strategies would increase the likelihood of successful outcomes. A limited number of studies, and the overall weak methodological quality of the studies, was a weakness Akbari et al. found in the review. The primary finding from the results was that non-passive interventions, such as structured referral sheets, have the potential to increase referral appropriateness. This is a key part of efforts in Alberta to improve referral processing.

Clarke et al. produced a systematic review focused on the effects of referral guidelines on the appropriateness of referrals.[89] Most of the included studies were complex interventions, looking not just at referral guidelines but concurrent healthcare management changes. Clarke et al. found that pre-referral investigation and treatment can be improved with referral guidelines. No findings on the rates of referral could be determined from the included studies. Clarke et al. also confirmed the findings of Akbari et al. when noting that when dissemination of guidelines was passive, referrals would not see improved quality.

Some specific studies have focused on orthopaedic referrals. Musila et al. developed referral decision guidelines based on a group in England.[90] They found that severity and

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with 5 to 8 per 100 being made to physician specialists. This is consistent in different countries too; for example

preferences of the patient should be incorporated into the decision whether to refer a patient for further care. These are seen further in prioritization and triaging options, mentioned later in this review. Roland et al. looked at orthopaedic outpatient referrals in England, from the perspective of the referring provider (GPs), the recipient of referrals (orthopaedic consultants) and patients.[91] There was a difference in the percentage patients who reported satisfaction with a consult (83%) and the percentage of patients orthopaedic surgeons thought were appropriate to see (43%). Combined with a long waiting list for the surgeons, Roland et al. noted that agreement on referral guidelines would help to fix the imbalance in referrals. The contents of the referral form itself were not explored, and one point highlighted – 20% of patients sought a referral regardless of any clinician advice – emphasizes that patient wishes, no matter agreed-upon guidelines, will still affect the number of appropriate referrals.

An ethnographic, qualitative analysis of orthopaedic referrals was completed in the UK by Richardson et al.[92] They found several issues in the referral process causing possible delays, starting with the decision of where to refer a patient – a physiotherapist or an orthopaedic surgeon. Patients, though knowing what they wanted, did not know their options for treatment – indicative that system changes will not necessarily be taken up by patients unless informed by a GP or specialist. A lack of feedback was also noted in the current system, with monitoring of referrals, and understanding the routes of referrals, being unknown by GPs and patients.

The result of this missing feedback to referring providers is poor patient care. Chen and Yee note that 98% of referrals contained background information on a patient, matching the time gathering a patient's history noted by Stange.[93] They also noted that in another study, only 32%

Piterman and Koritsas report 10.6 per 100 visits in Australia.[86]

of specialists received what they deemed adequate information from referring providers, while only 75% of referring providers received feedback from specialists. O'Malley and Reschovsky note 70% of referring providers report sending information, while 35% of specialists report receiving information.[94] For information flow the opposite direction, 81% of specialists report sending information to referring providers, while only 62% of referring providers note receiving information. This disconnect highlights why a consistent information interface is needed in any referral tool, and hints at organizational issues surrounding referrals being more critical than previously acknowledged.

This hints at how a referral should be accepted. One line of thought is that a central intake model, in which patient referrals for multiple specialists are received at one location, would result in better system outcomes. Bichel et al. note that a central intake model for rheumatology, endocrinology, respiratory, hematology, and gastroenterology in Calgary, Alberta resulted in patient waiting times being reduced, and efficiencies increased through means such as reduced duplicate referrals: the percentage of referrals not accepted decreased in three of the five specialties, and waiting times decreased in four of the five specialties.[95] Having sufficient and timely feedback is critical, since referring physician satisfaction decreases if response time from central intake increases, as was found in an evaluation of central intake for youth mental health services in Ontario.[96] Centralized intake has been used previously in areas such as mental health and addiction treatment and chronic pain treatment, with improved access being noted for disadvantaged groups.[97-99] However, for specialist services outside oncology and cardiac surgery, central intake with coordinated management is rare in Canada.[100] Central intake optimally requires integration of specialists and tertiary care to provide timely treatment options. Specifically regarding accessibility, waiting times can be reduced using a central intake model,

especially in situations where entry is highly variable.[101,102] Central intake serves as a pool which absorbs variable queues which might otherwise overwhelm (or reduce demand to zero) for an individual queue.[2] This is likely to be the case for referrals, where variability is caused by such factors as seasonality.[103] A standardized referral template would have the potential to reduce variability. Variation in the rate of arrivals of referrals causes issues in managing the flow of referrals through central intake, which might cause increased wait queues.

Once a referral has been accepted, several articles have looked at how patients should then be routed through a clinic. The first published paper recommended scheduling patients at average intervals equal to the length of the average appointment time.[104] Future research extended those findings to include arrival rates as a component for waiting times, and avoidance of supply-side effects which may induce more referrals to be made.[105] Worthington also highlighted that feedback to patients, when combining waiting lists or maintaining a single waiting list, would be essential for preventing waiting times from increasing unnecessarily.[105] However, a systematic review of appointment scheduling highlighted that little progress has been

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[2] As adapted from Cattani et al.[102], expected waiting times for individual queues are:

$$Waiting\ time_{single\ queue} = s\left(\frac{b}{1-b}\right)\left(\frac{c_a^2 + c_s^2}{2}\right)$$

Expected waiting times for a pooled queue are:

$$Waiting\ time_{pooled\ queue} = s\left(\frac{b^{\sqrt{2(n+1)}-1}}{(1-b)n}\right)\left(\frac{c_a^2 + c_s^2}{2}\right)$$

where s is the expected time it takes to process a transaction such as a referral, b is the fraction of time an individual is busy with processing, n is the number of individuals processing referrals, c_a is the coefficient of variation for arrivals, and c_s is the coefficient of variation for processing. With the assumptions that $0<b<1$ and $n\geq 2$, then the middle term in the single waiting time calculation is larger than the middle term in the pooled waiting time calculation.

made on scheduling, and that both more realism in modelling, incorporating factors that cause bottlenecks in scheduling, and multiple outcomes, should be considered in future analyses.[106,107] Other studies have noted how physical patient flow at clinics can be improved.[101] What has been unexplored is how processing of patients *before* they arrive at a specialist clinic can occur, with an eye on increasing performance of system metrics such as waiting times and increased percentages of acceptable referrals.

As noted above, interventions such as better quality referrals are needed. Who processes referrals is a question that will also be explored in this thesis, specifically in Chapter 4. Referrals can arrive direct to surgeons, to clinics, or to referral management centres, also called central intake clinics. The responsibilities of these clinics has been called into question as well as cost savings.[108] The goals of these clinics, which is to ensure consistent referrals, could be counted as an organizational improvement, which could be effective in lowering waiting times, as noted by Kreindler.[71]

How referrals are processed is the next area of focus. Escobar et al. provide evidence that if clinical equity is a goal, then prioritization of patients, opposed to first-in-first-out processing, should be completed.[109] This matches the goals of patient acceptability noted previously, in which waiting lists are accepted by patients with the knowledge that patients who need treatment the most are receiving it quicker. How this prioritization occurs is the subject of the next section.

2.10 Directing patients to the correct service at the correct time

Prioritization of patients is a controversial area, as noted above with the idea that fairness is the primary vision driving prioritization. MacCormick et al. explore prioritization in a 2003 systematic review.[110] Of 14 studies reviewed with a prioritization tool, seven used a weighted

linear model, and three used a matrix model. They noted that ethical aspects, and the overall impact of prioritization on patient and healthcare system outcomes, had not been evaluated. Testi et al. modeled implementation of a priority scoring algorithm for an Italian hospital.[111] They suggest that implementing priority scoring with an urgency categorization assessment would increase efficiency and equality. This has not been explored thoroughly with empirical evidence in the literature, as the only program to have been implemented is in New Zealand, where controversy over "culling" patients has led some to question reductions in waiting times.[71]

How to develop a prioritization system has been highlighted in the literature, and will be noted in further detail when discussing the WCWL project. Sampietro-Colom et al. focused on the process of developing a priority scoring system in Spain, using a conjoint analysis design.[112] Face and construct validity were used to test the assumptions of the models developed. Pain, difficulty in doing everyday activities, and disease severity were the top three priority variables as decided by the general public, patients and relatives, surgeons, and allied health professionals. Weights were different among the groups, though, which would still lead to value judgments needing to be incorporated into prioritization.

Whether clinically significant differences result in the creation of different prioritization scales is the topic of Escobar et al.[113] Two scales, the aforementioned scale created in Spain through conjoint analysis, and a hip and knee priority score based on the RAND method, were compared. The Pearson correlation coefficient between the two scales was 0.79 and an intra-class correlation (ICC) score between the two is 0.74. Comparisons between the two scales and the Western Ontario McMaster Osteoarthritis Index (WOMAC) were similar as well: 0.43 to 0.64 for the Spanish method, 0.50 to 0.74 for the RAND method. The RAND method was created using patient scenarios evaluated by orthopaedic surgeons, and rated through a Delphi

method; opposed to the conjoint analysis incorporating patient opinion for the Spanish method, the two scales differ enough in their creation to suggest that different scales should be functionally equivalent when scoring patients.

This was confirmed by a ranking study completed by Naylor et al. in Ontario.[114] Naylor et al. developed scenarios and had a panel rank patients based on appropriateness (on a 7 point scale) and urgency (on a 4 point scale) through a Delphi method. They found that for appropriateness the panel agreed in 92.5% of scenarios and in 73.8% of scenarios for urgency. A 7 point scale was then created for both urgency and appropriateness, which could then be used to score patients consistently off patient charts. The same patient scenarios were seen very similarly between practitioners (patients, though, were not included in this analysis), suggesting again that priority scores will not differ significantly, regardless of the scale used.

New Zealand was the one jurisdiction to explicitly implement priority scoring, and as previously mentioned, had mixed results. Gauld and Derrett analyzed a booking system in New Zealand that introduced priority scoring in an effort to reduce wait lists for elective procedures.[115] Several issues arose, which they noted included lack of consistency in priority criteria, no piloting of the system, and not enough funding for high priority patients to receive surgical procedures. For orthopaedic procedures, stakeholders decided that social factors should be incorporated into the decision for surgery. Agreement on these social factors did not occur, and final criteria decisions were made at a hospital level basis, opposed to a national or state-wide basis. The culling of the patients, rather than being blamed on priority scoring itself, was blamed on a lack of funds which resulted in only a portion of high priority patients receiving surgery. Validation of a priority score is one finding of Gauld and Derrett that has since been incorporated into other priority scoring projects.

The main Canadian initiative to develop explicit priority scoring has been led by the Western Canada Waiting List project. Five elective procedures, including hip and knee replacement, were selected, with each procedure having standardized clinical criteria selected.[8] Regression was then used to create weights for each criteria variable, and a scoring algorithm created and validated by surgeons and GPs. These criteria included:

- 1) pain at motion and rest,
- 2) ability to walk without pain,
- 3) functional limitations,
- 4) findings from a physical examination of the affected joint,
- 5) potential for progression of disease,
- 6) threat to patient independence in society.

While endorsed by four western Canadian provinces, full implementation of these criteria has not been completed in any province enough for an evaluation to occur.

Following the surgical criteria mentioned above, the WCWL expanded to evaluate criteria for a surgical consultation with an orthopaedic surgeon. The goal was to develop a prioritization tool for primary care to refer patients to orthopaedic specialists using a validated tool.[116] The criteria from the surgical prioritization were revised based on feedback from primary care providers and orthopaedic surgeons, providing face validity. Mobility and medication use were added, and the potential for progression of the disease was removed. An explicit score was given to answers for each criterion. Mean intra-rater ICC was calculated to be 0.79, suggesting that medical providers tend to recognize the same patients to be of high urgency. These validation scores have been implemented in Saskatchewan, but no post-implementation evaluation has been completed.

Based on the New Zealand experience noted earlier, validation of prioritization scores is a critical issue that must be addressed before scoring is used in practice. Escobar et al. validated the modified RAND method noted above for hip and knee joint replacement in Spain.[117] A prospective survey of joint replacement patients compared patient scores using the RAND method with WOMAC scores. Correlations between the scores were 0.79 for function, 0.69 for pain, and 0.51 for stiffness categories. Details were given on face, construct, convergent and discriminant validity, with all of these met by the way the modified RAND method, the finding that a hip patient rated worse than a similar knee patient, and the correlations were high. The correlations would not be one, due to the modified RAND method incorporating social criteria, opposed to the WOMAC scale. Conner-Spady et al. validated the WCWL surgical prioritization scores using visual analogue scale (VAS) urgency, maximum acceptable waiting times, WOMAC, and EQ-5D, with correlations determined between those scales and the WCWL scores.[118] The correlation was 0.79 with VAS urgency, 0.38 for maximum acceptable waiting times, 0.33 with EQ-5D, and 0.33 with WOMAC. The composite score of the other scales compared to the WCWL score was 0.79, which was deemed acceptably reliable.

2.11 The appropriateness of referrals to specialists

Regardless of the system used to refer patients, and the procedures to classify patients, there is the potential for errors to arise. Prioritization scores are still subject to primary care provider opinion, which is close to but not exactly what specialists rate patients. These errors arise from communication issues, primary care providers not knowing what to refer onto specialists, and other issues which cause referral forms, priority scores, and patient choice to have no effect.

Bowling and Redfern surveyed patients, GPs, and specialists in England regarding their opinion of the referral process.[119] Patients and GPs agreed that seeing a specialist was the best course of action, with 95% of patients deeming a visit necessary, and 89% of GPs feeling they could not deliver care to the patient. Specialists on the other hand thought that 10% of patients were inappropriate, and 22% of patients were inappropriate in the sense that more testing and examinations could have been completed before referral. However, another study on rheumatology patients in Norway asserted that GPs use too much laboratory testing, with the result of delays for patient treatment.[120] In both cases, having unclear referral guidelines may result in opaqueness for testing requirements that would be accepted by specialist surgeons.

In the absence of clear guidelines for referring a patient to a specialist, what makes a primary care provider refer a patient has been researched. Earwicker and Whynes gave simulated cases to GPs in England, along with costs and choices for potential referrals of those cases, and asked what the GPs would recommend.[121] They found that GPs focus on waiting time and specialist interest driving decisions to refer, followed by costs of referral.

Bertakis et al. follows up on this point by looking at predictive factors which would cause a primary care provider to refer a patient to a specialist from the primary care view, opposed to the primary care view of specialists as in the Earwicker and Whynes study.[122] Patient referrals were monitored at a California hospital in a prospective study. Patient demographics were explored in terms of which patients got referred to speciality care. Bertakis et al. found statistically significant numbers of older patients, patients in worse health, and patients who saw primary care more often would be referred to a specialist more often than younger and healthier patients. Of all referrals, 8.8% of 813 total referrals (for 232 patients) were to orthopaedic clinics, making it the second largest destination for referrals, outside surgery. An older patient

population causes its own concerns, as was raised in Weiner et al.[123] The mean age of the patient population at a hospital in Indiana in the Weiner et al. sample was 72, indicative of an older population. They found that 8% of referrals required more than one order from primary care to a specialist for a referral to get scheduled. Of referrals sent to specialists, 71% were scheduled, with 1% of referrals were scheduled but not attended. Patients who were previously hospitalized, as would be more likely with an older population, were more likely to not have a referral completed. Issues regarding referrals mentioned included lost paperwork, missing clinical details, and faulty communication. These are issues that could be neglected without patient input, which an older population may not be able to provide the necessary input to keep a referral from being misprocessed. Another study by Forrest et al. looking at physicians at several sites in the U.S. found that 80% of referrals had been completed.[124] Forrest et al. found that instead of lost paperwork, most patients did not complete referrals due to the belief that they feel better without the need for any further care (48%), lack of time (37%), or the patient disagreed with the initial diagnosis (27%).

Communication errors were mentioned by Weiner et al. as a possibility for referral delays and lower scheduling rates. This has been a problem predating electronic referral, as noted by McPhee et al. in 1984.[125] McPhee et al. prospectively studied primary care provider referrals from a California hospital. Of the referrals sent, 98% contained patient background, but only 76% contained an explicit reason for the referral, with only 9% making direct verbal contact with a surgical consultant. Only 55% of referrals resulted in feedback from the consultant to the primary care provider, despite both surgeons and primary care providers having offices in the same building. Of primary care providers who wanted consultation results, only 61% received results from the surgical consultant. When a referring provider personally contacted the surgical

consultant to schedule a patient for a return visit with two or more reasons for referral, a higher percentage of referrals received a response back to the referring provider.[3]

Gandhi et al. surveyed primary care providers and specialists at a Massachusetts hospital to determine further details on how these communication issues arose.[15] Specific issues for primary care providers and specialists are noted in Table 3.

Table 3: Significant problems with the current referral process

(adapted from Gandhi et al.[15])

Primary Care Providers		Specialists	
Timeliness of information from specialists	54%	Timeliness of information from primary care provider	41%
Redundant aspects of the current process	35%	Time required to receive insurance approvals	39%
Time required to create adequate referral notes	31%	Time required for medical management approvals from other physicians	31%

A total of 28% of primary care providers and 11% of specialists were dissatisfied with information they *sent* to the other provider, while 28% of primary care providers and 43% of specialists were dissatisfied with what they *received* from the other provider. Lack of medications and medical history were the main sources of complaints by specialists. Included in these were estimates by primary care providers that 19% of referrals were actually re-referrals for a variety of reasons. Specialists reported sending feedback regarding a patient within seven days for 87% of referrals; primary care providers reported receiving feedback from specialists within seven days for only 36% of referrals. Four weeks after a referral visit, one-quarter of

[3] Of primary care providers who did not want results from the surgical consultant, 40% still received results.

primary care providers had not received feedback from the specialist. This highlights the need for data collection to occur, which has not been found in any academic studies to date. The discrepancy between the date a referral is sent back to a primary care provider, and the date a referral is received by the primary care provider, is especially noticeable. An aside for comparison with analysis later in the thesis, Gandhi et al. noted that primary care providers most often sent letters to specialists (40%), followed by computerized notes (33%) and email (28%).

As noted above, the reason for a specialist consultation is missing on a large number of referral from referring providers. A study by Rupp of knee referrals at a Nevada specialist office highlights another important issue, which is incorrect diagnoses by primary care.[126] The study focuses on multiple orthopaedic ailments, not just osteoarthritis. It suggests that if a specialist office relies on the reason given on a referral, it could delay treatment for individuals who are more urgent than the reason suggests. If an orthopaedic specialist relies on an inconsistent recommendation on whether a patient is urgent, then a similar problem might arise.

These errors suggest that system-wide improvements are needed. With such improvements, the number of inappropriate tests and treatments initially given to patients will be reduced. Further data collection will also answer issues regarding conflicting evidence between primary care providers and specialists, in terms of what is included (or not) on referrals and the timing of sending and receiving referrals.

2.12 Electronic referral tools

The previous issues regarding patient choice, prioritizing patients, and eliminating unnecessary duplication or medical tests, are all tied into the structure of the referral system for patients with hip and knee pain. One mechanism that these can be tied together into a more efficient structure

is by an electronic referral tool for use by referring, primary care providers and orthopaedic specialists.

Electronic tools have been used elsewhere in medicine to positive results, suggesting that physicians and patients are not against electronic tools in practice. Haukipuro et al., as an example, highlight videoconferencing for orthopaedic consultations in Finland.[127] They find that patients who attend videoconferencing for a consultation, even at their primary care provider's hospital 160km away from the surgeon, were just as satisfied as patients who attended a consultation in-person with the surgeon. The only caveat was that examining telemedicine patients was harder, resulting in teleconferencing being recommended if further diagnostics were not needed. Email consultations have been found to work, with the caveat that questions from primary care must be worded carefully to avoid specialists recommending unexpected consultations.[128]

Email and other electronic management of referrals and patient care has been completed in many specialties. Patients in England with osteoporosis were entered into an electronic referral and management system. Patel et al. noted the electronic tool to manage patients also incorporated treatment guidelines and functions which printed imaging request and referral templates.[129] They found that more patients who had osteoporosis were being treated, up from 34% to 81% of a prospective group, and imaging was conducted on more patients in the group. Patterson et al. used a prospective group to study neurological referrals at a Northern Ireland hospital.[130] They found that of the 76 patients referred from nine primary care providers, 45% ended up being managed by email alone, while 43% ended up being referred to a neurologist. Neurologists saved an estimated 44% of time consulting under the new email tool, from 30 minutes per referral to 17 minutes per referral. Every GP surveyed said that patient care

improved and the electronic system streamlined GP clinic practices. Another study estimated that waiting times were reduced over 5 years from 72 weeks to 4 weeks, in spite of an increase in referrals, with a 35% reduction in system costs per patient of using email for referral instead of conventional referrals.[131] Specific time points for measuring waiting times, and other system-related reasons that could be causing the reduction in delays, were not explored in the paper.

Wootton et al. listed features of electronic referral across three established systems in Finland and the U.K.[84] The referral structure plotted was similar to the referral plot in Figure 2. Wootton et al. also gave several suggestions to avoid problems with missing patients. These included:

- 1) a single point of contact for referrers, such as a central intake clinic;
- 2) an option for choosing a physician, such as a specific surgeon or next available option;
- 3) acknowledgment of receipt and status information seen by both parties;
- 4) progress tracking of the referral.

They also pointed out that with performance monitoring, and clinic reorganization (such as reallocating nurses and managing clinic demand), it is possible that gains could occur compared to other forms of consultation for non-urgent cases.

Weiner et al. explored a web-based system for processing referrals, and found that an electronic tool increased scheduling of referred patients relative to a paper-based system at a midwestern American hospital.[132] Additional features included staff at both the referring provider and at the specialist being able to identify and receive reminders about unscheduled referrals using the same electronic interface. These reminders were set at two days for urgent patients, seven days for semi-urgent patients, and 14 days for routine patients. The percentage of referrals being scheduled increased from 54% to 83%, while the median time from when the

referral was made to when the appointment occurred decreased from 168 to 78 days. For orthopaedic sites, scheduling went from 48% to 81%. A total of 5% of referrals were denied under the new system, with 26% being duplicated orders, 26% not meeting clinical criteria, and 20% not being treated at that clinic site (being incorrectly directed). Only 2% of denied referrals were missing information and deemed incomplete. This electronic system got information to the specialists, but the study did not address whether the correct information was being given to the specialists, which might be part of the 78 days of delay remaining after the tool was implemented. Dennison et al. note in an England-based study of electronic referral for colorectal surgery appointments that the electronic interface was completed in one day compared to seven days through paper.[133] This suggests that, if similar to scheduling consultation appointments, significant gains may not occur just from better ordering of patients, but from a reduction in the work needed just to schedule a patient for a consultation.

While Weiner et al. and Haukipuro et al. mentioned training as part of their implementation of electronic tools for referrals and consultations, the specifics of that training are not noted. Heimly provided some detail as to organizational issues which must be present to implement electronic tools, in this case electronic referral of health records between hospitals and general practitioners in Norway.[134] While electronic forms of other communications, such as discharge summaries, were used substantially, electronic referrals were not. He suggested that health authorities have a strategy for cooperation, so that multiple agents are not in charge of implementing IT solutions. Recommendations for organizational problems to be addressed were also raised, given the complexity of the referral process, even excluding electronic referrals. Technical problems also must be solved, which included incompatible software packages. Staff issues were also raised by Morrison and Lindberg, who noted that studies of computerization on

healthcare jobs have not been thoroughly analyzed, and gains seen in system metrics have not been shown on staff welfare.[135] They recommended further evaluation of workplace habits to confirm that productivity from computerization is not reduced. The workload on general practitioners could be increased, which is also a worry with electronic referral. Proper management, such as completing referrals in the presence of a patient and having guidelines available electronically to determine if a patient should be referred or not (thereby reducing inappropriate referrals), is another concern that must be addressed with electronic referral.[136]

The economics of technology with electronic referrals has been little studied.[137] A gap in RCTs, long-term evaluation, and small sample sizes are key issues yet to be studied.[138] Harno et al. used a prospective study to research telemedicine in the form of an intranet email consultation for primary-to-secondary referrals in Finland.[139] They found that teleconsultation would have a net benefit of €7,876 ($13,715 in 2011 Canadian dollars), with the average referral costing €179 ($311 in 2011 Canadian dollars) more when done by paper, with in-person consultation instead of intranet email. No details of the patient population were given, so it is uncertain if a more vulnerable or unhealthy population would have the same savings.

2.13 Modelling of system changes

Several types of modelling have been used to determine the effects of system changes on medical system outcomes. Three primary types are decision trees, Markov processes, and discrete event simulations.[140] Decision trees take a population perspective, assuming patients make (or receive) decisions at certain points following branches based on those decisions to an endpoint, which could mean either successful treatment, death, or departure from the framework of the study. Markov analyses also are population-based, differing in that probabilities are

assigned to the decision points, allowing as well for transitions to different outcomes, as well as potentially staying within an outcome. Discrete event simulations follow individuals, rather than populations, through a series of events, with the chances of an event or outcome occurring depending on probability distributions.

A decision tree structure was used by Bozic and Chiu to diagram care for patients receiving care that would lead to total hip replacement versus patients receiving medical management alone.[141] Another example was by Quintana et al. to determine whether a patient with a given level of osteoarthritis should receive total hip replacement.[142] In the case of this thesis, no decisions are being made, except to estimate the effect from introducing a referral processing enhancing element. Instead, one way sensitivity analyses are run using Microsoft Excel. Running a simulation via spreadsheet using scenario analyses has been done elsewhere, for instance by Bensley et al. to simulate health outcomes from changing care pathways for cardiac care in Britain.[143] Cipriano et al. developed a discrete event simulation model (using 100 simulations) to determine how changes to surgical supply across Ontario would impact surgical waiting times.[144] They found that allocating surgeries across regions, regardless of population in each region (city or rural), would lead to greater efficiency and a greater number of patients receiving surgeries. Decreased waiting times would require a 12% increase in surgeries to cover for 8.7% increase in demand over the 10 year time horizon of the model.

Decision trees use cohorts and expected values, with no timing of steps or interactions between model variables explicitly incorporated.[145] Other models can be developed using a aggregated cohort model, an individual level model, or a model with interactions, or various combinations of these types. Interactions between different providers, introduced later, would

likely necessitate a more complex model, such as discrete event simulation or system dynamics.[146]

The simple projection model developed and used in this thesis (Chapter 7) serves only as a first exploratory step that captures the key features of an electronic referral tool to examine alternative scenarios. Scenario analyses have arisen in an effort to introduce concrete scenarios instead of abstract models to decision makers.[147] This allows for interrelationships and uncertainties to be explored without the amount of detailed information needed in other modelling techniques.[148] Scenario analyses can be used as a flexible approach when approximations are needed, and don't rely as heavily on subjective probabilities to address uncertainty in estimating results.[149] These scenario analyses are based on the referral diagrams detailed in Chapter 4, which can provide the basis for more detailed and complex modelling.

2.14 Other changes to referral processing in Canada

Few published studies have been found for current waiting time information that focuses on the interval between when a referral is made and when a surgical consultation occurs. Several models have looked at that time interval when different interventions are applied. One initiative in Ontario introduced advanced practice physiotherapists (APPs) to assist with triaging in a centralized intake setup.[150] This study found that waiting times, with the help of established benchmarks, were reduced for patients entering a joint assessment program which would lead to total joint replacement. A significant reduction of 64 days for hip and 77 days for knee patients was found in total time spent from referral to surgery date for those entering the program.

This is indicative of evidence that centralized intake can work. Other jurisdictions have implemented forms of electronic referral, which have shown positive results. An initiative in

Ontario, the Waiting Times Information System (WTIS), was implemented in hospitals around the province for surgeries and procedures such as MRIs, inclusive not just of time for surgery but also for time to see a surgeon for consultation, which is deemed Wait 1 (*T_referral* to *T_surgeon*).[151] Though times from decision to treat to surgery decreased from 11-65% (with cardiac procedures a lone category increasing by 16%), information on surgical consultations was not available.

Similar initiatives to use electronic referral and/or centralized intake have occurred elsewhere in Canada. An initiative in Calgary, Alberta, the Medical Access to Services (MAS), addressed the issue of referrals to multiple specialties.[95,152] The initiative created a single referral template, which would then be used to provide referrals from general practitioners to either centralized offices for each specialty, or for some specialties, specific surgeons. Waiting times to see a surgeon for specialties such as rheumatology and gastroenterology decreased, despite an increase in referrals seen in gastroenterology.[95] The reductions were seen in all levels of urgency, from highly urgent (reduction in 12 mean days compared to the previous referral structure) to routine cases (reduction in 47 mean days). The percentage of referrals deemed complete reached 60%, and the number of initially accepted referrals reached 80%.[153] The project, in addition to providing a common referral and centralized intake for the specialties, also resulted in changes in waitlist management, triage prioritization, and the processes used by specialties to receive patients through referrals. The study was not completed for orthopaedic specialties, and was focused on just one region, as opposed to province-wide introduction. Variations in current referral evaluation between specialists were not highlighted in detail, though changes to processing of referrals were noted. The process was not intended to be electronic either, meaning some potential changes (such as 100% completeness of referrals)

could not be tested. The proposed electronic referral tool enhancements mentioned in this thesis would address some of these concerns, with full completion of referral requirements, next available surgeon status available province-wide, and MSK triaging for hip and knee TJA.

Manitoba, through the Bridging General and Specialist Care (BGSC) project in 2008-2010, introduced an electronic referral tool for physicians, combined with evaluation and changes of current referral guidelines to send patients to specialists.[154] Feedback to physicians improved using the program, and the improvements made in the referral guidelines were noted by physicians. However, referral rates and the percentage of appropriate referrals did not change significantly, though it may be a vestige of only a two year trial period. As well, despite the electronic interface, a significant proportion of physicians did not use the electronic interface. Primary reasons given were a lack of integration with current EMR systems, limited number of specialities included, and the need to change office procedures for processing referrals. It is these procedures that will be highlighted in this thesis, showing where potential issues can arise when introducing a new referral tool, or introducing new referral processing guidelines.

Chapter Three: **Methodology**

In this thesis, the first objective was to evaluate current referral practices from referring providers to specialist MSK clinics for hip and knee pain in Alberta, as measured by three dimensions of quality of care: appropriateness, accessibility, and efficiency. The second objective was to assess the potential impact from introducing an electronic referral tool on the three outcome dimensions. To address the first objective, a mixed methods study was conducted, involving a retrospective patient chart review, time studies, and semi-structured interviews. Results from this are reported in Chapters 4 and 6. The findings from the first objective were used to inform the scenario analyses, which then addressed the second objective. The scenario analyses examined referral system enhancing elements to estimate the impact on the three outcome dimensions related to referral processing. These results are reported in Chapter 7.

The study parameters were defined using the PICO framework.[155] PICO is an acronym for Patient/Program, Intervention, Comparison Intervention, and Outcomes. Sections 3.1-3.4 will define these parameters for the research questions posed in this thesis. Section 3.5 will detail the specific qualitative and quantitative research methods used to collect data. Section 3.6 details data analysis techniques used in the results. Section 3.7 details the procedures used in scenario analyses. Details of the ethics approval for this project are provided in Section 3.8.

3.1 Patient population and MSK clinics

There are two distinct groups that are evaluated in this thesis. Patients seek care for pain that is based in the hip(s) and/or knee(s), and demand elective care that could lead to TJA. MSK clinics in Alberta supply medical therapies for hip and knee related ailments. Both are explored separately in the next two subsections.

3.1.1 Patients referred to MSK clinics

Not all patients who have hip and knee pain will seek medical care – some patients may self-treat. Each patient has a patient-specific threshold that determines when that patient will seek medical care from a healthcare provider. A fraction of patients with hip or knee pain will seek medical care through their primary care provider. The all-age prevalence of general practitioner visits in 2006 in Birmingham, England, was 1.97 per 100 people for osteoarthritis related diseases (ICD-9 code 715).[156] For 65-74 year olds, the prevalence was 7.18 per 100 people, and for 75-and-over the prevalence was 9.05 per 100 people. Patients over 65, in greater pain, and males were more likely to consult with a general practitioner and an orthopaedic surgeon regarding receiving a hip or knee TJA from a study in Ontario.[157] The pain could be for one hip joint (left or right hip joint), for one knee joint (left or right knee joint), or some combination of the four joints. Arthritis – the primary reason for hip and knee replacement due to pain – consists of 100 different conditions, which could impact more than 100 joints in the body.[40] Two arthritis types with the highest prevalence rates are osteoarthritis [OA] and rheumatoid arthritis [RA], which are described here briefly.[158,159] RA is a chronic inflammatory form of arthritis that attacks joints, and can be controlled, if not partially healed, by pharmacological therapies.[160] Patients who have symptoms of RA are seen by rheumatologists. Rheumatologists may practice

at hip and knee clinics, but will not be the focus of this study. OA, caused by deteriorating joint cartilage, has some pharmacological relief, but the deteriorating joint usually negatively impacts quality of life for patients. The hip and knee are two of the most common sites for osteoarthritis to develop, and are physiologically tied together.[33] The solution for most end-stage hip and knee OA related pain is elective total joint arthroplasty [TJA] for the hip or knee from an orthopaedic surgeon. The orthopaedic surgeon must determine if a patient has OA severe enough to warrant surgery. The referral process from primary care to an orthopaedic surgeon is intended: a) to route patients for a clinical opinion from an orthopaedic surgeon; and b) to provide information to the surgeon to help assess the patient.

The patient population was intended to represent patients living in Alberta. The location of patients varied: some did not live in the same town as the MSK clinic or surgeon; some out-of-province patients also sought care in Alberta. There was not an explicit reason given in patient records at any clinic why patients chose a specific hip or knee clinic for treatment. Reasons could include that the chosen clinic is the closest clinic to the GP or the patient, the GP knows a surgeon at the clinic, or the patient has family members nearby in case a joint needs replacement and the patient needs care afterwards. Patients are not strictly zoned to specific clinics in Alberta.

The patient population was defined as those referred to a MSK clinic because a GP or other referring provider recommended specialized assessment and/or treatment of hip or knee pain. Referring providers, as shown in Chapter 4, are not limited to GPs and other primary care providers: they also include other specialists, and potentially other orthopaedic surgeons. As a result, the term *referring providers* will be used instead of GP. The referring provider may or may not have completed a course of initial medical management on the patient. The pain may

not be of hip or knee origin, and/or may not be caused by OA. Once either a) triaged, b) seen by a clinician, and pain is determined to not be of hip and/or knee origin, these patients are defined as inappropriately referred patients, and were routed back to the referring provider or elsewhere for other specialized treatment. This will be further discussed later in the outcomes section (3.4) and in Chapters 4 and 6. The selection of charts for review is discussed further below.

Interviews with MSK clinic staff revealed that patients who either:

- have a previous relationship with an orthopaedic clinic or surgeon,
- are seeking care for a second joint (after a previous surgery on another joint),
- are seeking revision surgery on a previously replaced joint,

were processed differently than those who are being referred for a first consultation. Most of the referral steps were skipped for these patients; as a result, the focus of this thesis will be on patients who sought an *initial* consult with a surgeon.

3.1.2 MSK clinics receiving referrals

MSK clinics were standalone from hospitals, and are sites where orthopaedic surgeons and musculoskeletal specialists assessed and consulted with patients. Surgeons at these sites were assisted by nurses, occupational therapists, physiotherapists, and other nursing staff that varied depending on the clinic. These staff visited with patients and were responsible, once a patient was accepted for treatment, for orthopaedic care (and confirming the patient received other specialist care potentially necessary for further orthopaedic care) for the patient. Specific staff at each clinic determined which patients were accepted for care. Some staff, such as medical office administrators and central intake administrators, did this exclusively, while others were responsible for this on top of other duties. These included hip and knee patients, in addition to

providing some shared resources for surgeons who operated on other joints besides hips and/or knees. In Alberta, there were 11 locations where orthopaedic surgeons were located at the time of this study in 2010-2011. One site was an independent orthopaedic surgeon that does not have other staff available to receive referrals or triage patients and hence is not counted as an MSK clinic. One site was disbanded after the study period. This left nine MSK clinics in Alberta as of 2012. One site did not have a formal central intake clinic unlike the other eight clinics, but is still included as a clinic in this thesis.

The properties of each clinic throughout Alberta varied. For the thesis, three clinics were studied. Characteristics of these three MSK clinics are given in Chapter 4. These clinics volunteered through the Alberta Health Services (AHS) Bone and Joint Strategic Clinical Network (BJSCN) Hip and Knee Working Group to have their referral practices assessed to evaluate the feasibility of implementing an electronic referral tool. The BJSCN is a group of expert clinicians working with patients and families to improve the quality of bone and joint care in Alberta. Through the BJSCN, clinics cooperate and share techniques to improve specific outcome measures, both patient and system, at different stages of TJA.

The clinics that volunteered for this study possess characteristics that represent a range of clinical properties for all MSK clinics in Alberta as part of Alberta Health Services, the provincial organization responsible for health care delivery for 3.7 million Albertans. They are noted below in detail based on six descriptive attributes.

3.1.2.1 Setting

Alberta can be broken into three types of locales for the purposes of setting, matching Statistics Canada guidelines. Urban sites are clinics located in Calgary and Edmonton, which are

equivalent to census metropolitan areas (CMAs), which had a population of at least 100,000 people. Rural sites are areas with less than 1,000 people and areas that did not have at least 400 people per square kilometre. There were no towns in Alberta with fewer than 1,000 people with an MSK clinic. A slightly revised definition of a clinic located in a municipality with less than 450 people per square kilometre was used for this research to match AHS definitions of rural versus urban more closely. There are three clinics in this category which are counted as rural. Locations in between are denoted as mid-sized cities, with approximately 535 to 868 people per square kilometre, and city populations between 55,000-90,000 people. These definitions can also be applied to other Canadian locations with MSK clinics. Other provinces have similar variations in locations of surgeons and MSK clinics: British Columbia, for instance, has surgeons located in Vancouver, Prince Rupert, and Prince George – locations which match the Alberta classification.

The location of a clinic has an impact on patient access to care. A rural clinic reduces travel time for patients who do not live in cities, making it easier for patients and caregivers to attend consultations and appointments. This is an important note, as a more accessible clinic reduces the number of missed appointments for patients. Urban clinics serve an important role as well, given the large percentage of seniors (61.1%) living in urban areas, and 81.5% of seniors living in urban or midsized cities.[161] This addresses ease of accessibility for seniors – the population most likely to receive TJA.

3.1.2.2 Number of surgeons

An MSK clinic could have two setups: 1), a single surgeon practicing – when a patient went to a single surgeon clinic, they consulted with the one surgeon practicing there, and 2), a multi-

surgeon clinic, where two or more surgeons practiced. With two or more surgeons, a next available surgeon option could be offered to patients, as well as an option for a patient to select a specific surgeon among the multiple surgeons at the multi-surgeon clinic. The next available surgeon option differed operationally among the clinics (more detail is given in Chapter 4) but was tactically the same at all clinics – when consultation time became available, the first-in-line of the next available patients was scheduled for a consultation. For this thesis, the number of surgeons at a clinic, for confidentiality reasons, was grouped into three categories: 1 surgeon, 2-9 surgeons and 10 or more surgeons.

3.1.2.3 MSK screening to triage patients

During the study period, some clinics had MSK screening while others did not. This option will be further discussed in Chapter 4. Briefly, MSK screening is when a patient is assessed by a trained clinician before consulting with the surgeon. MSK screening serves as an intermediate step assessing primarily low and medium acuity patients. These patients are assessed surgical, medically manageable, or not treatable at the clinic. Patients whom are assessed surgical are then routed for a surgical consultation with an orthopaedic surgeon. MSK screening triaged patients to determine who was of high severity and needed a consultation quicker. This characteristic will be noted when analyzing accessibility measures.

Clinics with MSK screening currently exist in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, and Nova Scotia.[162] However, MSK screeners do not exist at every clinic where orthopaedic surgeons practice in those provinces, as will be noted for Alberta in Chapter 4.

3.1.2.4 Connectivity between clinics and surgeons

This characteristic measured how well and how much surgeons and MSK clinics interacted with each other. The categories were high, moderate and low integration. This connectivity variable was a qualitative judgment based on observation at each clinic. Surgeons did not exclusively practice at each clinic – some surgeons maintained standalone offices and referred hip and knee patients to the clinics. The MSK clinic and the surgeon's office maintained contact for transfer of patient records and scheduling of the patient and surgeon. Office staff had varying degrees of connectivity, ranging from being in the same building to using the same paper or electronic records. This tied into the number of surgeons, as connectivity between the surgeons meant that a next available surgeon option could be given. Surgeons whom were not connected did not share patient lists, though other reasons may exist for why surgeons do not share patient lists.

3.1.2.5 Complexity of patients

The complexity of patients at each clinic varied, as some could handle all complexities, and some could handle only low complexity patients. Complexity is defined by American Society of Anesthesiologists (ASA) categories, which were intended to predict mortality and morbidity. For Clinic 2, ASA category level 1-2 patients (low complexity) were seen; the other two clinics had no restrictions in terms of complexity. These categories are:

- Level 1: healthy patients,
- Level 2: patients with mild systemic disease,
- Level 3: patients with severe systemic disease,
- Level 4: patients with systemic disease that is a threat to life.

The complexity category also explicitly accounts for obesity, as will be noted in Chapter 4. Clinic 2 was located at a site where obese and complex patients could not have surgery at the local hospital. These patients were routed through various means to other MSK clinics.

3.1.2.6 Degree of electronic use

This is a qualitative measure, accounting for the degree of electronic recordkeeping used at each clinic. Electronic records during referral processing were the only item analyzed by this measure – usage for other aspects, such as clinical consultation and surgical records were not tracked. The categories were less advanced, moderately advanced and very advanced:

- Less advanced: most records were kept on paper, with staff transferring folders of paper to track patients,
- Moderately advanced: most processing was done with electronic records, though paper records were still used for some essential tasks in processing,
- Very advanced: all processing, with the exception of initial receipt of records from the referring provider, was done electronically.

These three volunteer MSK clinics represented approximately one-third of hip and knee referrals in Alberta: approximately 6,000 of 18,000 referrals in 2011. Representativeness of the sample to all nine hip and knee clinics in Alberta cannot be guaranteed with this sample. However, the three MSK clinics, though, reflected the range of variation in the six clinical characteristics as noted above and further detailed in Chapter 4. These findings are likely representative of hip and knee referral patterns and triaging before a surgical consultation when compared to other Alberta clinics, other provinces in Canada, and other healthcare systems worldwide. This is a reasonable representation of the range of clinic types in Alberta. With other jurisdictions, results should be

interpreted in the context of limitations mentioned in Chapters 4 and 8. The specific steps in referral processing (such as what is required for a referral to be accepted, or what triaging is done upon acceptance of the referral) could be different in other jurisdictions. The overall process, though, is the same: a patient must move from primary to specialist care, with information for that transfer provided on a referral.

3.2 Intervention – the current state of referral processing in Alberta

Alberta currently has a system of referring providers, including GPs as well as orthopaedic surgeons and other specialists who refer to other orthopaedic specialists, who first see patients seeking therapy or relief from pain, such as hip and knee pain. Medical management therapies, including physiotherapy, walking aids, pharmacological therapies, and weight loss or gain plans, could be recommended by the referring provider. If those therapies were exhausted, or the practitioner wished to seek further opinion on the hip or knee pain before (or during) medical management, the referring provider would refer the patient to a specialist. For hip or knee pain, the patient was routed to an orthopaedic surgeon. Most surgeons in Alberta sent hip and knee patients to specific MSK clinics, which are multidisciplinary centres where patients could receive care pre-consultation, such as an MSK assessment, through to a surgical consultation, through to pre-surgical preparation and post-surgical follow-up. TJA procedures took place in hospitals located in the town of the MSK clinic, and not within MSK clinics themselves.

Orthopaedic surgeon(s) practiced within one specific clinic, and did not practice at multiple clinics. Each MSK clinic had distinct methods for processing referrals that were similar to other clinics, though not exactly the same. Referrals were processed and patients triaged to medical management or a surgical consultation at all clinics, but techniques to complete these

steps differed at each of the clinics surveyed. This is described in greater detail in the clinic-by-clinic descriptions in Chapter 4.

3.3 Comparator – A proposed referral intervention: The NO WAITS electronic referral tool

To address concerns with the referral system, such as incomplete tracking of consultation waiting times, high percentages of incomplete and incorrectly directed referrals, and clinic staff time needed to process these referrals, Alberta has considered introducing an electronic referral tool. One electronic referral tool has been proposed in The New Opportunities to Reduce Unnecessary Waiting for Hip and Knee Arthroplasty through Information Technology Systems [NO WAITS] project (Appendix B). This project was introduced as a potential answer to these multiple referral issues. Patients who chose to wait for specific events in treatment were not tracked by either AHS or Alberta Health and Wellness (AHW), the two main bodies for health care in the province. Electronic alerts were not systematically available across the province, which would allow for referring providers and orthopaedic surgeons to monitor the waiting time of a patient, and take action if the waiting time approached a threshold benchmark, which for surgery is currently 26 weeks, to be reduced to 14 weeks by 2015. For surgical consultations, benchmarks have been set so that a referral is accepted within 4 weeks by 2015.[54] Waiting queues across the province were not tracked from one source, meaning "gaming" of the system by scheduling a patient in multiple MSK clinics could have taken place.

The NO WAITS electronic referral tool proposed to address these issues. An electronic messaging system would be implemented, allowing referring providers to electronically send records to MSK clinics. Referral information would be filled in online using a standardized

referral template, forcing completion of all MSK clinic requirements, including whether a patient was being referred for a hip and knee issue to a hip and knee clinic. Electronic mail would be used to communicate between providers, and reminders would be provided to medical specialists if waiting time benchmarks were passed. A single point of record would then be used for all further transactions, including surgeries, follow-up visits, medical management, and rehabilitation.

An electronic referral tool would also force recognition of clinical care pathways. These pathways have not been made explicit before beyond working documents, and this thesis intends to highlight where variations occur in referral processing, which can then be incorporated into any provincial wide referral tool. These variations can be reduced in part by using consistent waiting time measurement standards, which are established by the Alberta Wait Times Rules. The Wait Times Rules set a defined list of timestamps to track the progression of a referral and a patient from when a referral is made through to surgery (Chapter 5).

The end goal would be to reduce waiting times for surgical consultations, and reduce the number of incorrectly directed or incomplete referrals received. By improving the appropriateness of referrals arriving to the MSK clinics, waiting times could be reduced, improving accessibility for patients. These outcomes are discussed in the next subsection, while the impact of an electronic referral tool being introduced is discussed in the scenario analysis methodology in Section 3.7 and Chapter 7.

3.4 Outcomes for measuring referral system performance

The Alberta Bone and Joint Health Institute (ABJHI), Alberta Health Services (AHS), various physicians in primary care, and MSK clinics and orthopaedic surgeon all had different internal

measures used to measure system performance for processing referrals. Steps have already been made to standardize these measures through initiatives such as the Alberta Wait Times Rules, discussed further below. Further steps can be taken to improve tracking with the implementation of the Wait Times Rules. An electronic referral tool would measure these times consistently, and in addition ensure that a referral would have enough information to be processed by an orthopaedic surgeon. Changes from this tool would primarily impact the workflow and the processing of referrals. As a result, system-based outcomes were chosen for analysis in this thesis.

The basis for the health outcome measures was a quality report published by the Institute of Medicine in the United States.[17] This report set out to establish specific measures for health care measurement, primarily from a patient perspective but also from a health system perspective. This was adopted by the Health Quality Council of Alberta into a six variable quality of care matrix to organize and measure, using a common language, components of the health care system.[13] The Alberta Quality Matrix for Health provides outcomes that measure different areas the patient encounters in the healthcare system (Appendix D). In consultation with researchers at ABJHI, and confirmed by initial clinical interviews, three system variables were chosen to measure the effectiveness of any referral processing tool. These measures were accessibility, referral appropriateness, and efficiency.

3.4.1 Accessibility

Accessibility was defined by the Alberta Quality Matrix as "health services [which] are obtained in the most suitable setting in a reasonable time and distance."[13] Distance could not be changed, as the mandate of this project did not allow for additional sites to be added, which would

increase ease of access for patients by cutting travel distance. The one exception was to determine if patients had easier access in another city, they could then access this city. This became the basis of including access, via a next available surgeon option, to surgeons across the province as a system measure. This is a scenario analyzed in this thesis (Chapter 7).

The timing of patient events was deemed an important factor, given the lack of previous guidance in the literature. Inconsistent timing definitions had also led to issues comparing clinical performance in internal ABJHI studies. As a result, specific waiting time rules were developed by ABJHI, in conjunction with AHS, and were endorsed in 2010 for use across the province by the Alberta BJSCN (Chapter 5 and Figure 3). The previous standard had previously been clinics using their own internal definitions, which though similar to each other had varied slightly. Consistent waiting times tracked by the clinics therefore allowed comparison of times for quality purposes across the province.

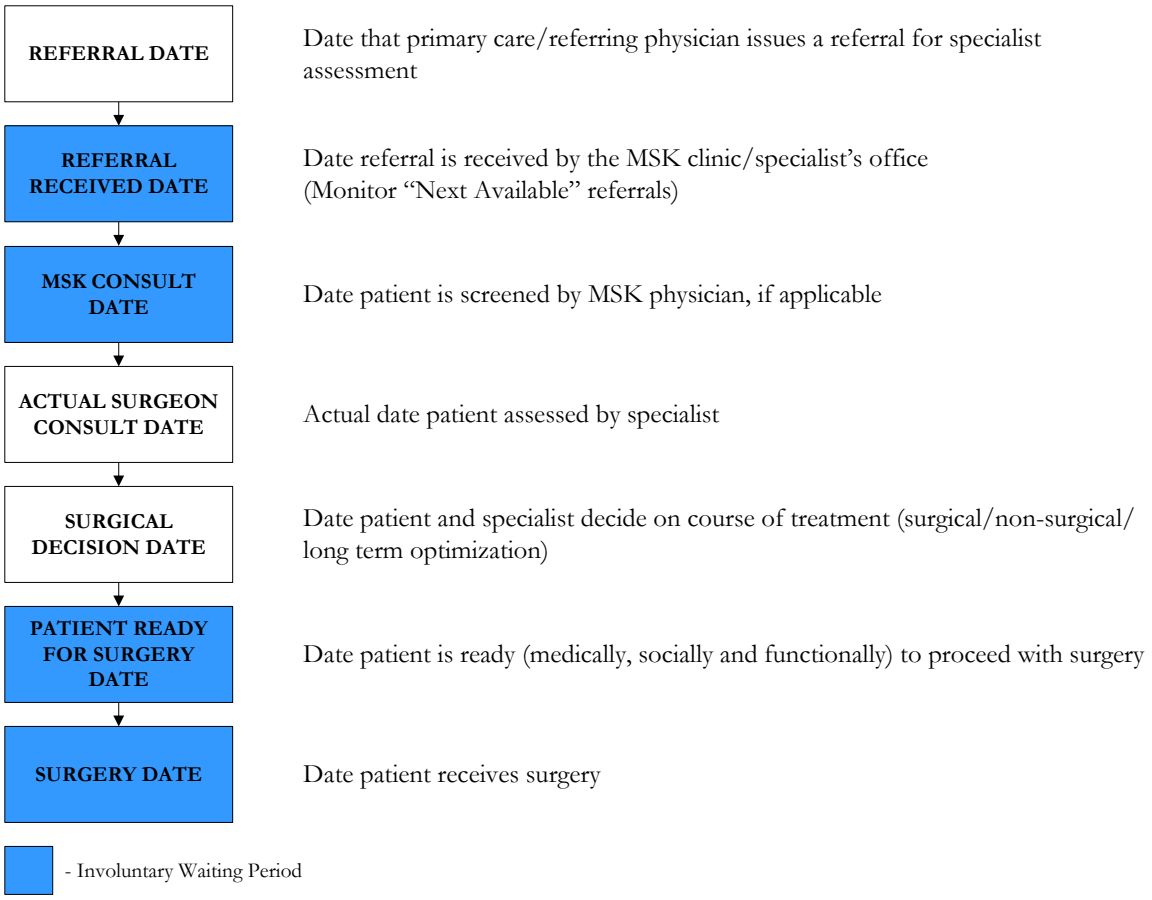

Figure 3: Alberta Bone and Joint Health Institute produced steps for waiting time (adopted from Alberta Bone and Joint Health Institute)[163]

These times, noted in Figure 3, give consistent guidelines to referral processing and patient care up to surgery. Through the consultation date ("actual surgeon consult date", *T_surgeon*), specific definitions used in the information collected from the clinics were:

- **Referral date** (*T_referral*): The date a written referral was produced (not dictated) by the referring provider. This was the same at all three clinics.
- **Referral received date** (*T_received*): The date a written referral was received via fax by the clinic or orthopaedic surgeon. This differed slightly at each clinic. This usually was

the date on the faxed referral form. Depending on the clinic, if the fax date was not available or in error, it is recorded as either the date on the referral note, or the date the referral is processed at the clinic.

- **Completion date** (*T_complete*): This date is not on the Bone and Joint Clinical Network times, but was noted during the research to be an important date for referral processing. This was the date a referral was deemed complete and correctly directed, and accepted for consultation at the recipient clinic. If a referral was not accepted for consultation, the patient could go no further in the referral process. Incomplete referrals would be stuck at this point until action was taken either to provide information that would lead to acceptance, or to remove a patient referral at this step.

  As well, this date was critical because the patient had no control over any process occurring before this step. The acceptance of a referral depended only on information sent by the referring provider, and received by the clinic. These two factors together led this to be added to the list of time stamps tracked in the thesis.

  These differed by clinic, however, due to availability of information, and hence will be measured differently when reported in the thesis:

  - For Clinic 1, the date an acceptance notice was sent to the referring provider.
  - For Clinic 2, the date the referral was screened, all required elements were present, and was sent to the surgeon for evaluation.
  - For Clinic 3, the date the referral was evaluated by a clinic administrator and scheduled for a consult or MSK screening.

- **MSK consult date** (*T_MSK*): The date a patient was physically assessed by an MSK (musculoskeletal) physician. This was a visit intended to determine whether a patient

was a surgical candidate or was nonsurgical. Several factors determined what the outcome of this process was. The physician itself varied depending on the clinic, ranging from a retired surgeon, to a practicing surgeon, to a medical practitioner trained to assess patients.

Availability was important, as is noted above on the clinic characteristics. At clinic 2, the patient did not visit with the orthopaedic surgeon or other specialist for the screening. Instead, the surgeon evaluated the referral alone and determined if the patient was potentially surgical. The other clinics had an MSK screening which the patient attended in person.

The outcome of these visits would be a recommendation for a surgical consultation, a recommendation for medical management, or long-term optimization that would lead to consultation in the future. Definitions for these terms are given in the Appendix A.

- **Consult date** (*T_surgeon*): The date a patient attended an orthopaedic surgeon's assessment. The outcome from this visit would either be a recommendation for surgery, a recommendation for further medical management, or referral back to the referring provider. Definitions of each are given in the Appendix A.

In addition to timing, an additional variable included was the percentage of patients who had next available surgeon selected on their referral form. One limitation in the charts was the information compiled from the referral forms was limited, leaving it unclear whether the patient wanted next available, whether the referring provider wanted next available, or whether a decision was made in agreement with the two individuals. However, having this option selected implied that the clinic should make a best effort to schedule a patient as soon as possible. It was

tracked to determine how much demand there is by patients to receive access to a surgical consultation as quickly as possible.

The next available option varied depending on the clinic, as noted in Chapter 4. With patients who waited for a long time that was not consistently defined, Clinic 1 gave a second opportunity for patients who had selected a specific surgeon to select the next available surgeon. This added some patients to the next available list, and could not be separated from those originally choosing the next available surgeon option.

3.4.2 Referral appropriateness

Appropriateness in the Alberta Quality Matrix was defined as providing "health services… relevant to user needs and… based on accepted or evidence-based practice."[13] For this thesis, appropriateness was defined as whether the specialist is providing the correct care to the patient, once that patient is referred to the specialist by a referring provider. A patient referred to an orthopaedic surgeon should be in need of treatment that can be provided by an orthopaedic surgeon: this is correct care. How this can be determined by an orthopaedic surgeon is based upon evidence-based practice: specialists need complete and thorough information on a referral about a patient to decide how to triage a patient before a consultation. The only information a specialist has about a patient comes from the referral package. How clinics handle the referral package from a referring provider, both whether the information is present in a referral form and whether the referral has been sent to a specialist who can treat the patient, is the basis of *referral appropriateness*. This differs from *patient appropriateness*, which is decided only after a surgeon consults with a patient. *Patient appropriateness* should not, and cannot, be determined from referral processing, which was primarily done by central intake administrators and nurses.

Each clinic has different rules for determining if a referral is appropriate; this is detailed in Chapters 4 and 6. In essence, each clinic asks whether each referral was complete and correctly directed. This was defined as:

- Complete: A referral package had all elements completed accurately and included to allow for evaluation and further processing. As will be noted in Chapter 4, required referral elements differed among the clinics. The referrals from each clinic are checked to confirm that they have the required element, and a percentage of all referrals with that element were calculated to calculate the percentage of referrals complete with that specific element. If an X-ray was required, the correct x-ray was sent as an attachment to the referral or could be accessed online.

  In addition to the clinic requirements, completeness was defined in terms of the referring provider filling out a template fully. In this case, the ABJHI Referral Template, given in Appendix C, gives a guide to information that, if fully completed, would allow any orthopaedic specialist in the province to have the information needed to complete a proper evaluation of the referral. This was estimated as the percentage of all referrals which fill out every element in this template.[4]
- Correctly directed: A referral was sent to the proper specialist who could treat a patient. Also noted in Chapter 4, and in the characteristics of each clinic, some clinics handled specific cases while not handling other cases. This included both the reason for being sent, such as the type of joint (hand, foot, hip, knee, ankle), and the complexity of the joint (revision) or the patient (high complexity or low complexity). If a clinic could not

handle the specific patient, the referral would then be sent back to the referring provider to be forwarded to another clinic, and it was deemed denied. These could include cases such as spinal issues or RA. The percentage of all referrals that were denied were estimated for each clinic and reported in the results.

Referral appropriateness focuses more on the information a referring provider sent to the clinic, and is not directly related to the clinic or specialist surgeons. Repeated incomplete or incorrectly directed referrals, though, suggested that information on clinical requirements was not getting to referring providers. This had an impact on both the waiting time of patients, and on the third outcome measure, efficiency.

3.4.3 Efficiency

The Alberta Health Quality Matrix defined efficiency as "resources [that] are optimally used in achieving desired outcomes."[13] For referral processing, these resources were primarily the usage of office resources – specifically clinic staff time – by MSK clinics to accept a referral, deal with referrals that were not initially accepted, and triage patients based on referral information. This thesis just analyzes clinics; referring providers will be ignored. When a referral arrived at an office, several tasks were completed by MSK clinic staff. These tasks differed by office, and are detailed in Chapters 4 and 6. Tasks were organized by general category, as noted in the time study detail below. The use of this outcome aimed to judge resource utilization, in terms of staff time, in a variety of referral processing tasks.

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[4] The ABJHI template has changed over time; however, a form of the ABJHI template (with some elements changed) was available for the entire timeframe of incoming referrals to the pilot clinics.

3.5 Methods to answer the research questions

Both qualitative methods such as semi-structured interviews, and quantitative methods such as analysis of referral information from the MSK clinics, time studies, and scenario analyses, were used to inform the framing of the analysis, quantitative estimates, and to answer the research questions listed in Section 1.3. The first research question was answered by interviews, the analysis of referral information, and time studies. The second research question was answered by scenario analyses, which were used to estimate referral process enhancements listed in Section 1.3 and are described further in Section 3.7 and Chapter 7. The analysis plan included three distinct steps:

- Semi-structured interviews. These were done at initial clinical meetings with medical office administrators and nurses to plot referral processes and determine data availability. This allowed for development of referral process maps, and the choice of outcome measures for analysis.
- Patient chart reviews. Design and use of a data extraction form to conduct patient chart reviews for referral information. From the semi-structured interviews, determination of data availability for variables regarding referral processing was completed. This resulted in a data extract form (Appendix E) used to estimate accessibility and referral appropriateness measures. This information was then extracted from a pseudo-random sample of patient charts at each clinic.
- Time studies. These studies evaluated and estimated the use of staff time. This step timed central intake administrators, nurses, and clinic administrators at each site in tasks related to referral processing. This informed efficiency measures. Follow-up interviews took place immediately following the time studies.

Details of each part, including the methods of each part and the output, are listed below. Data analyses (Section 3.6) and scenario analyses (Section 3.7) followed to conclude the study.

3.5.1 Semi-Structured interviews

A high level generalized outline of referral processing steps at the clinics had been previously discussed at ABJHI. This information was used to build basic, introductory decision trees to describe referral processes, starting from the first visit to a GP through to surgical consult.

An effort was made to be complete with these trees, meaning that different patient and medical factors were considered and all possible decisions and outcomes were considered. Pathways included patients seeking second surgeries, patients arriving from different sources, patients receiving medical management, and patients receiving intermediate assessment, which will be detailed in Chapter 4. The first of two main purposes of these diagrams – one for each clinic, and an idealized referral structure that incorporated electronic referral – was to spark discussion among clinical staff with regard to accuracy and completeness, and to receive comments on what each clinic would want in a revised referral structure. This would ensure face validity of the analysis. The second main purpose was to represent the complete set of paths a referral can follow as it is processed at a clinic. Each path then was populated with data on the number of individuals at a specific point, the time spent at a specific point, or the percentage of patients taking a specific path. This would provide the information necessary for analysis.

The initial plan for the visits was to determine what was currently occurring regarding referral processing at the clinics, what information was currently being collected regarding referrals, and what should be incorporated into an electronic referral tool. This involved taking the draft documents and diagrams produced in association with ABJHI and going to each clinic,

meeting with the central intake administrator at each. At these visits, the diagrams were gone through step-by-step, with opportunities for revisions and comments from the administrator. Following this was a semi-structured interview, which asked detailed questions about each clinic and referral processes at the clinic. Sample questions for the semi-structured interviews appear in Appendix F.

Following the initial clinical visits, the referral trees were revised based on clinic input. This was done in conjunction with the thesis advisory committee and with ABJHI. Study outcomes at this point were decided, and were detailed earlier (Section 3.4). Further preparation for clinical visits was completed, and the decision was made to extract data from clinical charts and complete further detailed visits to the clinics, specifically using a time study.

3.5.2 Data extraction from patient charts

As mentioned above, it was decided to complete a data extraction form for patient charts at each clinic. This form would be used to extract information on waiting time estimates, what was completed on the referral template or letter, and the triaging completed on the patient. For this to occur, a data extraction form (Appendix E) was designed. The design centred on the referral maps created beforehand, and retrieved information related to referral processing. The form was broken into several parts, roughly in line with the order of processing a referral:

- Information on the patient was collected, including the joint causing the referral;
- Initial information on who sent the referral, when, and when the referral was received was collected;

- Whether the referral was initially accepted, denied, or was pending then followed, along with a reason for that status[5];
- Information included on the referral form itself was then noted, along with any information about nonsurgical treatment provided by the referring provider, and whether the patient (or referring provider) explicitly accepted a next available surgeon option, if chosen or given;
- If an MSK screening took place (detailed further in Chapter 4), information on the date on recommendations for nonsurgical therapy were collected;
- The time and recommendations from a surgical consultation with an orthopaedic surgeon were then collected;
- Information on any activity that occurred afterwards, such as the decision to date, pre-surgical medical activities, and surgical dates, was collected.

This information is then aggregated by clinic. The number of charts collected was chosen to meet hypothesized changes if a referral tool is eventually implemented, specifically:

- Increasing the number of initially accepted referrals from 65% (an *a priori* estimate) to 99%;
- Reducing waiting times from when the referral was made to when the surgical consultation occurred by 10%.

For these two changes to be tested with statistical accuracy, approximately 210 charts were required. Reviewing at least 210 charts would meet a goal of 80% power, which is equivalent to Type I error: where the null hypothesis (of no change in either of the two hypotheses above)

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[5] Explanations of these statuses varied slightly by clinic, and will be given in the Chapter 4

would be incorrectly rejected, and a goal of 5% for Type II error: where the false null hypothesis (of no change) is rejected. In the end, a total of 218 charts were collected.

3.5.3 Time studies and follow-up interviews with clinic staff

Time studies were completed at each clinic to provide information that was not recorded in patient charts. Two staff members at each clinic were selected for the study: one clinical office administrator and one triage nurse. This included tracking referrals as they arrived, which allowed an estimate of the number of incorrectly directed referrals that could not be obtained from chart extracts.

To complete this, the researcher listed the time, an anonymous identifier to identify separate referrals, the activity that took place, and the duration of the activity. Afterwards, the activities were coded in a spreadsheet. These were then combined into categories, which included:

- Evaluation of referral for completeness and determining if the referral is accepted, denied, or pending for further information,
- Entering of the referral information and triage information into the clinic EMR,
- Feedback to the referring provider (including phone calls to and from the referring provider regarding patient status),
- Electronically scanning records into the clinic EMR.

All referral processing steps are covered by these four categories. Each clinic would have the lead central intake administrator time tracked, and one other staff member – a nurse at Clinic 1, a surgeon's administrator at Clinic 2, and a scheduling administrator at Clinic 3 – tracked.

After the time studies were completed, follow-up non-structured interviews occurred with the clinicians observed. Questions were asked regarding workload, what-if scenarios for different referrals, and further clarification questions based on the patient charts and initial interviews. This was due to full information, specifically regarding inappropriate referrals, not being collected at any time in the data extraction process.

Once analyses were prepared, a visit was made to the clinics to confirm the results and findings. This gave the clinics an opportunity to comment and provide clarification and revisions as necessary. The full data analyses were shown to the clinics, along with summary statistics (Chapters 4 and 6) in a powerpoint presentation. Feedback was then incorporated into the final versions of each chapter.

3.6 Data analysis

Statistics estimated included the mean, median, and 90th percentiles for waiting times, and percentages of referrals for next available surgeon selections, complete and correctly directed referrals, and MSK screening options and results. 90th percentile waiting times are used throughout Alberta, and are used in benchmark waiting time goals, and were estimated using Stata 11. The Stata algorithm for computing percentiles is searching until a value satisfies $Pr(X \leq C_{90})=.9$, where the 90th percentile of a continuous random variable X is C_{90}. Means and medians, on the other hand, help to inform the distribution of waiting times, and present what the average patient (or the patient at the 50th percentile) face, opposed to a "worst-case" scenario of the 90th percentile. For efficiency measures, the average time per referral was estimated based on the time studies.

The denominator for the percentage measures, unless otherwise mentioned, was the number of referrals sampled – which included referrals which arrived both correctly and incorrectly directed.

3.7 Scenario analysis methodology

As noted in the last four specific research questions in Section 1.3, there are specific elements of referral processing that, if improved, could impact accessibility, referral appropriateness, and efficiency. These potential changes were estimated using scenario analyses. Using one-way sensitivity analysis, an estimated impact was measured on key system outcomes from changes that might result with improvements to the referral system, such as the introduction of an electronic referral tool. The subsections below detail comparator data (Section 3.7.1) which was used with Alberta clinic data collected (Section 3.1) on three system metrics (accessibility, referral appropriateness, and efficiency, as mentioned in Section 3.4), how the scenario analyses were chosen (Section 3.7.2), and the development and design of scenarios used in the analyses (Section 3.7.3). These steps approximately follow Hsia et al.'s practices for scenario analyses.[164]

3.7.1 A Comparator with Alberta: Hamilton Niagara Haldimand Brant LHIN

Data for providing comparator estimates of the analyses was courtesy of the Regional Joint Assessment Program (RJAP) in the Hamilton Niagara Haldimand Brant Local Health Integration Network (HNHB LHIN) in Southern Ontario.[150] Primary care providers referred patients with hip and knee pain and disability to one of three multidisciplinary clinics for review and triaging, with patients requiring surgical consult given a next available surgeon option. This is similar to the proposed referral system for Alberta. The referral was first assessed by clerks who obtained

complete referral information from referring providers. Once accepted, advanced practice physiotherapists (APPs) took the lead as case managers in assessing patients, directing care and evaluating the appropriateness and acuity of the patient at the clinic. All patients were evaluated by the APPs: acute patients were forwarded onto orthopaedic surgeons for surgical review. The goals were to reduce surgical consultation waiting times and to decrease the number of inappropriate referrals seen by a surgeon.

The 700,000 person region had a central intake clinic and advanced nurse practitioner triage structure introduced for TJA. Approximately 2800 people per calendar year were referred to the RJAP, which was started in 2007. Hamilton data from April 2009 through September 2010 were used as a reference comparator for the Alberta program: referral enhancements in Hamilton had been fully implemented by 2009, and the outcomes from the RJAP serve as a target reference point for implementation of the referral process enhancements in Alberta. Hamilton clinic information was extracted regarding waiting times, the percentage of patients attending a screening prior to a surgical assessment, the percentage of patients receiving surgical assessments from an orthopaedic surgeon, and the percentage of referrals with next available surgeon selected, as listed in Chapter 7.

3.7.2 Development and design of scenarios

Four scenarios were designed for testing in the scenario analyses: province-wide next available surgeon, standardized referral forms, MSK screening, and separation of voluntary from involuntary-related waiting times for consultation with an orthopaedic surgeon. These scenarios represent potential referral system elements which, incorporated into an electronic referral tool, would reduce waiting times via increased patient choice, more accurate referral information from

the referring provider to the specialist, increased number of patients that are screened (and hence triaged), and more accurate waiting time measurement. These scenarios were created in consultation with project analysts and managers at the Alberta Bone and Joint Health Institute (ABJHI), which evaluates bone and joint practices in Alberta. These scenarios were discussed with clinicians in semi-structured interviews for face validity regarding their applicability to their practices. Scenarios included:

- Scenario 1: Next available surgeon option. This option, given on standardized referral forms in Alberta for hip and knee TJA referrals, provides patients and referring providers the choice of receiving a consultation (leading up to potential total joint arthroplasty) with the next available surgeon, as opposed to choosing a specific surgeon for the consultation. Patients who do not choose next available or select a specific surgeon were automatically given the next available surgeon option at all clinics.

  A proposal exists to expand this option to a provincial-wide next available surgeon model. If family support is available for a patient through follow-up care, the patient should be allowed to choose any clinic across Alberta. With an electronic referral tool tied into EMRs and MSK clinic scheduling systems, waiting times for each clinic and surgeon would be provided to the patient and referring provider, facilitating the choice of clinic. Full access of waiting times is likely to lead a proportion of patients to choose a next available surgeon. This would potentially lower waiting times across Alberta. This is quantified by the current difference between those who specified a specific surgeon and all other patients.
- Scenario 2: Fully completed and standardized referral forms. Processing rules for patients at clinics vary, such that referring providers frequently provide incomplete or

incorrectly directed referrals. As a result, clinic staff are burdened with the need to retrieve the appropriate information to process a referral, increasing patient waiting time. With an electronic referral tool, requirements for each clinic or each specialty could be highlighted on a standardized form. A referral could not be submitted to the specialist without having all required elements complete. Though this would not eliminate all errors, such as incorrect x-rays, it would markedly decrease omissions and errors on referral forms. Waiting times for surgical consultation will potentially be reduced. This is quantified by the current difference between initially completed accurate and initially incomplete referrals.

- Scenario 3: MSK screening of patients for triaging. Staff at MSK clinics who do not have MSK specialist screeners (APPs, nurses, or surgeons) who assess patients (primarily non-urgent, lower-grade osteoarthritis patients) are compelled to triage patients for treatment based on referral content and supporting documentation. This potentially leads to inconsistent triaging depending on referral quality, and as a consequence to nonsurgical patients unnecessarily waiting for a surgical consultation instead of receiving prompt medical management.

  With an electronic referral tool, standardized referral forms would contain urgency questions that are derived from the validated Western Canada Wait List consultation urgency questionnaire for hip and knee arthroplasty. This information can provide clinics the information to properly triage and determine the urgency of a patient.[116] Combined with increased usage of clinic MSK screeners, it is expected that unnecessary surgeon consultations would be reduced. This would decrease waiting times for patients assessed surgical or deemed urgent, enable immediate routing to surgeons, and provide surgeons

more time with complex patients and for surgeries. This is quantified by the difference in waiting times between patients who attend an MSK screening before a surgical consultation and patients who attend a surgical consultation directly.

- Scenario 4: Voluntary versus involuntary waiting time. Currently, waiting time is not divided and measured between voluntary and involuntary causes. Voluntary delays are patient-related causes of waiting such as personal and social reasons that lead the patient to choose to delay treatment or a surgical consultation for hip or knee pain. Involuntary delays are system-related causes where a patient is not choosing to delay treatment for hip or knee pain, for example caused by system delays where a referral was incomplete or incorrectly directed to a specialist office which could not treat the patient, or a clinical delay, where a patient could not proceed with a surgical consultation due to the need for a patient to first receive treatment from other clinicians.

  An electronic referral tool would be able to classify these delays, and track when and why patients choose to voluntarily delay treatment. These times would then be separated from system-related causes, leading to a more transparent understanding of the causes for waiting times, and the ability to target system interventions to reduce waiting times more accurately. This is quantified by estimates of the current percentage of current delays which are voluntary-related.

3.7.3 Computation of scenario analyses

Four scenarios were developed, as mentioned in the previous section. Each scenario required inputs and a choice of output(s). Each input was related to the estimated change listed in the scenario. Estimated parameter inputs were discussed and chosen by the researchers using input

from clinicians and health research analysts at ABJHI. In each scenario, one of the inputs was a value representing the current Alberta state. Each output(s) was (were) related to the metrics derived from the three quality dimensions mentioned in Section 3.4. Both mean waiting time and 90th percentile time (the time in which 90% of patients were seen by) were reported.

For each scenario and the respective inputs, one-way sensitivity analyses were used. These took current system data from each clinic surveyed, and weighted them by the percentage of all Alberta hip and knee referrals seen each year. For instance, of approximately 18,000 Alberta referrals seen, Clinic 1, representing urban clinics, was linearly weighted by 9000/18000 (the estimated number of referrals seen at one urban clinic multiplied by two of those clinic types in Alberta, divided by the total number of referrals in Alberta). This weight was then applied to all inputs and outputs.

Using Microsoft Excel, the weighted inputs were then used to calculate the changes in each output. Each scenario used the finding that there were a percentage of patients at each clinic which had gone through the scenario already and a percentage which had not gone through the scenario. These values for each choice were then weighted to produce a province-wide estimated, weighted output(s).

Data from Hamilton were used in two ways. First, an input value was used which approximated the current situation in Hamilton. This produced a comparator result which showed how, with Alberta implementing a program similar to Hamilton, the output(s) would change from the current Alberta state. Second, these newly estimated output(s) could then be compared to the current Hamilton output statistics, to see how wide the estimated variations between the Alberta estimates and the current Hamilton output statistics are. Hamilton, in

essence, serves as a benchmark for estimating how Alberta might gain using an electronic referral tool.

3.8 Ethics

Ethics approval was received from the Conjoint Health Research Ethics Board at the University of Calgary (ethics number E-23601). The Principal Investigator was Dr. Deborah Marshall, and approval was received in March 2011 and renewed in March 2012.

Chapter Four: **Analysis of MSK Clinics**

Following the methodology outlined in Chapter 3, the three pilot clinics chosen were analyzed. Referral processes at each clinic were documented, informed by semi-structured interviews and time studies of clinical staff. The referral process diagrams for each clinic are the result of these steps. A concurrent review of patient referral records was undertaken. Accessibility and referral appropriateness results were estimated from these records. Efficiency measures were also estimated using the time studies.

MSK clinic characteristics are given in Table 4. The clinics which volunteered for the study provide some degree of representativeness for comparison to other Alberta MSK clinics, as noted by the variation in these characteristics. Specific definitions for these characteristics were given in Chapter 3.

Table 4: Alberta MSK clinic pilot site characteristics

	Setting	Number of surgeons	MSK option available	Connectivity between surgeons and clinics	Complexity of patients	Degree of Electronic Use
Clinic 1 ~4000-5000 referrals per year	Urban	Multi-surgeon (10-20)	Yes	Highly integrated	Handle all complexities	Very advanced
Clinic 2 ~200-400 referrals per year	Rural	Single-surgeon	No	Moderate integration	Low complexities	Moderately advanced
Clinic 3 ~400-600 referrals per year	Midsized city	Multi-surgeon (2-9)	Yes	Moderate integration	Handle all complexities	Moderately advanced
Alberta Total ~18,000 referrals per year	2 Urban 4 Midsized city 3 Rural	6 Multi-surgeon 3 Single-surgeon	-	-	-	-

The analyses chapters are outlined as follows:

- Chapter 4 looks at each MSK clinic individually. Clinical properties are noted, followed by a description of referral processing. Results are given related to referral appropriateness, accessibility, and efficiency. The end of each clinical section contains referral path maps.
- Chapter 5 highlights the development and implementation of standardized Wait Times Rules for Alberta. Standardized rules allow for consistent accessibility outcome measurement across clinics. This manuscript also is relatively rare in that *T_referral* to *T_surgeon* waiting time is highlighted in addition to surgical waiting time. This manuscript is currently in press at Longwoods Healthcare Quarterly, and is authored by Deborah Marshall, Tanya Christiansen, Christopher Smith, Jane Squire Howden, Jason Werle, Ken Fyie, and Cy Frank.
- Chapter 6 is a summary of the three primary outcomes mentioned in Chapter 3, with highlights of the analyses – a generalized referral processing guide to all three clinics and statistics related to the three outcome measures as referenced in Chapter 4 – plus discussion related to other studies.
- Chapter 7 presents the results of the scenario analyses using the four scenarios listed in Section 3.7. Potential electronic referral enhancements are discussed in this chapter.

4.1 Clinic 1

4.1.1 Characteristics of clinic 1

Clinic 1, as noted in the methodology (Chapter 3), is located in an urban centre. It is a multi-surgeon, highly integrated hip and knee clinic, which is able to handle patients of any

complexity, including revisions. The clinic was technologically advanced, with incoming referrals scanned in, and paperless records used in all subsequent patient and between-surgeon interactions. Patient records were recorded on an EMR, and this EMR could be accessed by the central intake administrator, nurses, surgeons, and clinical administrators. Changes any of those staff members make to the EMRs were instantly available for all clinical staff. Paper records were scanned in and then attached to the EMR. Waiting time and interactions between the clinic and patients or their referring providers were also currently tracked electronically, via timestamps for certain events, as will be noted below. Observation of this clinic took place in April of 2011. A total of 127 patient charts were reviewed by the researchers (KP and BS) during the data extraction that took place between March and April 2011.[6]

4.1.2 Referral processing at clinic 1

At this clinic, there is a central intake for all incoming referrals. This clinic is staffed with sixteen orthopaedic surgeons, each with associated nursing staff, and administrators who review, process, and schedule patients. Surgeons each have their own staff, which in effect act as distinct offices which are combined together, along with physiotherapy and other office staff, into the clinic.

Central intake is defined as a combined queue for all patient referrals arriving for orthopaedic surgeons that are sent for hip and knee related pain. More than 3,000 referrals arrive each year to this clinic. Central intake receives referrals from two sources: referring providers

[6] Researchers associated with the Alberta Bone and Joint Health Institute had access to patient records for quality assurance purposes in other projects. Data was extracted using the data extract form developed for patient charts (Appendix E) and anonymized for record keeping, with no record numbers, names, addresses, personal IDs, Alberta personal health numbers, unique lifetime identifiers, or 6-digit postal codes noted. The paper extracts were then encoded into an Excel spreadsheet, and further analyzed using the Stata statistical software.

and other orthopaedic surgeons. Both sources provide new referrals for hip and knee pain, as well as patients who may have been seen by an orthopaedic surgeon previously, for a consultation or for treatment. These are combined with referrals that arrive from referring providers via orthopaedic surgeon offices. Not all referrals that go straight to orthopaedic surgeons will be seen by central intake – only hip and knee referrals are sent to the clinic; referrals for other procedures are kept at the surgeon's offices. Among the sample of referrals, 96% come from GPs and 1% from other orthopaedic surgeons (a complex case from another region). For 3% of referrals, the source of the referrals was unclear.

These referrals arrive to central intake at Clinic 1, which is maintained by the central intake administrative assistant. The central intake administrative assistant divides the referrals into two batches: referrals that have been sent for a specific surgeon, and referrals that selected or dictated a next available surgeon option. Referrals that did not select either a specific surgeon or a next available surgeon were routed to the next available queue. The former are then processed by the central intake administrative assistant who receives the referrals from surgeon's staff, while the latter are processed by a next available nurse. Referrals are then checked for appropriateness by the appropriate assistant. Two checks are made: whether a referral is complete, and whether a referral is correctly directed. A complete referral form comes with demographic information and a correct x-ray report. A correctly directed referral means that the referral form indicates it is for a patient suffering from hip or knee osteoarthritis. The complete referral is judged by the central intake administrator in all cases. Missing information resulted in a referral being put into a pending queue, while complete information allowed processing to continue. The referral, if not pending, would then be forwarded to the surgeon's staff or the next available nurse to determine if the patient was suffering from hip or knee OA, and if so, to judge

the urgency of the patient. This was determined by evaluating medicines and past treatment the patient received and x-ray results which indicated whether there was bone-on-bone wear of the joint indicative of osteoarthritis.

Some records, mostly from specific orthopaedic surgeon offices, arrived on paper via letter. Most referrals arrived via electronic fax, and were scanned into the software package to be processed by an assistant. Scanning in records was the responsibility of the central intake administrator. Some assistants switched between the scanned referral and the EMR software, using paper only as a temporary record to fill in dialog boxes. Other assistants printed paper records out of the referrals, and use these to enter EMR records, shredding the paper records when completed.

Referrals could be accepted, denied, or put in a pending queue by administrative assistants – the central intake administrators, the nurses, or the surgeon's staff. Referrals that were missing information were put in the pending queue, and once information was received from the referring provider, were either accepted or denied. Time spent in a pending queue can vary, from one day up to half a year. Information such as demographic data that was missing was filled in by calling the referring provider, and was taken care of by the central intake administrator. If medical information was missing, such as an incorrect or missing x-ray report, a pending notice was faxed back to the referring provider, and follow-up would be expected from the referring provider. A call to the referring provider may also occur in addition to the faxed pending notice. If information is not received within a given time, a follow-up notice or call to the referring provider could be sent, though this occurred only as time allowed for the central intake administrator. If a referral had been incorrectly directed (for a non-hip, non-knee, non-osteoarthritis reason, or when the evidence sent in the referral did not suggest osteoarthritis), the

new referral was a duplicate referral, or a referring provider requested a patient be removed from the wait list, the patient referral was rejected, and notice was faxed back to the referring provider. Referrals were accepted if they were deemed complete and correctly directed. Notice was faxed to the referring provider, and for next available patients, an acceptance note was also mailed to the patient. The wait-time clock at this clinic started when a patient was either accepted, or put in the pending queue.

The patient was then queued on the waiting list. A booking card for the patient was completed, which started waiting time tracking for the patient. If the referral gave an indication of high acuity OA, the administrative assistant could note the patient was urgent, which highlighted the patient on the queue. The surgeon's office would then contact the central intake administrative assistant as appointment time is freed, who would then direct next available patients to the surgeon, with urgent patients given a higher priority. The surgeon's office would then book a consultation with the patient.

Through the timeframe set to evaluate patient charts, patients had the option of being sent by a nurse to see a MSK physician before a surgical consult. The MSK physician was a sports medicine specialist who was trained to assess patients for acuity of osteoarthritis. Almost all next available patients were routed to see the MSK physician, including both urgent and non-urgent patients, while fewer patients routed to a specific surgeon would see the MSK physician. The MSK physician could then recommend that a patient be deemed nonsurgical, and therefore receive medical management, or continue as a surgical candidate. An optional notation in the patient EMR, specific to this clinic, noted whether a patient agreed with that assessment, or asked to see a surgeon for consult/continue with medical management. Patients continuing on would then be booked for an appointment with a surgeon.

Patients who went straight to surgical consult then were combined with patients recommended for surgical consult by the MSK physician, as well as patients who were assessed nonsurgical but still wanted to see a surgeon. A surgical consultation with an orthopaedic surgeon then determined if the patient was nonsurgical, surgical, or should be placed in a long-term optimization queue. This long-term optimization queue is indicative of a patient who is a candidate for surgery, but is not ready for surgery immediately, due to other comorbidities.

If a patient needed a revision or a follow-up, the patient was automatically put on an accepted queue, and did not need to have a referring provider resubmit information. The patient would then have a booking card created, and an appointment set to see a surgeon.

4.1.3 Results and analysis

4.1.3.1 Referral appropriateness

Patient chart analysis indicated that 81% (n=103) of the referrals were accepted by the clinic upon first submission to the clinic by the referring provider. Of the rest, 15% (n=19) were deemed pending, 1% (n=1) were denied, and 3% (n=4) could not be accounted for and were judged to be missing information. The reasons for rejecting or pending (at the first submission of a referral form) are listed in Table 5. A total of 6% of the referrals, though missing information initially, were able to be fixed quickly and thus were not formally put in the pending queue.

Table 5: Reasons for rejection or pending referrals for clinic 1

TOTAL REFERRALS	127	
No issues raised	103	81%

Initially denied or pending		24	19%
	Referral documentation incomplete or missing elements	15	12%
	Xrays not appropriate for referral	4	3%
	Incorrectly directed referral	1	1%
	Other	4	3%

Reasons for other are: resend referral to specific doctor (1), affected joint not indicated on referral (1), patient cannot speak English and needs an interpreter (1), only one page of referral sent (1).

Most referrals arrived with no issues (81%). This suggests that 19% of arriving referrals were not complete, and as a result take staff resources to attain information to deem the referral acceptable or not. An electronic referral tool would be able to eliminate most of the reasons for denied or pending referrals, such as missing documentation or demographic variables. An electronic referral tool would be unable to determine if an x-ray would be of the correct angle or joint (which consisted of n=4 of the pending or denied referrals), but a reminder to the referring practitioner regarding the correct x-ray angle would likely reduce incomplete referrals.

Incorrectly directed referrals were not a significant number of referrals. The one referral incorrectly directed in the chart extraction was resubmitted with a correct reason, though this took 296 days from when the referral was originally sent to when it was finally accepted. At the time-tracking visit (by KF) separate from the chart analysis, 2 of 30 referrals (7%) were rejected, but one of the two was a patient requesting to have a referral removed, which resulted in the patient moving from the pending queue to being denied. This was tracked at the time-tracking visit, since the charts stored at the clinic did not contain charts of patients who had been rejected and did not come back to the clinic.

Specific information on the template type is given in Table 6.

Table 6: Template type for referrals at clinic 1

Referral type present		120	(of n=127)
	ABJHI template	82	65%
	Other template	5	4%
	Letter	39	31%
Missing		7	(of n=127)
	Patient had been seen by provider previously	2	2%
	No information or missing	5	4%

Explanation for Other Template: Medi-Centre templates used.

Multiple sources: ABJHI template and letter (6). [hence of the 120 referrals with information, 114 contain one referral forms, 6 contain two referral forms].

Most referring providers used the ABJHI template as a referral form (65%). The second most used form is a letter (31%). None of the letters seen at the time-tracking visit contained an urgency checklist as is used in the new ABJHI template, resulting in no specific urgency score for a patient. Instead, a review of the referral would be done to see if it was mentioned in the referral packet that a patient was “urgent”. This limits the triage process for these patients.

What is included on the referral form will be important from an electronic referral perspective. Details for all referrals are given in Table 7.

Table 7: Items included on referrals from referring provider for clinic 1

Included on Referrals:	Number included	% (of n=124 with data; n=3 missing data)
REFERRAL BASICS		
Patient demographics	124	100%
Referring physician info	123	99%
Preferred surgeon specified	26	21%
Next available surgeon specified	88	71%
Neither preferred surgeon nor next available surgeon specified	10	8%
Reason for referral	122	98%
Height	27	22%
Weight	27	22%
BMI	13	10%
Relevant medical history	114	92%
EVIDENCE OF OA		
X-ray film	1	1%
X-ray report	112	90%
MRI	13	10%
Whether an indication was given as to whether or not previous ortho surgery occurred	25	20%
IMPACT OF OA		
Relevant comorbidity history/complexity	91	73%
Medication list	88	71%
Medical urgency (lifestyle)	32	26%
Medical urgency (WCWL)	15	12%
Other	6	5%

Note: the next available surgeon option specifies whether a "next available surgeon" option was specifically chosen on the referral form. This contrasts to having a "preferred physician specified", in which a specific surgeon was given by the referring provider. If neither the "next available surgeon" option nor the "preferred physician specified" options were chosen, the referral was slotted to the next available surgeon.

Explanation for missing: No referral on chart (1), no referral information available (1), no referral information available as patient was seen by orthopaedic surgeon previously (1).

Two perspectives can be used to determine whether referrals have complete information or not. One is the perspective of ABJHI that all fields must be filled out, resulting in a "complete" referral form. This requirement would enable a nurse or a surgeon to triage a patient. The required elements are given in Table 7 and are shown on the referral form in Appendix C. However, as noted above, a second perspective is that referrals are currently being accepted in which some, but not all, of these fields are filled out. At Clinic 1, the following are required:

- Demographic Information: 100% were filled out. No forms were missing this information, which would result in the clinic calling up a referring provider.
- X-ray reports: 90% of referrals provided an x-ray report. There is no region-wide system to access x-rays or x-ray reports if they are not included in the referral packet.
- Urgency questions: 73% mentioned relevant comorbidity history/complexity, which details other ailments a patient may be suffering. This variable is not required when deeming a referral complete and correctly directed. It is used, however, in determining the urgency of a patient for scheduling. Only 26% of referrals mentioned anything about urgency, which is used to judge how urgent a patient is for scheduling purposes. Of the 82 patients charts with submitted ABJHI referral templates, only 15 (18%) completed the WCWL questions relating to acuity. The WCWL questions were implemented on a version of the referral template during this timeframe, though, so this percentage will be skewed down.

Though not a criteria for appropriateness, a determination for the percentage of surgical patients could be estimated. Of patients who went on to a MSK physician (n=106), 67% (n=71) were assessed surgical (see patient flow diagrams at the end of this section in Figure 4 and

Figure 5). These patients were combined with several patients (n=16) who went straight onto a surgical consultation, along with two patients who were referred after the MSK option was eliminated, and one patient who was assessed nonsurgical but wished to still see a surgeon. The patients who went straight to surgical consultation may not have been able to make a MSK appointment when offered; this information was not available. Of the referrals that made it onto a surgical consultation (n=90), 83% (n=75) were assessed as surgical, and 6% (n=5) were assessed as suitable for long-term optimization leading to surgery. Of the referrals that were assessed surgical by an MSK physician (n=71) who had a surgical consultation (n=61), 89% were deemed surgical by the orthopaedic surgeon, 7% were given long-term optimization plans, and 4% were deemed nonsurgical.

4.1.3.2 Accessibility

Consistent datestamps were collected from patient charts to determine wait times. The main date points were:

- Referral made by referring provider: the date on the referral form from the referring provider (not necessarily when the referral was sent by the referring provider);
- Referral received by clinic: the date on the referral when it was received by Clinic 1 – either a faxstamp, or, if a faxstamp is in obvious error (e.g. wrong year), the date on the referral.
- Referral deemed complete by clinic: the date when the referral has been accepted, with all information complete, and the patient awaits either a MSK physician consultation with a retired surgeon at the clinic, or surgical consultation;

- MSK physician visit: the date (in the clinic EMR) in which a MSK physician visit took place;
- Surgical consult visit: the date (in the clinic EMR) in which the first surgical consultation occurred.

Table 8 gives a listing of durations, in business days, for each relevant datestamp, as noted in the Wait Times Rules. These are also highlighted on the patient referral process diagrams given at the end of the section in Figure 4 and Figure 5.

Table 8: Wait times for different durations, in terms of business days per individual referral for clinic 1

	[1] Duration (business days): Referral made by referring provider → to referral received by clinic	[2] Duration (business days): Referral received by clinic → to referral deemed complete by clinic	[3] Duration (business days): Referral deemed complete by clinic → to MSK physician visit at clinic	[4] Duration (business days): Referral deemed complete by clinic → to surgical consult visit at clinic
Mean	8	15	40	81
Median	2	3	41	76
90%	16	60	74	129
std dev	25.38	39.35	27.96	45.83
25%	1	2	15	50
75%	4	7	57	97
Min	0	1	1	17
Max	252	296	122	293
N_present N_missing	124 3	92 36	79 48	73 54

Details on missing observations:

- A total of 127 referrals were evaluated at this clinic. Of these:
- 1 does not have a referral made date, 2 do not have referral received dates (n=3 missing in Column 1).
- 2 do not have referral received dates, 34 do not have complete dates (n=36 missing in Column 2).
- 34 do not have complete dates, 21 did not attend MSK physician dates. 7 are missing both (n=48 missing in Column 3).
- 34 do not have complete dates, 37 did not have surgical consult dates, 1 is missing a surgical consult date. 18 are missing both (n=54 missing in Column 4).

The mean time from the time referrals are made to the time referrals are received by the clinic was 8 days, with a median time of 2 days and a 90th percentile time of 16 days. This would be made instantaneous by any electronic referral package, as delays in sending a referral would be eliminated.

The mean time from the time referrals are received to the time referrals are deemed complete was 15 days, with a median of 3 days and a 90th percentile time of 60 days. The mean time from the time referrals are deemed complete (i.e. accepted) to a MSK screening was 40 days, with a median of 41 days and a 90th percentile time of 74 days. For patients who go straight through to a surgeon, the time was 62 days, compared to patients who go through MSK as well, in which patients must wait an additional 46 days in addition to the 40 days to see the MSK physician (averaging out to 85 days, with a median of 81 days). When estimated for all patients, the mean time from when a referral was deemed complete to surgical consultation was 81 days, with a median of 76 days and a 90th percentile time of 129 days.

One aspect of time which could not be tracked was a breakdown between voluntary and involuntary reasons for delays. It is assumed that, before a referral is deemed complete, any delays are system-related reasons, and not due to any action of the patient, hence involuntary. Voluntary delays are not necessarily the fault of the clinic, or of the referring provider. Delays in having a consultation could be patient related too, and might be indicated when a patient chooses a specific surgeon instead of next available. However, after a referral is deemed complete, a patient may choose to delay an appointment for a variety of reasons. These are not tracked in the EMR, and hence cannot be analyzed without an internal timeline linked to the initial patient visit to the clinic.

Three stratified analyses are given in Table 9. These give wait times for several different datestamps, stratified by the type of joint causing pain for a patient (part a), whether a referral was deemed complete or incomplete upon first receipt by the clinic (part b), and whether a patient requested a specific surgeon or not (part c). The wait times represent the time that referrals were made to the time that referrals were received (column (i)), the time that referrals were made to the time referrals were deemed complete (column (ii)), and the time referrals were deemed complete to the time that the first surgical consultation occurred (column (iii)).

Table 9: Stratification of waiting times, by (a) type of joint, (b) status of referral upon arrival, and (c) whether next available surgeon was selected on the referral form at clinic 1

Type of joint:

	Knees			Hips		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon
Mean	4	19	79	13	24	84
Median	2	4	71	2	7	83
S.D.	8.26	49.09	35.12	38.22	46.93	56.08
Range	[1,63]	[1,296]	[21,190]	[1,252]	[1,266]	[17,293]
N	74	47	39	50	45	34

(b) Complete or incomplete referral

	Complete referral			Incomplete referral		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon
Mean	9	15	82	4	61	71
Median	2	4	76	2	36	67
S.D.	27.57	37.24	46.55	5.01	80	40.74
Range	[1,252]	[1,266]	[17,293]	[1,18]	[7,296]	[24,146]
N	104	79	65	20	13	8

(c) Next available surgeon or specific surgeon selected

	Originally received next available			Originally chose specific surgeon		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon
Mean	5	19	78	15	29	88
Median	2	5	76	2	7	78
S.D.	11.62	44.29	41.22	44.33	57.79	57.60
Range	[1,85]	[1,296]	[17,190]	[1,252]	[1,266]	[24,293]
N	86	67	52	34	24	20

On average, hips took longer than knees, including the system-related steps of ensuring a complete referral (24 mean days, 7 median days versus 19 mean days, 4 median days). There is little percentage difference from that point in the process to the consultation date, though overall hips took slightly longer (84 mean days, 83 days median versus 79 days mean, 71 days median).

For complete versus incomplete referrals, completed referrals take much less time from time of referral to time deemed complete (15 days mean, 4 days median versus 61 days mean, 36 days median). If a referral is complete at the onset, there is no need to go back to the referring provider, causing a decrease in patient wait times compared to incomplete referrals.

For next available status, there is a significant difference in the mean durations, as those patients who selected the next available surgeon take less time than those who chose a specific surgeon, in terms of the duration from when a referral was made to when it was deemed complete (19 mean days, 5 median days versus 29 mean days, 7 median days). From the time a referral was deemed complete to the time that the consult occurs, there was not much of a median difference, though the difference is apparent when measuring the mean (78 mean days, 76 days median versus 88 days mean, 78 days median).

4.1.3.3 Efficiency

Specific details for processing tasks, and time doing these tasks rounded to the nearest minute, by central intake at Clinic 1 are given in Table 10. The time spent by staff at Clinic 1 per referral was approximately 14-15 minutes. When estimated for the approximately 80 referrals per week that the clinic receives, these tasks take approximately 1000-1040 minutes (~17 hours) per week.

Table 10: Staff time per referral for specific tasks at clinic 1

	Evaluation of referral for completeness	Entering referral into clinic EMR	Feedback to referring provider	Scanning in information
Clinic 1	~2 min (by the central intake administrator, including time to organize and prep referral for evaluation) ~2 min (by the nurse, to evaluate referral for signs of OA)	~1 min (by the central intake administrator)	~1 min for accepted ~2 min for pending/denied (by central intake administrator or the nurse)	~8 min (by the central intake administrator)

The approximately 4 minutes spent evaluating a referral confirmed that demographics, urgency and an x-ray report were contained within the referral package, and was completed by the central intake administrator and a nurse. Referral entry into an EMR took approximately 1 minute by the central intake administrator. Feedback in the form of a template letter faxed back to the referring provider took approximately 1-2 minutes in total. The time to process a referral lengthened substantially if a referral arrived incomplete – with approximately 2 to 8 minutes spent on a call to a referring provider to request missing information. This time was potentially spread over several days if initial phone contact could not be made, or if patient information was not immediately available.

Added to each referral processing time would be scanning and attaching paper records to the electronic EMR, which took an average of 8 minutes per referral by the central intake

administrator. This step increased the workload substantially for staff, almost doubling the time necessary to evaluate and enter a referral.

One factor that was not tracked internally was the amount of time spent receiving calls from patients and GPs. These calls come in through the day, and are handled by both schedulers (for patients seeking appointment information and rescheduling) and by the central intake administrator (for referring providers seeking information on the status of a referral on the waiting list).

Waiting times for patients were exported to Excel, with minimal data cleaning needed. Macros had already been designed to calculate waiting time intervals for patients for reporting purposes.

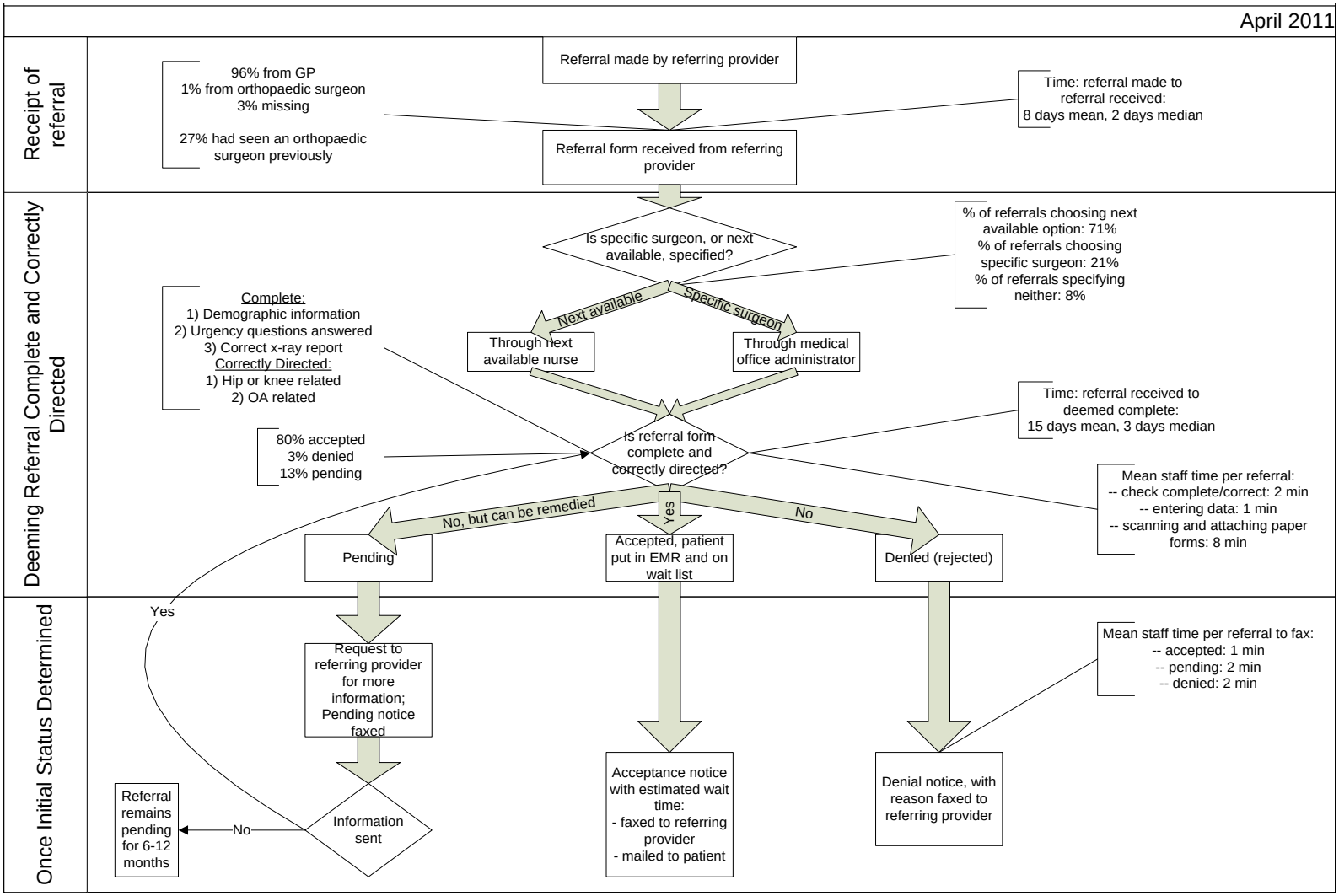

Figure 4: Patient referral process from referring provider to complete and correctly directed referral at clinic 1

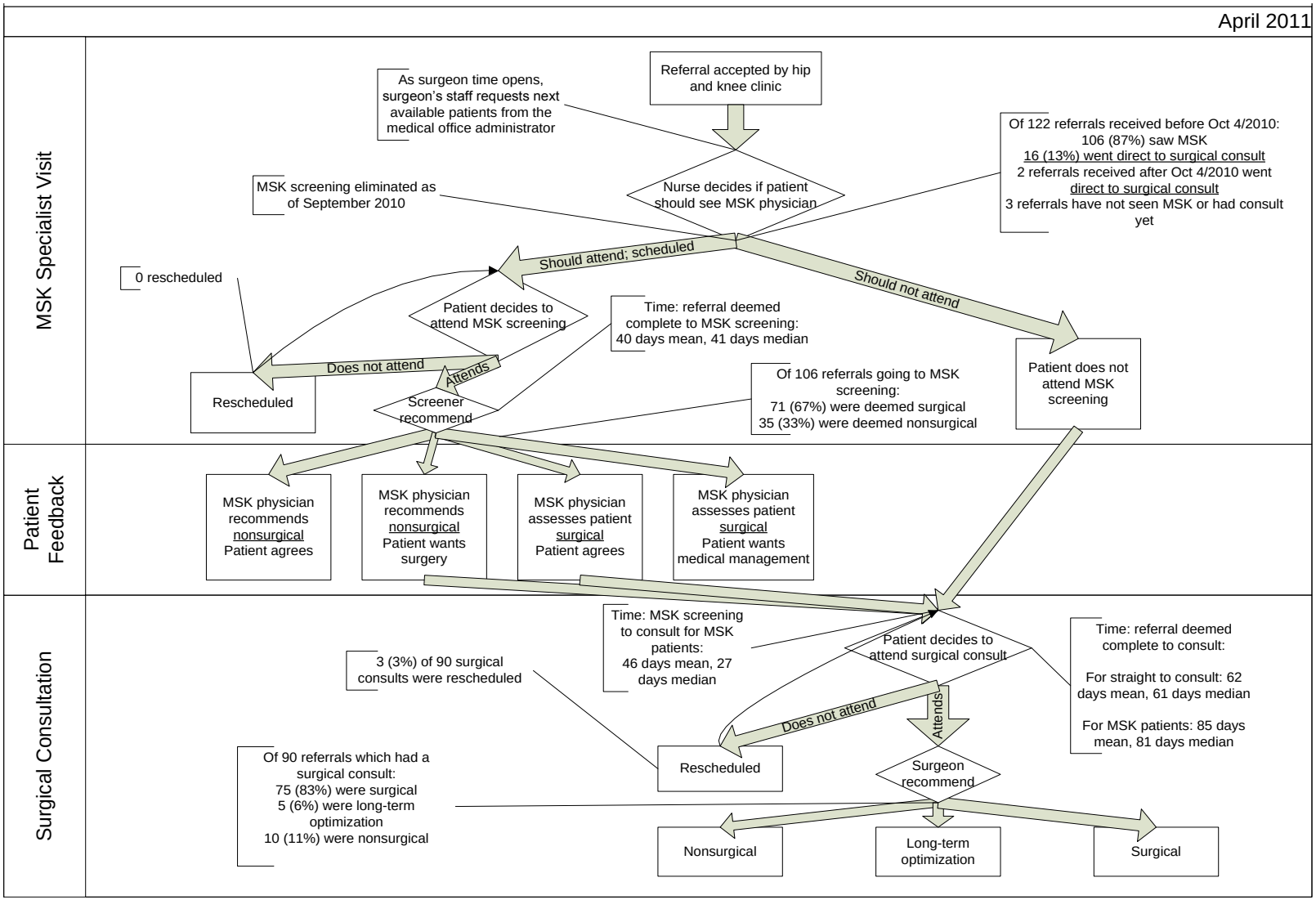

Figure 5: Patient referral process from accepted referral to surgical consultation at clinic 1

4.2 Clinic 2

4.2.1 Characteristics of clinic 2

Clinic 2, as noted in the Methodology (Chapter 3), is located in a rural location. It is a single-surgeon, moderately integrated hip and knee clinic, which is able to handle patients of low complexities. The clinic was moderately technological, with incoming referrals arriving via fax and scanned in to an EMR. The site, a multispecialty centre, contained both the surgeon's office and the hip and knee clinic. Paper records were used to communicate patient records between the surgeon's office and the hip and knee clinic. Some patient records could be accessed via a region-wide electronic system, which both the surgeon and hip and knee clinic use. There were two EMRs used at this site – one for the surgeon and surgeon's administrators, and one for the clinic for the central intake administrator, nurses and physiotherapists – during the clinic evaluation. Changes made at one office could not be seen at the other office due to the two separate EMRs. Waiting times were tracked electronically, though compiling the data and entering the data involved a more manual process than at the other two clinics, taking substantially longer to calculate. Interactions between the surgeon and their office and central intake were sometimes stored electronically, and sometimes were just noted on pieces of paper that were attached to printed referral records, and were later destroyed and not archived.

Observation of this clinic took place in April of 2011. A total of 41 referrals were reviewed by the researchers (KP) during the data extraction that took place in March 2011.

4.2.2 Referral processing at clinic 2

This centre consists of a surgeon's office populated with one orthopaedic surgeon, and a hip and knee clinic. The number of referrals to this clinic is approximately less than 300 per year. The

surgeon's office sees referrals related to hip and knee replacement, shoulder ailments, and tendon ruptures. At this centre, the orthopaedic surgeon and staff receive all referrals, with hip and knee OA related referrals directed to the associated hip and knee clinic and its staff of central intake and nurses. The surgeon has two medical office administrators that were involved in processing referrals. Specific staff at the clinic included two program administrators who process referrals (both of whom serve as part-time physiotherapists in addition to their referral processing and patient management duties), as well as one physiotherapist, two occupational therapists, one secretary, and one nurse.

All musculoskeletal referrals from referring providers arrived to the office of the single surgeon at this clinic. Referrals arrived primarily from GPs, with the exception of one undetermined source noted in the data extraction. Approximately 75% of referrals came from GPs outside of the centre where the clinic is housed, while the remainder come from physicians practicing within the centre. GPs from within the centre tended to send informal memos as referral forms, with information available over a central computer network. GPs outside the clinic primarily sent faxed referrals. The date a referral is made is recorded on the referral form itself; the date when a referral is received is not tracked electronically at the clinic, and is noted from fax datestamps.

Incoming referrals were routed to a medical office administrator who works for the surgeon. The referrals were checked for completeness using several requirements: complete demographic information, an x-ray report (or, alternatively, an MRI if a patient is young), BMI (or height/weight), with a medical history (both previous interactions with the surgeon, and other comorbidities) as well as a current medication list of the patient both used in determining the urgency of a patient. If the referral arrived incomplete, the surgeon's administrator had several

options to retrieve the information. If the referral arrived from a referring provider within the centre or within the health region where the surgeon is located, an EMR was retrieved and evaluated to attempt to fill in the missing information. Further, the x-ray itself could be accessed by the surgeon's administrator in most cases if the patient is from within the region. If the referral came from outside the region, or information could not be retrieved from EMRs, a call was made to the referring provider for the information. The referral was also evaluated at this point to see if it was correctly directed. A correctly directed referral means that the referral form indicated the patient was suffering from a shoulder ailment, tendon rupture, or osteoarthritis that could lead to hip or knee arthroplasty.

After being deemed complete and correctly referred, a booking card was prepared for the referral and the waiting time clock starts for the patient. After being entered into the surgeon's EMR system, the referrals are then routed to the surgeon for screening.[7] At this review, the surgeon determined, after reading the referral, if the patient was a candidate for further evaluation by the surgeon. If the patient was not a candidate, then a notation was made to reject the patient. Rejection usually occurred if a patient was incorrectly directed to the surgeon. This referral review, in essence, served the role of a MSK physician screening at the other clinics. Accepted semi-urgent patients involving shoulder pain or tendon ruptures are routed by the surgeon's administrator to the surgeon's office. Accepted joint cases are forwarded onto the hip and knee clinic by the surgeon's administrator. Rejected non-joint replacement patients at this point are kept by the surgeon's administrator, who sends a rejection notice to the referring provider. The referral is then removed from the record system of the surgeon.

Accepted joint replacement referrals were then sent by the surgeon's office to the program administrator at the hip and knee clinic. The program administrator handles patient processing, and in effect acts as the central intake administrator, for Clinic 2. Rejected joint replacement patients were removed from the EMR, and a rejection notice was faxed back to the referring provider. If the patient was screened through for a first surgical consultation, patient data was then entered into the clinic EMR. Notably, at the time of the time tracking visit, the clinic EMR was different than the surgeon's EMR, and the two systems do not communicate with each other. As a result, patient data had to be entered twice. Variables used at this point to triage the patient included (but are not limited to) the x-ray report, the age of the patient, and the mobility of the patient. With complete information, an acceptance letter was then sent to the referring provider. The patient was then put onto the pending queue of the clinic.

The accepted referral is then sent back to the surgeon's office, where the surgeon's administrator will schedule the patient for a surgical consultation, and deal with subsequent scheduling issues. The progress of the patient at the clinic for hip and knee related issues, and correspondence with the referring provider, primarily took place from the clinic and the program administrator. Once the first surgical consultation occurred, the nurse at the hip and knee clinic will receive data related to the visit. After the first surgical consultation, the patient was removed from the pending queue of the clinic.

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[7] After the timeframe of clinical observation, this has also been completed by surgeon trainees instead of the surgeon.

4.2.3 Results and analysis of clinic 2

4.2.3.1 Referral appropriateness

Patient chart analysis indicated that 56% (n=23) of referrals were accepted upon first submission, and do not have issues with incomplete data. 44% (n=18) are initially deemed incomplete. Of the latter referrals, 89% of the incomplete referrals (16 of 18) are due to referral documentation being incomplete. The reasons for rejecting or pending are detailed in Table 11.

Table 11: Reasons for rejection or pending referrals for clinic 2

TOTAL REFERRALS		41	
No issues raised		23	56%
Initially denied or pending		18	44%
	Referral documentation incomplete or missing elements	16	39%
	Xrays not appropriate for referral	1	2.5%
	Other	1	2.5%

Reasons for other are: awaiting MRI results as of the chart review date (1).

While the majority of referrals arrived with no issues (56%), a significant proportion arrived with missing information (39%). Of the referrals with missing information, most were missing height/weight/BMI information.

Incorrectly directed referrals were not a significant problem at this clinic. No incorrectly directed referrals were seen in the chart reviews, and none were noted at the time-tracking visit out of eight processed referrals in one time study session. If a referral was sent to the surgeon or clinic with incomplete documentation, a reminder was faxed to the referring provider, detailing what procedures the surgeon carries out, and what is necessary for the referral to be processed for each procedure. Referring providers in the region, with those reminders, would know what

patients (and what is needed for each patient) to refer to this clinic. Incorrectly directed referrals result in an immediate denial of the referral.

One important detail is that the term "pending" is used differently in this document than at the clinic. Clinic 2 has a pending queue for patients who are correctly directed and have a complete referral (i.e. are "accepted"), which patients do not leave until they see the surgeon for a consultation. "Pending" in this document is when patients are not moving forward in referral processing, due to incomplete information on a referral form, or having been incorrectly directed.

Specific information on the template type is given in Table 12.

Table 12: Template type for referrals at clinic 2

Referral type present		40	(of n=41)
	ABJHI template	11	27%
	Other template	3	7%
	Letter (see explanation in paragraph below)	16	39%
	Other (see explanation in paragraph below)	10	24%
Missing		1	(of n=41)
	Patient had been seen by provider previously	0	0%
	No information or missing	1	2%

Explanation for Other template: information was retrieved from an in-house, electronic charting system, that can be accessed by both the surgeon, the clinic, and referring providers working at the same centre.

No multiple sources (i.e. two different forms for referral) were noted.

Most referring providers used a letter as a referral form (39%). The second most used form was the ABJHI template (27%). "Other" consisted of 24% of referrals. The use of letter referrals, and the composition of "other" referrals, is explained as follows. The surgeon and the hip and knee clinic was tied into two software systems. One was a *centre-wide* system used at the medical clinic which is located at the same centre as both the surgeon and the hip and knee

clinic. As a result, referring providers at these clinics sent memos (letters) to the surgeon, and the in-house electronic charting system was printed out by the surgeon's office for the surgeon to evaluate the patient – this makes up all of the "other" cases. Second, a *region-wide* software package allowed for an EMR to be accessed by any surgeon or physician in the region. As a result, most referring providers within the region sent letters, with a reference to further information on the electronic EMR.

Details of what are included on the referral forms – accessed electronically or on templates – are given in Table 13.

Table 13: Items included on referrals from referring provider for clinic 2

Included on Referrals:	Number included	% (of n=31 with data; n=10 missing data)
REFERRAL BASICS		
Patient demographics	30	97%
Referring physician info	29	94%
Preferred surgeon specified	1	3%
Next available surgeon specified	0	0%
Neither preferred surgeon nor next available surgeon specified	30	97%
Reason for referral	30	97%
Height	13	42%
Weight	13	42%
BMI	12	39%
Relevant medical history	29	94%
EVIDENCE OF OA		
X-ray film	5	16%
X-ray report	30	97%
MRI	9	29%
Whether an indication was given as to whether or not previous ortho surgery occurred	16	52%

IMPACT OF OA		
Relevant comorbidity history/complexity	21	68%
Medication list	13	42%
Medical urgency (lifestyle)	12	39%
Medical urgency (WCWL)	0	0%
Other	0	0%

Note: the next available surgeon option specifies whether a "next available surgeon" option was specifically chosen on the referral form. This contrasts to having a "preferred physician specified", in which a specific surgeon was given by the referring provider. Clinic 2 only has one surgeon, hence this option is ignored or not filled out for most incoming referrals.

Explanation for missing: No referral information available (1), in-house chart electronically with records resulted in no referral being sent and no access to the record (8), no referral on chart (1).

If the criteria for a complete referral are based on what is required by the clinic and the surgeon, the following results were obtained:

- Demographic information: All but one (97%) of referrals with information contained full demographic information. No information is available about which variables are missing in the one missing referral.
- X-ray report: 97% of referrals contained an x-ray report.
- BMI (height and weight): 42% of the referrals contained height and weight, and 39% explicitly contained a BMI statistic. One referral contained height and weight, but not BMI. Combined, this meant only 13 of 31 referrals contained a necessary component (BMI data) for referral processing at Clinic 2.
- Urgency questions: 94% of referrals contained a medical history. However, only 42% of referrals contained a separate medication list, which is arguably a component of a patient's medical history. Medical urgency questions, which would help the clinic to

triage patients, were done in only 39% of referrals, with none of the referrals having the validated WCWL medical urgency questions completed.

Though it is simple to call and acquire BMI/height/weight data from a referring provider, this effort resulted in a time cost incurred by the administrator at the surgeon's office.

4.2.3.2 Accessibility

Consistent datestamps were collected from patient charts to determine wait times. The main points are:

- Referral made by referring provider: the date on the referral form from the referring provider (not necessarily when the referral was sent by the referring provider);
- Referral received by clinic: the date on the referral when it was received by the clinic – either a faxstamp, or, if a faxstamp has an obvious error (e.g. wrong year), the date on the referral.
- Referral deemed complete by clinic: the date when the referral has been accepted, with all information complete, and the patient awaits either a MSK physician consultation, or surgical consultation;
- MSK physician visit: the date (in the clinic EMR) in which a chart review by the surgeon took place (roughly equivalent to the MSK screening at other clinics);
- Surgical consult visit: the date (in the clinic EMR) in which the first surgical consultation occurred.

Table 14 gives statistics for durations, in business days, for each relevant datestamp, as noted in the Wait Times Rules. These are also highlighted on the patient flow diagrams given at the end of the section in Figure 6 and Figure 7. The referral received by clinic field was not filled out

consistently, due to technological limitations of the EMR software. As a result, an additional column – referral made by referring provider, to referral deemed complete by the clinic [Column 2a] – is included in Table 14, to allow more information to be retrieved from patient charts.

Table 14: Wait times for different durations, in terms of business days per individual referral for clinic 2

	[1] Duration (business days): Referral made by referring provider → to referral received by clinic	[2] Duration (business days): Referral received by clinic → to referral deemed complete by clinic	[2a] Duration (business days): Referral made by referring provider → to referral deemed complete by clinic	[3] Duration (business days): Referral deemed complete by clinic → to chart review at clinic	[4] Duration (business days): Referral deemed complete by clinic → to surgical consult visit at clinic
Mean	3	4	11	2	42
Median	2	1	4	1	32
90%	4	4	28	2	50
std dev	6.21	9.63	19.10	1.08	42.86
25%	1	1	2	1	25
75%	3	1	8	2	38
Min	1	1	1	1	14
Max	31	47	107	5	217
N_present	23	23	41	40	40
N_missing	18	18	0	1	1

Details on missing observations:

A total of 41 referrals were evaluated at this clinic. Of these:

- 18 do not have a referral received date, (n=18 missing in Columns 1 and 2).

All referrals have referral made and referral deemed complete dates.

- 1 does not have an MSK screening date available at the clinic by the surgeon (n=1 missing in Column 3).
- 1 does not have a surgical consult date available at the clinic (n=1 missing in Column 4).

The mean time from the time that referrals are made to the time that referrals are received by the clinic (Column 1) was 3 days, with a median time of 2 days and a 90th percentile time of 4 days. The mean time from the time that referrals are received to the time that referrals are deemed complete (Column 2) was 4 days, with a median of 1 day and a 90th percentile time of 4 days. Taken together, the mean time from the time that referrals are made to the time that referrals are deemed complete by the clinic (Column 2a) was 11 days, with a median of 4 days and 90th percentile of 28 days.

The mean time between the time that a referral is deemed complete and correctly directed by the surgeon's administrator and the time that it is reviewed (screened) by the surgeon at the clinic was 2 days, with a median of 1 day and 90th percentile of 2 days. This screening triages patients, and confirms (from the point of view of the surgeon) that the patient has the potential to be surgical, and is not of a level of complexity that means the patient must be routed to another clinic. No medical management is recommended to patients who are deemed not surgical, and the screening is a very quick look at the referral, not a consultation with the patient. The patient is not seen by the surgeon or a nurse during this review. However, it does provide a quick indication for the patient and staff whether a surgical consultation will occur. From that point, the mean time from the time that a referral was deemed complete to the first surgical consultation was 42 days, with a median of 32 days and 90th percentile time of 50 days.

Voluntary versus involuntary reasons for delays were not tracked at Clinic 2. While some denotations were recorded in the EMR for patients, paper records which were not kept

were used to track which patients chose to delay consultations or further treatment. The primary reason for delays, which was estimated to occur in no more than 10% of patients, was farm harvest. A total of 5% of consultations are rescheduled, as noted in Figure 7. These waits, perhaps patient-related, can be separated out when calculating wait times using an electronic referral tool.

Two stratification analyses are given in Table 15. These give wait times for several different datestamps, stratified by the type of joint causing pain for a patient (part a), and whether a referral was deemed complete or incomplete upon initial receipt by the clinic (part b). The wait times represent the time that referrals were made to the time that referrals were received (column (i)), the time that referrals were made to the time that referrals were deemed complete (column (ii)), and the time that referrals were deemed complete to the time that the first surgical consultation occurred (column (iii)).

Table 15: Stratification of waiting times, by (a) type of joint, (b) status of referral upon arrival at clinic 2

Type of joint:

	Knees			Hips		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon
Mean	5	11	49	2	10	29
Median	2	4	33	1	4	29
S.D.	7.78	21.38	52.95	1.64	14.98	6.75
Range	[1,31]	[1,107]	[14,217]	[1,6]	[1,47]	[19,43]
N	14	26	25	9	15	15

(b) Complete or incomplete referral

	Complete referral			Incomplete referral		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon
Mean	2	7	48	8	15	34
Median	1	2	33	4	8	27
S.D.	1.5	21.88	53.23	11.66	14.51	24.9
Range	[1,6]	[1,107]	[20,217]	[1,31]	[3,47]	[14,125]
N	17	23	22	6	17	17

On average, knees took longer – for both the system-related involuntary delays of ensuring a complete referral (11 mean days, 4 median days versus 10 mean days, 4 median days) and to the time of a first surgical consultation (49 days mean, 33 days median versus 29 days mean, 29 days median). However, the sample size for both groups is small: as a result, these results should be viewed with caution.

With respect to complete versus incomplete referrals, completed referrals took less time from the time of referral to the time deemed complete (15 mean days, 8 median days versus 7 mean days, 2 median days). If a referral was complete at the offset, there was no need to go back to the referring provider, leading to a decrease in patient wait times compared to incomplete referrals.

For complete versus incomplete referrals, the expected differences are seen between when a referral is made and when a referral is deemed complete: referrals that arrive complete took 7 mean days, 2 median days to process, versus referrals that arrive incomplete, which took 15 days mean, 8 median days to process.

4.2.3.3 Efficiency

Specific details for processing tasks, and time spent at tasks, by central intake at Clinic 2 are given in Table 16. The time spent by the staff of the surgeon for processing a referral was approximately 4-11 minutes, depending on the feedback given to the referring provider; the time spent by clinic staff on processing a referral was approximately 3-5 minutes, again depending on the feedback to the referring provider. As a result, approximately 7-16 minutes per referral was spent by both offices on processing. Paper records are kept by the surgeon and the clinic, which results in no electronic records being used at Clinic 2; hence, no records are scanned.

Table 16: Staff time per referral for specific tasks at clinic 2

	Evaluation of referral for completeness	Entering referral into clinic EMR	Feedback to referring provider	Scanning in information
Clinic 2	~2 min (by the surgeon administrator)	~2 min (by surgeon administrator) ~ 3 min (by the clinic program administrator, also evaluates referral for OA)	~2 min for accepted (by clinic program administrator) ~2-5 min for pending (by surgeon administrator, calling an office or retrieving an x-ray) ~5 min for denied (by surgeon administrator)	Not applicable (all records are paper records, hence no scanning takes place)

The time spent evaluating a referral is to confirm that demographics, an x-ray report, and height/weight/BMI are included, and whether or not the optional medical history is included in the referral package. This took approximately 2 minutes, and is done by the surgeon's administrator. Referral entry into the EMR did not take long at approximately 2-3 minutes, but at the date of the time-tracking visit, it had to be done twice: once for the surgeon, and once for the clinic, due to EMR incompatabilities. This took approximately 5 minutes per referral for both groups.

At this point in the process, the time spent on feedback depended on the status of the referral. For accepted referrals, a note was prepared from a template, and faxed to the referring provider, taking approximately 2 minutes. For pending notices, quick telephone calls were made

to the referring provider for demographic information, which took approximately 2 minutes to prepare. For retrieving an x-ray from the region-wide EMR system, approximately 5 minutes was needed. For denial notices, a specific notice would be typed up and sent to the referring provider along with the referral. The surgeon and the clinic would then have no record of the referral being received.

Time spent on the phone varied. Calls to referring providers for information took around 1-2 minutes. In some cases, several calls were needed over several days. Calls for information from referring providers would be routed to the clinic, and calls for information from patients were routed to the surgeon. These came through the day, and would take 1-3 minutes each to deal with. Time communicating between offices did not sum up substantially, as the offices were located approximately 30 seconds apart.

Records were transferred between offices on paper, and intermediate notes were kept on paper at both the surgeon's office and the clinic. These were not usually entered into the EMR. Waiting time calculations at the clinic were estimated using Excel through imported patient data from the EMR system at the clinic, and took approximately 1-2 days to clean and calculate by the clinic program administrator.

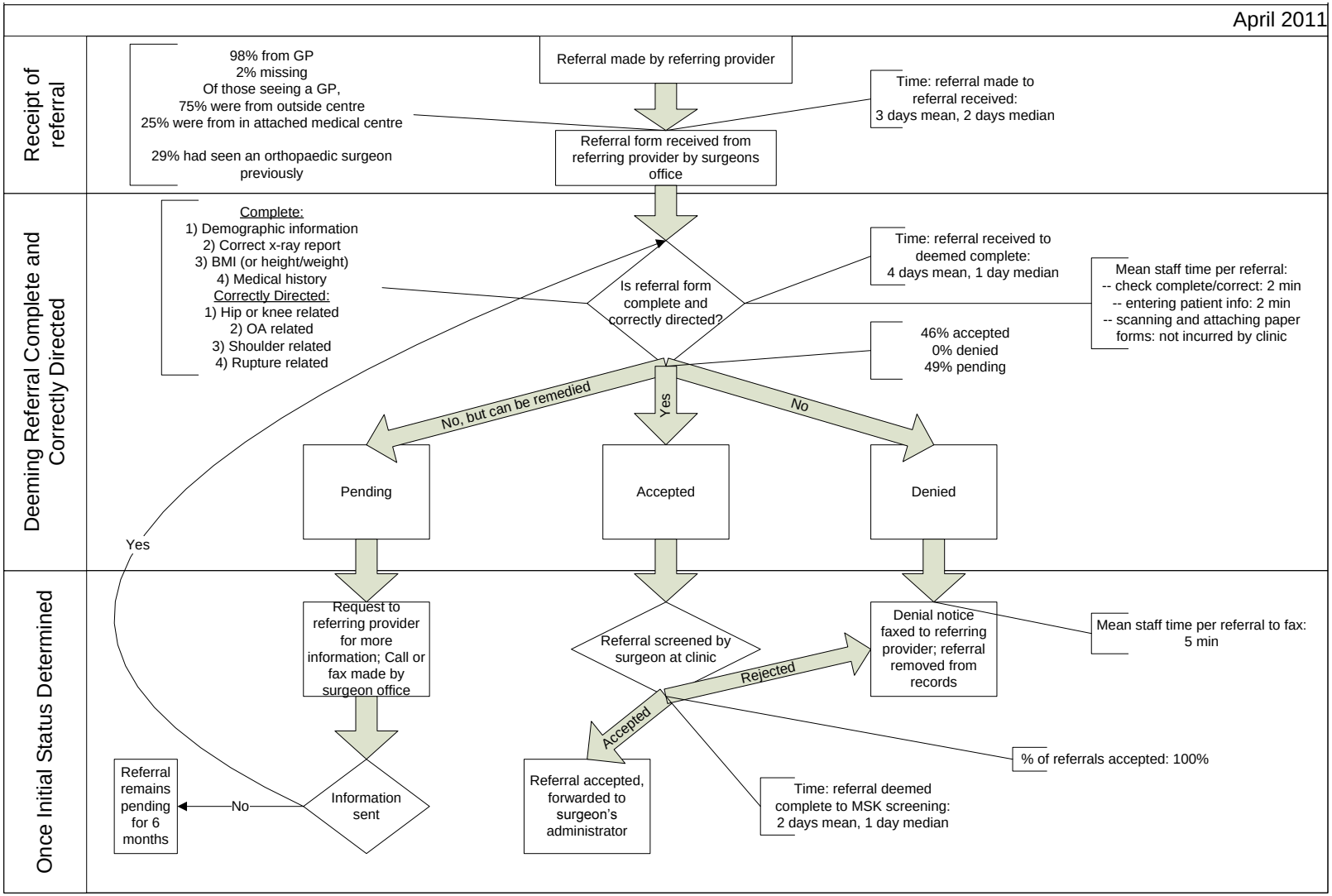

Figure 6: Patient referral process from referring provider to complete and correctly directed referral at clinic 2

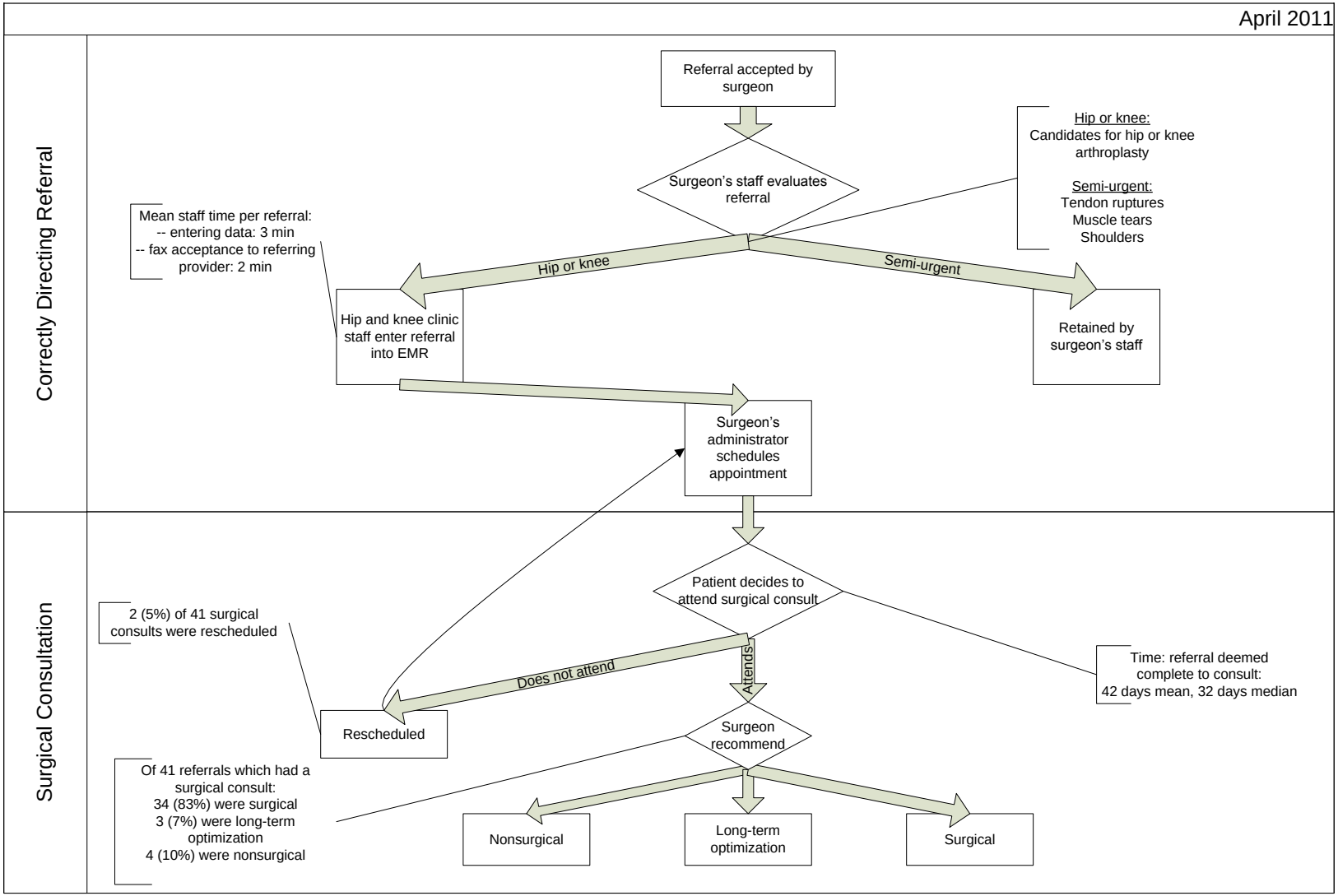

Figure 7: Patient referral process from accepted referral to surgical consultation at clinic 2

4.3 Clinic 3

4.3.1 Characteristics of clinic 3

Clinic 3, as noted in the Methodology (Chapter 3), is located in a mid-sized municipality. It is a multi-surgeon clinic, moderately integrated hip and knee clinic, which can handle patients of any complexity level, including revisions. Clinic 3 was moderately advanced in the use of technology, with patient records recorded on an EMR system that had limitations, such as flexibility to track MSK assessments. Paper records were still used for tracking patients in some aspects of the hip and knee clinic operation due to those EMR limitations. Waiting times were tracked electronically, as were interactions both at the clinic and with specific surgeons, and patient records were shared between clinics and surgeons using the EMR. The clinic was also integrated with EMR systems used by associated surgeons.

Observation of this clinic took place in April of 2011. A total of 50 patient charts were reviewed by the researchers (KP) during the data extraction that took place in March 2011.

4.3.2 Referral processing at clinic 3

This centre serves as the central intake site for six surgeons, with nursing staff, physiotherapists, and medical office administrators. Orthopaedic surgeons at this centre practiced separately from the clinic, and maintained their own practices at offsite locations, along with their own associated nursing staff and administrators. Surgeons would also come to the clinic to assess some patients. The number of referrals to all surgeons numbered approximately 425 per year. All patients with hip and knee-related pain were processed through the central intake clinic, regardless of which surgeon to which they are referred. Central intake received referrals from GPs and not from surgeon offices, unless a hip and knee referral was mistakenly sent to a surgeon initially. In the

latter case, for hip and knee related referrals only, they were faxed to the hip and knee clinic directly from the surgeons. Of these new referrals, 92% originated with a GP. Approximately 12% of referrals noted were for second joints.

Hip and knee referrals were then evaluated by an administrator at the clinic. The administrator checked to confirm the referrals were complete and correctly directed. A complete referral was one which contained demographic information, an accurate x-ray report, and current medication being taken by the patient. The former two variables were required while the latter variable, though not explicitly required, would usually be attained by the nurse if not reported on the referral. Patient height and weight, though not required, was used by the nurse in determining the current health of a patient, and would sometimes be attained by the nurse if not reported. The administrator then checked to confirm the referral relates to hip and knee OA, confirming that the referral was correctly directed.

If any of this information was missing, a referral was deemed pending, and the missing information was requested from the referring provider by the administrator. All contacts were made by telephone with the referring provider, and a faxed pending notice was sent to the referring provider. If the information was provided by the referring provider, it was sent back to the administrator, who then evaluated the referral with the newly supplied information. There was no systematic process at Clinic 3 (or at any clinic) for attaining and following-up with referring providers for missing information. If the referral was not correctly directed, it would be denied, and a denial notice faxed back to the referring provider by the administrator stating the reasons for denial. If the referral was deemed to be complete and correctly directed, it was forwarded to the central intake nurse for further review.

The central intake nurse checked the referral form and attached documents for signs of OA. An x-ray report gave the nurse an indicator of the severity of OA for the patient. Answers to lifestyle questions – WCWL-style urgency questions – were used to assist in the judgment of the impact of OA on the patient. Height and weight were used to determine the health status of a patient entering the clinic, but were not required and would not result in a rejection of the referral by the nurse. Having determined whether OA is present and to what degree, the nurse developed a qualitative view of acuity for the patient, and then decided whether to accept the patient for a surgical consultation. The patient would either then be accepted for an MSK screening, an orthopaedic consultation, or rejected. If the patient was rejected, the referral was sent back to the administrator, who sent a denial notice to the referring provider with the reasons for denial. An MSK screening with a full-time surgeon was assigned to patients who showed low grade (severity) OA based on the x-ray and urgency question evidence. If there was evidence of higher level OA on the x-rays and evidence of high urgency based on severity questions, then the patient was assigned to a consultation with a surgeon.

Once a referral was accepted by the central intake nurse, either for a consultation or an MSK screening, the referral was sent back to the clinic administrator. If not made explicit on the referral form, the clinic administrator would contact the referring provider by phone and offer times for the patient to see the next available surgeon. The patient was then called and scheduled, and an acceptance notice was sent back to the referring provider and the patient. Along with the notice was a reminder for the patient to receive necessary dental care before attending a consultation. This would shorten the time needed to prepare for surgery if the patient was assessed surgical, and would provide a check for the orthopaedic surgeon to determine if the patient needed further long-term optimization before surgery. Approximately three weeks before

either the screening or consultation, the patient would then be contacted by the clinic administrator.

MSK screening took place approximately once a month, and was completed by a practicing surgeon. The surgeon determined whether a patient with low grade (severity) OA was surgical or nonsurgical based on clinical evaluation and review of the referral package. MSK patients were scheduled on a first-in-first-out basis, with paper records used by the clinic administrator for determining which patients should attend the screening and to triage the patients for scheduling. If the recommendation was nonsurgical, the patient was routed back to their referring provider with a medical management plan. If the patient was assessed to be a surgical candidate, the patient continued to a surgical consultation with an orthopaedic surgeon.

If the patient was receiving a revision surgery, the patient was not referred to the hip and knee clinic, but was instead kept by the surgeon. If the patient was receiving rehabilitation post-surgery, they were not formally accepted, but were scheduled to be seen by the surgeon or by the hip and knee clinic.

4.3.3 Results and analysis at clinic 3

4.3.3.1 Referral appropriateness

In the sample extracted from patient charts, no information was available on the reasons for denying/holding referrals. This information was not tracked electronically at this clinic, and any paper notations made at the time of rejection, or pending while information is received from the referring provider, were not included in patient charts after being processed. This was a limitation of the current EMR at the clinic.

During the time-tracking visit, information was also collected on the number of referrals that were accepted or rejected. Of the seven referrals received by the nurse at the central intake clinic, representing approximately two to three days of referrals, one was sent to the MSK physician at the central intake clinic for further screening, while the other six were forwarded onto the surgeons – no referrals were rejected. Of two incoming referrals seen by the secretary, representing slightly less than one day's worth of referrals, none were denied or put on a pending queue – both were referred onto the nurse for evaluation. All referrals that were evaluated during the time-tracking visit contained sufficient information, allowing both the secretary and the nurse to properly evaluate the patient.

Specific information on the template type is given in Table 17.

Table 17: Template type for referrals at clinic 3

Referral type present		47	(of n=50)
	ABJHI template	6	12%
	Other template	8	16%
	Letter	38	76%
	Other	1	2%
Missing		3	(of n=50)
	No information or missing	3	4%

Explanation for Other Template: Medi-Centre templates used.

Multiple sources: ABJHI template and letter (1), other template and letter (5) [hence of the 47 referrals with information, 41 contain one referral forms, 6 contain two referral forms].

Note: referrals encompass November 2009-December 2010, hence requirements for referral types may have changed over time.

Most referrals sent to Clinic 3 used a letter (76%). Another template and the ABJHI template were the next most used options for a referral, at 16% and 12%. This clinic had a template of its

own, which followed the ABJHI template, which is what most of the "Other templates" are in Table 17. This changed over the timeframe studied, so that most referrals received towards the end of the time period were letters and the ABJHI template.

Details of what are included on the referral forms, including the letters and both forms of templates, are noted in Table 18.

Table 18: Items included on referrals from referring provider for clinic 3

Included on Referrals:	Number included	% (of n=49 with data; n=1 missing data)
REFERRAL BASICS		
Patient demographics	48	98%
Referring physician info	48	98%
Preferred surgeon specified	10	20%
Next available surgeon specified	39	80%
Neither preferred surgeon nor next available surgeon specified	0	0%
Reason for referral	48	98%
Height	2	4%
Weight	2	4%
BMI	1	2%
Relevant medical history	47	96%
EVIDENCE OF OA		
Xray film	0	0%
Xray report	46	94%
MRI	6	12%
Whether an indication was given as to whether or not previous ortho surgery occurred	13	27%
IMPACT OF OA		
Relevant comorbidity history/complexity	35	71%
Medication list	32	65%
Medical urgency (lifestyle)	31	63%
Medical urgency (WCWL)	11	22%
Other	9	18%

Note: the next available surgeon option specifies whether a “next available surgeon” option was specifically chosen on the referral form. This contrasts to having a “preferred physician specified” in which a specific surgeon was given by the referring provider. If neither the “next available surgeon” option nor the “preferred physician specified” options were chosen, the referral was slotted to the next available surgeon.

Explanation for missing: No referral information available as patient was seen by orthopaedic surgeon previously (1).

Two different criteria can be used to judge what is being included on the referrals, in Table 18. Basing the criteria off what the clinic itself explicitly requires, the following results were obtained:

- Demographic information: All but one (98%) of referrals with information contained full demographic information upon first receipt. Missing information here would likely result in a call to the referring provider.
- Correct x-ray report: All but three (94%) of referrals received contained an x-ray report upon first receipt. However, since initial pending/rejected reports are unknown, it cannot be determined whether these were the correct x-ray reports (i.e. the correct joint or angle), or whether the x-ray report was unintentionally not included in the referral.
- Current medication: 65% of referrals included a list of current medications in which the patient was taking. This data served as a factor assisting the nurse in triaging patients for treatment.

Medical urgency, though not required, was noted by the nurse as another component that helped to triage patients either into the MSK screening queue at the central intake clinic or straight to a surgeon and their office for a consultation. Most referrals (65%) contained answers to lifestyle

questions, such as how the patient was affected by OA. These notes did not use the WCWL validated question list for medical urgency (22%), though 7 of 11 (63%) of the ABJHI templates completed the WCWL medical urgency questions. Similarly, only 4% of referrals contained height/weight information, though this was primarily used to determine the medical complexity of a patient, and was not a requirement for a completed referral. Some of the height/weight data could be attained using Netcare, which as an EMR was used widely by physicians in the clinic region.

The second criteria for judging the elements on a referral form are whether it matches the ABJHI referral template. In this case, all fields must be filled out, resulting in a complete referral form that would enable a nurse or surgeon to quickly and adequately triage a patient. The required elements are given in full in Table 18. As seen, multiple elements were not included, ranging from lifestyle questions to explicitly noting whether or not previous orthopaedic surgery occurred.

A determination for the percentage of surgical patients could be estimated, despite initial acceptance data missing. Of patients accepted (n=50), 38% (n=19) saw a MSK physician for initial assessment (see Figure 8 and Figure 9). Of those 19 patients, 32% (n=6) were assessed surgical, 63% (n=12) were assessed nonsurgical, and 5% (n=1) were assessed surgical but went on to surgical consultation. Of the patients seeing a surgeon for consultation, all of them were deemed surgical (n=38).

4.3.3.2 Accessibility

Consistent datestamps were collected from patient charts to determine wait times. The main dates were:

- Referral made by referring provider: the date on the referral form from the referring provider (not necessarily when the referral was sent by the referring provider);
- Referral received by clinic: the date on the referral when it was received by the clinic – either a faxstamp, or, if a faxstamp is in obvious error (e.g. wrong year), the date on the referral.
- Referral deemed complete by clinic: the date when the referral has been accepted, with all information complete, and the patient awaits either a MSK physician consultation with a surgeon at the central intake clinic, or a surgical consultation with one of the surgeons associated with the clinic;
- MSK physician visit: the date (in the clinic EMR) in which a MSK physician visit took place;
- Surgical consult visit: the date (in the clinic EMR) in which the first surgical consultation occurred.

Table 19 gives a listing of durations, in business days, for each relevant datestamp, relating to the Wait Times Rules. Date information is relatively incomplete, especially for data determining whether a referral was deemed complete. As well, several patients routed to MSK screening did not consult with a surgeon. As a result, in addition to the four main categories of wait times, two additional categories, in Columns 5 and 6, were estimated based on the referral received date. The referral received date was present in more of the observations than the date deemed complete, as evidenced in the last two columns.

Table 19: Wait times for different durations, in terms of business days per individual referral for clinic 3

	[1] Duration (business days): Referral made by referring provider → to referral received by clinic	[2] Duration (business days): Referral received by clinic → to referral deemed complete by clinic	[3] Duration (business days): Referral deemed complete by clinic → to MSK physician visit at clinic	[4] Duration (business days): Referral deemed complete by clinic → to surgical consult visit at clinic	[5] Duration (days): Referral received by clinic → to MSK physician visit at clinic	[6] Duration (days): Referral received by clinic → to surgical consult visit at clinic
Mean	7	16	-	131	63	132
Median	2	11	-	134	49	133
90%	15	20	-	181	116	198
std dev	15.77	23.31	-	47.13	42.53	85.08
25%	1	6	-	110	28	72
75%	4	17	-	160	97	168
Min	1	2	-	24	15	17
Max	86	113	-	223	159	487
N_present	47	22	-	22	17	36
N_missing	3	28	-	28	33	14

Note: The duration of "referral deemed complete to MSK visit" is included to show that direct comparison to the metrics used at the other two clinics is impossible, due to a lack of data.

Details on missing observations:

A total of 50 referrals were evaluated at this clinic. Of these:

- 2 do not have a referral made date, 2 do not have a referral received date (1 is missing both, hence n=3 for the first column missing)

- 2 do not have a referral received date, 28 are missing a deemed complete date (2 are missing both, hence n=28 for the second column missing)

While there are 29 MSK visits, 31 patients do not have an MSK visit. Combined with the 28 missing for a deemed complete date, there are no records that have both an MSK visit date and a referral deemed complete date.

- 12 do not have a surgical consult date. Combined with 28 missing deemed completion dates, hence n=28 for the fourth column missing (12 of the missing complete dates do not have surgical dates, while 16 do).
- 12 do not have a surgical date, 2 do not have a referral received date, hence n=14 missing in the fifth column (no record is missing both).
- 2 do not have a referral received date, 31 do not have an MSK physician date, hence n=33 missing in the sixth column (no record is missing both).

The mean time from the time that a referral was made by the referring provider to the time that it was received by the clinic was 7 days, with a median time of 2 days and 90th percentile time of 15 days. The mean time from the time that a referral was received by the clinic to the time that it was deemed complete by the clinic was 16 days, with a median of 11 days and 90th percentile time of 20 days. As seen above, approximately two-thirds of referrals arrive with all the elements required by the clinic. Most information (such as the medication list of a patient) that is missing can be collected via a call to the referring provider, as opposed to missing x-rays, which puts a burden on the patient to meet with the referring provider or another specialist again.

The mean time from the time that a referral was deemed complete to the time that the surgical consult occurred was 131 days, with a median of 134 days and 90th percentile time of 181 days. There were no referrals with details on deemed complete dates who also attended a MSK screening. The mean time from when the referral was received to when the MSK screening took place was 63 days, with a median of 49 days and 90th percentile time of 116 days.

For patients who went onto a surgical consult, the mean time from when a referral was received to the consult was 132 days, with a median of 133 days and 90th percentile of 198 days.

Information on the time that a referral was deemed complete was of very poor quality. This was designated as the date a letter was sent to the referring provider, saying that the patient was accepted at the clinic. These data were not always available, since the clinic would often call a referring provider if the referring physician asked for a next available surgeon option in the referral form. These calls were rarely noted in an electronically accessible form.

Two stratification analyses are given in Table 20. This gives wait times for several different datestamps, stratified by the type of joint causing pain for a patient (part a) and by whether next available surgeon or specific surgeon was selected on the referral form (part b). Information on complete or incomplete referrals is not recorded. The wait times represent the time that referrals are made to the time that referrals are received (column (i)), the time that referrals are made to the time that referrals are deemed complete (column (ii)), and the time that referrals are deemed complete to the time that the first surgical consultation occurs (column (iii)).

Table 20: Stratification of waiting times, by (a) type of joint, and (b) whether next available surgeon was selected on the referral form at clinic 3

(a) Type of joint:

	Knees			Hips		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon
Mean	9	17	150	4	30	104
Median	2	12	143	1	17	111
S.D.	19.64	20.97	35.75	6.73	38.30	50.06
Range	[1,86]	[3,85]	[97,223]	[1,26]	[3,118]	[24,165]
N	28	13	13	19	8	9

(b) Next available surgeon or specific surgeon selected:

	Originally received next available			Originally chose specific surgeon		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon	T_referral --> t_received	T_referral --> T_complete	T_complete --> T_surgeon
Mean	5	19	131	13	38	133
Median	1	11	134	4	25	165
S.D.	14.42	31.80	40.36	20.93	31.80	71.71
Range	[1,86]	[3,118]	[52,223]	[1,66]	[18,85]	[24,196]
N	37	17	17	9	4	5

Hips took longer to deem complete, with a mean of 30 days (median of 17 days) versus a mean of 17 days for knees (median of 12 days). Once complete, the mean time to consultation was 150 days for knees (median of 143 days), versus a mean of 104 days for hips (median of 111

days). The sample data size is similar to Clinic 2, with similar caveats surrounding sample size and interpreting the results.

For next available status, there was a significant difference in the mean durations. Patients whose referrals arrived completed took almost 50% less time to be processed from the time that the referral was made to the time that the referral was complete (19 mean days, 11 median days versus 38 days, 25 median days). From the time that a referral was deemed complete to the time that a consult took place, not much of a difference was noted (131 mean days, 134 median days versus 133 mean days, 165 median days). Sample sizes for those choosing a specific surgeon are small so results should be viewed with caution.

4.3.3.3 Efficiency

Specific details for tasks, and time spent at tasks, by central intake at Clinic 3 are given in Table 21. The time spent by staff at Clinic 3 per referral was approximately 9-13 minutes, depending on the feedback given to the referring provider. When estimated for the approximately 8 referrals per week that the clinic receives, these tasks take approximately 70-110 minutes (~1-2 hours) per week.

Table 21: Staff time per referral for specific tasks at clinic 3

	Evaluation of referral for completeness	Entering referral into clinic EMR	Feedback to referring provider	Scanning in information
Clinic 3	~2 min (by the clinic administrator) ~ 4 min (by the clinic nurse – also clinically evaluates the referral at this time)	~2 min (by clinic admin)	~2 min for accepted (by clinic admin) ~5 min for pending (by surgeon admin, calling an office or retrieving an x-ray) ~1 min for denied (by clinic admin)	<missing> (not incurred by the staff of the surgeon or the hip and knee clinic)

The time spent evaluating a referral was to confirm that demographics, an x-ray report, as well as a medication list and height and weight are contained within the referral package. The referral, once at the clinic, is measured by a clinical administrator and a nurse. The clinical administrator is in charge of scheduling, entering patient records into the clinic EMR, and interactions with the surgeons who send the referral to the clinic. Once the referral was deemed complete, it was forwarded onto a nurse at the central intake clinic. The nurse then evaluates the referral for OA, and triaging the patients to a MSK physician, or to a surgeon for consultation.

Evaluating the referral for completeness took approximately 2 minutes by the clinic administrator. The administrator then spent 2 minutes entering in data from the referral into the clinical EMR. Most referrals arrived via fax, so the entry was from paper into the EMR. The average call to find missing information on the referral took five minutes. If an x-ray was

needed, the administrator would have to wait until the x-rays are received to resume referral processing, but would be working on other tasks in the meantime.

Once accepted, it was sent to a nurse, who evaluated the referral. The nurse also evaluated the referral for clinical measures, determining the degree of OA. This took approximately 4 minutes for the nurse to complete. The range for the referrals seen at the time-tracking visit was 2-7 minutes.

The amount of time spent providing feedback to the referring provider varies. The nurse gave instruction to the administrator on whether the patient should be seen for a surgical consultation, should be denied, or should be sent for MSK screening by a surgeon at the clinic. It took an average of 2 minutes to send an acceptance notice to the referring provider, and 1 minute to send a template denial notice.

Scanning costs are not incurred by the clinic; rather, these are incurred by each surgeon specifically. As well, this highlights the time spent by staff on a specific task, not necessarily the time it takes to complete a task. Ordering an additional x-ray for a patient would result in a longer, system-related wait time incurred by the patient, and not necessarily a further amount of time incurred by the clinic staff.

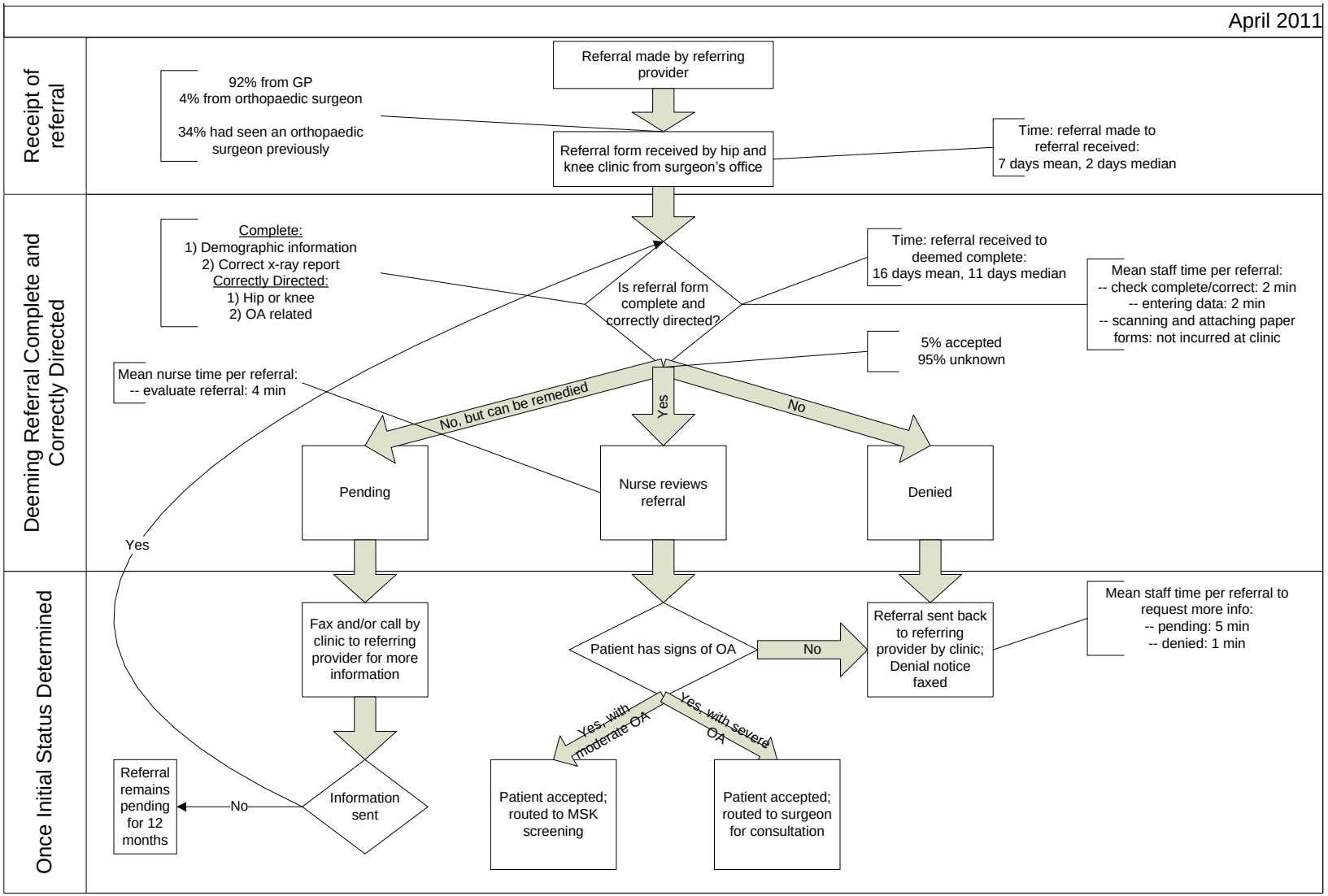

Figure 8: Patient referral process from referring provider to complete and correctly directed referral at clinic 3

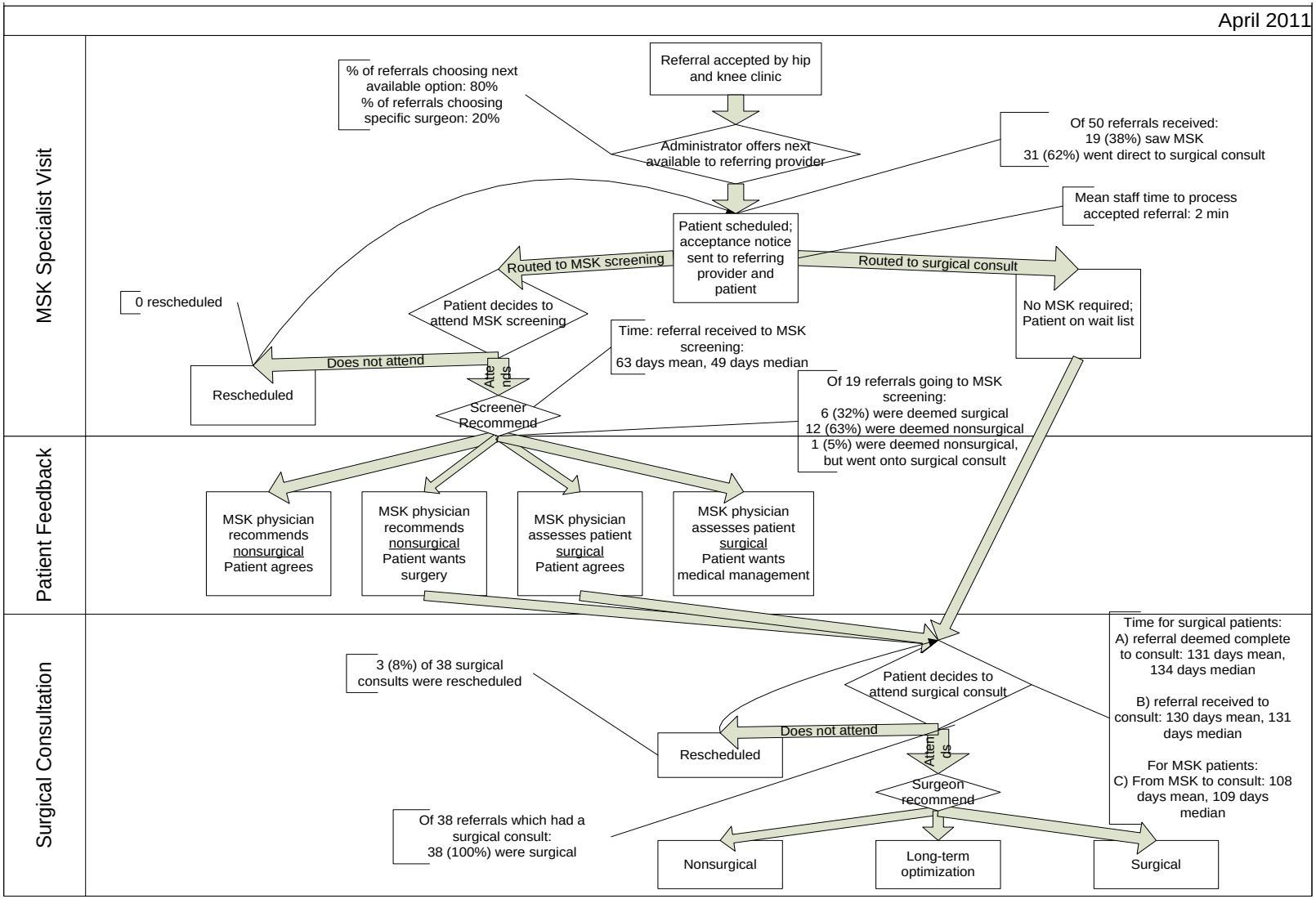

Figure 9: Patient referral process from accepted referral to surgical consultation at clinic 3

Chapter Five: **Manuscript One: Voluntary versus Involuntary Waiting for Joint Replacements: New Alberta Wait Times Rules for Hip and Knee Arthroplasty with Provincial Consensus**[8]

5.1 Introduction

Wait times for surgical procedures are an indicator of the public's access to the healthcare system and a reflection of the efficiency of resource utilization.[49] Increased demand for hip and knee arthroplasties has created concerns about long patient wait times for care and stimulated calls for potential solutions. By collecting information on wait times, strategies can be developed to improve access to healthcare services and meet targeted waiting times.[49] In general, the time a patient must wait for surgery varies by type of procedure, the number of patients waiting, the urgency of the surgical procedure based on disease severity, treatment patterns of physicians, and bottlenecks in the system such as staff and operating room time availability.[47,49,52]

In 2004, the First Ministers of Canada made timely access to quality care a priority in five areas: oncology, cardiology, diagnostic imaging, joint arthroplasty and sight restoration. Subsequently, in 2005, pan-Canadian benchmarks for seven procedures were established, with $3.8 billion allocated nationally since 2004 to reduce wait times through the Wait Times Reduction Fund.[11] As one of these benchmarks, the completion of a hip or knee arthroplasty from the point of decision to the date of surgery was set at 26 weeks.[3,68] Since then, provincial ministries of health across Canada have worked on strategies to create and monitor wait management systems for a range of specialized services.[57]

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[8] Published in Longwoods Healthcare Quarterly (Volume 15, Issue 3, pages 36-45), and provided here with consent of Longwoods Publishing. Authors are Deborah Marshall, Tanya Christiansen, Christopher Smith, Jane Squire Howden, Jason Werle, Ken Fyie, and Cy Frank. Web address for the journal is http://www.longwoods.com/publications/healthcare-quarterly; web address for the article is http://longwoods.com/content/23019 In this article, I assisted in preparing the manuscript, researching the background for the Wait Times Rules, and in development of the involuntary and voluntary waiting time definitions.

Despite system improvements in joint replacement across Alberta since 2004, using detailed care maps and new provincial practice approaches, as of 2010 benchmarks were still not being met. Although an overall decreased wait time trend was observed over a three year period from 2005 to 2008, the benchmark of 26 weeks was not being met by 23% of patients undergoing a hip arthroplasty and 28% of patients undergoing knee arthroplasty in Alberta.[3,49] Therefore, ongoing efforts are needed to continue to reduce wait times to ensure that all patients receive timely access to joint arthroplasty.

Alberta Health Services (AHS) is publicly funded and mostly responsible for the planning and delivery of care for 3.7 million Albertans. In 2010, AHS established the AHS Bone and Joint Clinical Network (BJCN) as a multidisciplinary provincial advisory network whose objective is to improve musculoskeletal (MSK) health services planning and implementation and ultimately the quality of care. Its Hip and Knee Arthroplasty Working Group (HKWG, a BJCN committee that focuses specifically on hip and knee arthroplasties) and the Alberta Bone and Joint Health Institute (ABJHI, which provides decision support to BJCN programs) pursued a wait times improvement initiative. Developing a new framework with standardized definitions and measurement metrics, this initiative produced a set of Wait Times Rules for hip and knee replacement patients.[62]

In this chapter, we present the motivation, process, and framework that formulated the Wait Times Rules. A key step in developing this framework involved the measurement of wait times across the entire care continuum using a standardized approach that differentiates between waits that are “voluntary” and patient-directed versus those that are “involuntary” and system-related. For example, a wait that is caused by a patient choosing to travel or live outside of the

province for an extended period should not be counted as part of the wait time as it is not a system-related wait.

The objectives of this chapter are twofold. The first objective is to outline the development of a framework and measurement metrics for the Wait Times Rules. The second objective is to outline where, from the point of first contact to surgery, wait times result from involuntary system-related waits that are unavoidable by patients versus voluntary factors that are influenced by patient preferences or choices.

5.2 Wait Times Rules: A five-phased process for development and implementation of a standardized approach

The rationale for developing and implementing the Wait Times Rules was the need to create a system to accurately track waiting times across the full care continuum, to assess performance and to implement changes to manage and reduce unnecessary waits. The development of the Wait Times Rules took place over five phases outlined in Table 22: determining the feasibility of the wait times initiative, gaining consensus through expert consultations on the data elements required, drafting and gaining approval of the Wait Times Rules by consulting with experts, and, finally, integrating the rules into government policy.

5.2.1 Phase One: Feasibility of a standardized provincial approach to measuring wait times

To begin the development of a provincial wait times tracking system, ABJHI referred to several sources to determine which event dates and other wait times data elements should be included. The initial sources included key performance indicators from a hip and knee care pathway and MSK clinic data from across Alberta.[73] The care pathway and a measurement framework incorporated patient and system quality of care outcome measures specific to total hip and knee

arthroplasties and were based on the six dimensions in the Alberta Quality Matrix for Health, which includes acceptability, accessibility, appropriateness, effectiveness, efficiency, and safety.[13]

The clinic data were collected from the MSK central intake clinics in Alberta, which provide total hip and knee arthroplasty health services. These clinics provide a central location for patient consultation with an orthopaedic surgeon and a comprehensive multidisciplinary assessment by a team of healthcare professionals specializing in joint replacement.[163] As of 2012, there were 9 MSK clinics located in the province and each has a catchment area to reach Alberta residents living in both rural and urban centres. Data collected by these clinics prior to the development of the Wait Times Rules had inconsistent start and end times of event dates; however, by meeting with each of these clinics, we were able to make comparisons to develop a standardized set of definitions.

ABJHI consulted with the BJCN, the HKWG and their constituents to determine which waiting time measures were important from the perspective of system performance, and the feasibility of developing a standardized provincial approach to data collection and reporting. This expert consultation process identified the seven key event dates that could feasibly be collected in a standardized manner and the measurement intervals that would distinguish between voluntary and involuntary waiting times. On this basis, they created the initial draft of the Wait Times Rules (Figure 10).

5.2.1.1 Wait times definitions

The seven key event dates include: the time of referral by a primary care provider, date the referral is received by a clinic, date of MSK screening visit (an evaluation by an orthopaedic

surgeon or MSK expert, if applicable), surgeon consultation date, date patient is ready to proceed with surgery, and the date patient receives surgery (Figure 10). In addition to collecting these event dates, the Wait Times Rules includes the documentation of patient characteristics and demographics to determine the number of patients waiting, where they are waiting and for how long they are waiting on a real-time basis in each service zone.

Standardizing definitions is recognized as an important first step towards implementing change, by improving the management and reporting of waiting time information.[57] In the literature, wait times have typically been defined at a high level and aggregate all steps between the primary consultation and the first specialist consultation into one wait.[57] What is unique about the definitions in the Alberta Wait Times Rules is that they go beyond the four measures commonly reported in the literature: referral date, surgeon consultation date, surgical decision date and date of surgery, to include an additional three time points which are: referral date received, MSK consultation date, and patient ready for surgery date. More detailed descriptions of these event date definitions are available in Table 23. Using these standardized wait time definitions, planners in the future will have a more accurate inventory of the number of patients waiting and where they are waiting.

Of particular interest will be the data collected around the event date described as patient readiness for surgery (T_{Ready}). This is a unique measurement in the Wait Times Rules and is expected to yield useful information for decision-makers because it differentiates between system-related (involuntary) and patient-related (involuntary) waiting times.

5.2.1.2 Waiting Time Measurement Intervals

To date, most wait time studies have not distinguished between voluntary and involuntary waiting. Typically, the three wait time intervals reported in the literature have been time waiting to see a specialist, the time to surgery and the total wait time from point of referral to the point of surgery.[57] The differences in how these wait times intervals are determined primarily depends on how the wait period is defined – where it begins and where it ends – which emphasizes the importance of the first step of establishing clear and standardized definitions.[57]

Wait time definitions that do not sufficiently delineate between involuntary and voluntary waits can result in ineffective wait time initiatives because the waits might actually be due to patient choice and not be influenced by health system capacity. Thus, our involuntary wait times interval was defined as a clearly system-related wait due to the limited resource availability (e.g. surgeon time, operating room time, in-patient beds and other required equipment) as well as wait time for consultation with other medical specialists who are all independent practitioners (e.g. dentist, anaesthetist, internal medicine). Involuntary waiting also included waits due to incomplete or inappropriate referrals that caused delays. In contrast, the voluntary waiting time interval was patient-related and directly impacted the ability to deliver care in a given time frame due to social (e.g. patient choice, vacation, work responsibilities), functional (e.g. home support not arranged) or medical factors (e.g. medical optimization plan not followed, such as smoking cessation, weight loss).

Figure 10 outlines voluntary waiting time intervals from $T_{Received}$ to T_{Ready} where the interval between $T_{Received}$ to $T_{Decision}$ can also be due to involuntary factors. Both the initial time interval from $T_{Referral}$ to $T_{Received}$ and the final time interval from T_{Ready} to $T_{Surgery}$ are considered involuntary waiting times.

Determining the proportion of a patient's wait that is influenced by involuntary versus voluntary factors will allow us to more specifically focus on operational system changes that can further reduce waiting times. By distinguishing and comparing between voluntary versus involuntary wait times, we will be better able to explore which patient factors may be significant predictors of longer wait times (e.g. age, sex, geographic location, the specific surgeon), and will be able to determine how system performance can be included, from the system perspective (involuntary delays) and incentives for patients (voluntary delays).

5.2.2 Phase Two: Consultation with experts

ABJHI solicited feedback from the HKWG on the drafted Wait Times Rules, the proposed framework and wait times definitions. This working group has representation from the MSK central intake clinics, hospitals, surgeons, primary care physicians, allied health, system administrators, policy makers and government.

In addition, ABJHI discussed the feasibility of a provincial tracking system and gained consensus on the Wait Times Rules, by conducting a survey of the 9 clinic sites across Alberta where most hip and knee arthroplasty surgeons were located. The primary intent of this survey was to gather input about the drafted Wait Times Rules and to gain an understanding of the data available at each site. A document detailing the data elements required to populate the Wait Time Rules was distributed by ABJHI to the 9 sites across Alberta.

Overall, survey participant feedback was primarily positive and supportive, with participants reflecting an overall understanding and acceptance of the Wait Times Rules and the need for a consistent mechanism for wait time reporting province wide. However, there was some concern expressed from MSK central intake clinics and acute care sites regarding the

difficulties that may be encountered at an operational level if additional data collection were needed, as this may alter current work flows. Also, several sites had electronic medical records that did not facilitate the collection of all the data required to fulfill the rules. The final concern was related to collecting the "patient ready for surgery date." As a patient is assessed and optimized for surgery, there are several factors that contribute to patient readiness. The patient must be ready (functionally prepared), willing (socially prepared) and able (medically prepared). Due to the variances in when these clearances occur, the plan was to address these on a site-by-site basis once the Wait Time Rules were finalized.

5.2.3 Phase Three: Finalizing the Wait Times Rules

The accurate measurement of wait times is dependent upon the availability of correct information related to the referral processes.[57] Therefore, before finalizing the Wait Times Rules a few additional steps were required. First, a system had to be put in place to intervene if patients referred for a surgical assessment could not be seen within a reasonable time frame. As part of Alberta's Five-Year Health Action Plan, 14 weeks for 90% of patients needing a total joint arthroplasty was established in November 2010 as the Alberta-specific wait times target. Second, as with any centralized repository of health information, steps were taken to fully ensure patients' privacy and the protection of their health information. Additionally, ABJHI entered into legal agreements with AHS and arthroplasty surgeons to perform quality assurance and improvement monitoring on an ongoing basis. Following these additional steps, the final draft of the Wait Times Rules was obtained in June 2010.

5.2.4 Phase Four: Implementation of the Wait Times Rules

As of May 2012, Wait Times Rules implementation awaited ministerial sign-off for provincial implementation as per the Alberta Wait Time Measurement and Wait List Management Policy for Scheduled Services. The ability to collect all wait times elements accurately and in real time is highly dependent on the availability of an electronic system, as manual collection is difficult. Starting May 2011, with the launch of the BJCN Transformational Improvement Program, all sites have been responsible for collecting, at minimum, data for the periods $T_{Received}$ to $T_{Surgeon}$ and $T_{Decision}$ to $T_{Surgery}$.

5.2.5 Phase Five: Integration of Alberta Wait Times Rules into government policy

The Alberta Wait Times Rules were integrated into the Alberta Wait Time Measurement and Wait List Management Policy for Schedule Services. Phased implementation of this Wait Time Policy was expected to begin in all publicly funded, scheduled health services in Alberta starting January 2012.

5.3 Key Learnings

Throughout Alberta, before the implementation of a standardized provincial approach, wait times were measured inconsistently and were not defined in a standardized manner; making wait time calculations between jurisdictions subject to error. Through a highly collaborative effort and a unified framework, we have now identified and implemented with greater detail specific time points and other data elements that more clearly define wait times specific to total hip and knee arthroplasties. Meeting with MSK central intake clinic staff and clinicians were a primary resource for understanding which data elements were feasible to collect across the province.

Through these meetings, we were able to gather real-time information that will allow us to make informed health policy decisions in the future. To complement the valuable clinically based data we received, the expert committee helped set the framework for the Wait Times Rules from an organizational perspective.

The involvement of the MSK central intake clinic staff has been vital to improving patients' perspectives. Aside from their ability to explain to patients the streamlining of coordinated multidisciplinary services offered through these central locations, they also explain to patients how they are part of a provincial initiative that aims to more closely monitor and decrease patient wait times. In this way, clinic staff can further ease patient concerns regarding having to wait too long for their surgery and possibly experiencing more pain symptoms and further functional decline. Significant effort was also directed towards facilitating communication between the MSK central intake clinics and the expert working group in order to finalize the data elements.

In the Wait Times Rules we addressed this issue of geographical location by including MSK central intake clinics with patients residing in both rural and urban centres. Geographical location has not been closely examined until now. However, if every patient in every zone is combined into one wait time, we hide substantial heterogeneity that is not accounted for in the benchmarks. Recognizing that aggregate wait times mask the differences that covariates such as age, comorbidities, geography, gender, etc. can create in wait times, our collaborative initiative to develop a tracking system will also facilitate the management of the provincial wait lists to recognize relevant high-risk subgroups.

Overall, the development of the Wait Times Rules has enabled us to separate out elements of the wait time from the point of referral to the point of surgery. Having progressed

this far, our attention will now focus on system factors that can be improved upon by operational changes. Our next step will be to compare the decision date to the ready date in order to quantify time spent in optimization or preparation for surgery.

The Wait Times Rules also catalyzed the process to develop an electronic referral system from primary care to specialist care; this is currently in progress through AHS. Once developed, this electronic referral system will enable the tracking of referrals on a province-wide basis for all elective surgical procedures, with automatic time-stamping of the seven key dates established in the Wait Times Rules.

5.4 Conclusion

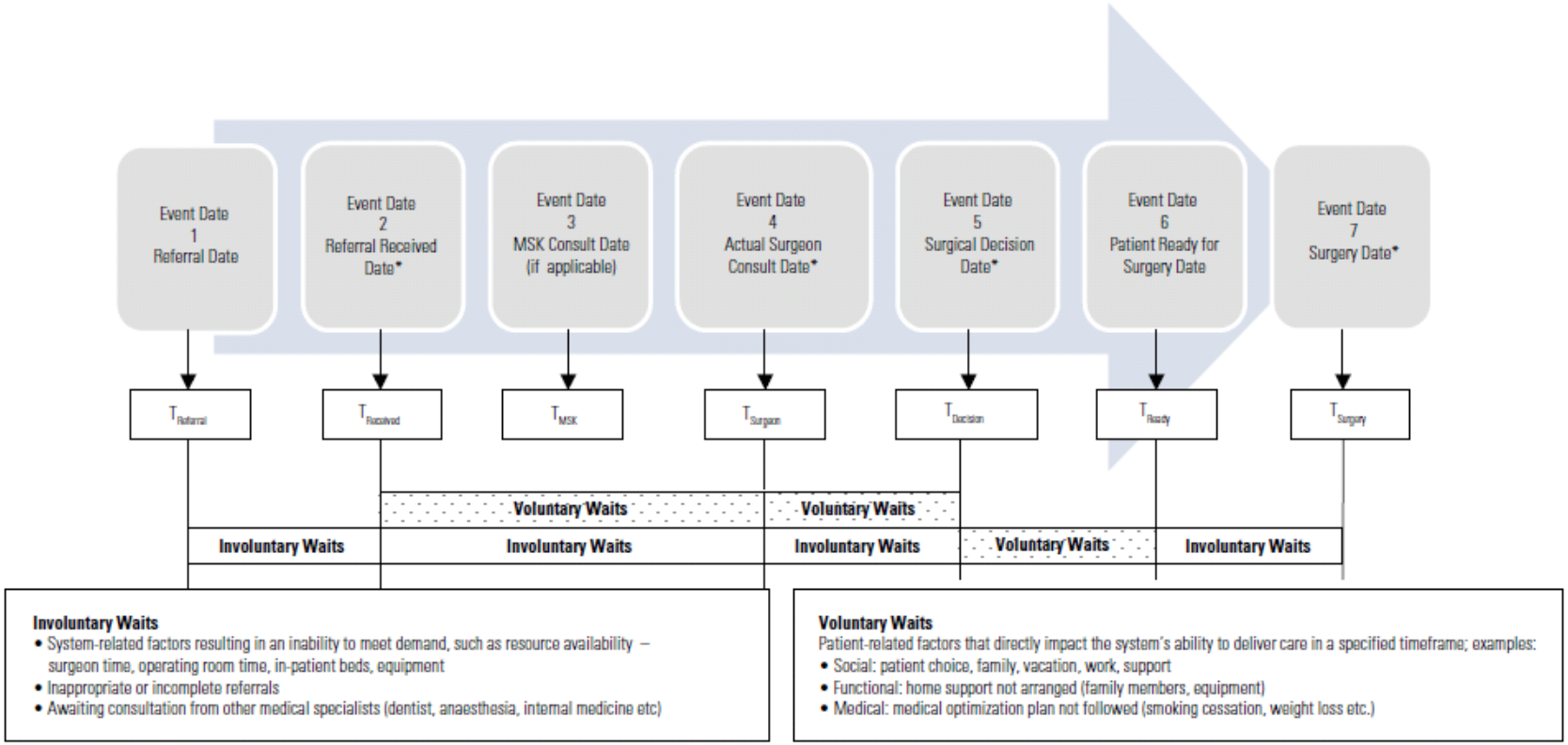
The development of the Wait Times Rules for hip and knee arthroplasties has laid the foundation to develop online referral of appropriate patients from primary care to specialist care plus enable subsequent tracking and feedback to enhance workflows and eliminate waste. The Wait Times Rules will track wait times across the full continuum, from the referral date through to surgery date. The rules will also help inform decisions about health policy options such as offering the next available surgeon. At institutions where queue lengths are long, policy makers may consider a redistribution of cases to another institution, with the aim of reducing treatment delays.

Standardized definitions and a standardized approach in the way wait times data are collected will give planners the means to accurately assess inventory and determine the number of patients waiting, where they are waiting and for how long on a real-time basis across the province and in each service zone. Current systems do not measure or report waiting times across the full continuum of time from the referral date through to surgery date. Measuring only the wait times from consultation to surgery can cause unintended consequences when strategies to

meet benchmarks are focused only on reducing this specific waiting time – wait times from referral to surgeon consult may increase, resulting in no benefit to the patient in terms of a shorter overall waiting time. In addition, current systems do not differentiate system failures from patient choice to wait – all waits are attributed currently to the system. The Wait Times Rules distinguish between involuntary versus voluntary wait times to differentiate between waits that are a consequence of system performance versus the result of a patient's choice to wait. Collectively, this information will help identify trends in waiting times and more appropriately direct improvement efforts.

As more data are collected, we also will gain a greater depth of understanding of the voluntary factors that influence waiting times and any trends in patient characteristics associated with these factors. We may find potential avenues by which to reduce waiting times through enhanced patient education strategies by addressing any concerns related to patient factors that could lead to longer wait times (e.g. concerns over weight loss prior to surgery, smoking cessation strategies).

The ultimate goal of the Alberta Wait Time Rules is to eventually meet the current Alberta-specific benchmark of 14 weeks from consult to surgery for 90% of patients needing a total joint arthroplasty. Future system-based initiatives to reduce wait times may include enhanced care map tracking and the implementation of real-time electronic alerts when wait times exceed benchmarks. These types of strategies may significantly enhance care path flows, improve timely decision-making and reduce wait times even further for total hip and knee replacements.



*commonly reported waiting times collected in THA and TKA databases

Figure 10: Data elements defining hip and knee arthroplasty wait times according to the Alberta Wait Times Rules

Table 22: Development phases of the Alberta Wait Times Rules

Wait Times Rules Development Phases and Actions
Phase one: Feasibility of a Standardized Provincial Approach to Measuring Waiting Times ➢ Determined feasibility of developing a provincial wait time tracking system and to identify key measures of system performance.
Phase two: Consultation with Experts ➢ Received expert feedback on the Wait Times Rules needed for a provincial tracking system
Phase three: Finalizing the Wait Times Rules ➢ Final draft endorsed by Working Groups including proposed framework and waiting times definitions.
Phase four: Implementation of the Wait Time Rules ➢ Implementation of the Alberta provincial tracking system for hip and knee arthroplasty with clinic sites collecting data by July 2010.
Phase five: Integration of the Wait Time Rules into Government Policy ➢ Integration of Wait Time Rules into the Alberta Wait Time Policy document by the Government of Alberta Dec 10, 2011.

Table 23: Data elements in the Alberta Wait Times Rules minimum dataset

Data Element	Abbreviation	Rationale
1. Patient's family name		Patient identification.
2. Patient's given name		Patient identification.
3. Patient's unique lifetime identifier (ULI)		Patient identification.
4. Patient's date of birth		Patient identification.
5. Patient's sex		Patient identification.
6. Joint (Hip, Knee) for which patient was referred (or is being assessed if this is a second joint)		Case identification
7. Side (left, right, bilateral)		Case identification
8. Date specified on the referral	$T_{Referral}$	To measure variances between date of referral and date referral is received.
9. Date referral received by clinic	$T_{Received}$	Starting point for wait for consultation.
10. Next available surgeon or first and last name of surgeon patient is assigned to		Stratifying appropriate wait list.
11. Patient accepted next available surgeon (Y/N)		If next available is not accepted, patient wait for a specific surgeon waiting period begins
12. Date of consultation by MSK physician	T_{MSK}	Stratifying appropriate wait list. Possible ending point for wait for consultation.
13. Actual date of consultation by surgeon	$T_{Surgeon}$	Ending point for wait for consultation.
14. Date of decision to proceed to surgery	$T_{Decision}$	Beginning point for wait for surgery.
15. Date patient is ready (medically, functionally, socially) for surgery	T_{Ready}	Includes patient deferrals, necessary medical preparation time and other

Data Element	Abbreviation	Rationale
		voluntary waiting time from wait for surgery.
16. Date of surgery	$T_{Surgery}$	Ending point for wait for surgery.

Chapter Six: **Analysis Article 1: Improving the Primary-to-Specialist Referral System for Elective Hip and Knee Arthroplasty in Alberta: Accessibility, Referral Appropriateness, and Efficiency**

6.1 Introduction

Waiting lists are used to manage patient access to specialists for many surgical procedures in Canada, with long waiting times being a concern.[4,5,165] A prime example is the surgical management of hip and knee osteoarthritis. Increased incidence and persistently long waiting times have resulted in Canada's First Ministers declaring hip and knee total joint arthroplasty (TJA) a priority area.[3] TJA is an end-stage intervention for osteoarthritis (OA), a degenerative condition of the hip and knees present in up to 40% of individuals over 70 years.[33,166-169] Hip and knee referrals to musculoskeletal (MSK) specialists are often inconsistently measured, with incomplete referral content, resulting in processing inefficiencies and unnecessary delays for patients.[15,49,100,124,126]

The specific goal was to evaluate current referral practices at three MSK specialist clinics in Alberta through mixed methods, using three quantitative system measures reflecting quality of care: accessibility (waiting times for referral processing), appropriateness of referrals (complete and correctly directed referrals), and efficiency (clinic time processing referrals), using a retrospective cohort of patients and consistent measurements for referrals and times. This chapter was designed to evaluate waiting times from the primary care provider (*T_referral*) to an orthopaedic specialist (*T_surgeon*), and steps in between, for patients who have been referred to MSK clinics (Table 24 shows timestamps for each step). It also addresses how many patients awaiting TJA in those settings will choose a specific surgeon or the next available surgeon. With regard to referral appropriateness, this chapter addresses whether referral forms sent to

specialists are complete enough to be processed at the surgeon's office. This is addressed by describing and analyzing the existing hip and knee referral process from *T_referral* to *T_surgeon*. With regards to efficiency, this chapter evaluates in detail the processes and timing for evaluation of referrals to clinics. The measures of accessibility, referral appropriateness, and efficiency provide a comprehensive view of clinic practices and statistics, and a framework to determine the effectiveness of future process-enhancing tools and reduce inefficiencies in referral processing.

6.2 Methods

6.2.1 Clinics and patient population

In Alberta, there are currently nine MSK clinics located throughout the province accepting patients for TJA consultations. Three representative clinics among those volunteered as pilot sites for an evaluation of their referral processes through the Alberta Hip and Knee Arthroplasty Working Group of the Bone and Joint Clinical Network (BJCN) of Alberta Health Services (AHS), the provincial organization responsible for health care delivery for 3.7 million Albertans. These volunteering clinics represent approximately one-third of hip and knee referrals in Alberta, and have different characteristics ranging, among several, from complexity of the patient based on ASA standards to technological use based on reliance on paper records (Table 25) and rules for processing referrals (listed in Results section 6.3). The patient population of this study includes only incoming individuals having hip or knee pain with evidence of arthritis in a previously non-replaced joint. Second joint pain and revisions are routed directly to the surgeon, while referrals for rheumatoid arthritis are routed by the clinics elsewhere.

6.2.2 Measurement outcomes

Three system performance metrics were selected to evaluate referral processing performance. These metrics were defined based on the Health Quality Council of Alberta's *Alberta Quality Matrix for Health*, which was adapted from the Institute of Medicine.[13,17] Detailed waiting time and referral appropriateness definitions are listed in Appendix A.

- Accessibility: Obtaining health services in a reasonable time. This is measured by consistent waiting time elements, the percentage of patients selecting a next available surgeon, and attempting to determine if waits are due to voluntary, patient-related causes, or involuntary, system-related causes.
- Appropriateness of referrals: Health services based on evidenced-based practice. This thesis does not analyze appropriateness of the *patient* for a consultation[114], but whether a referral contains all necessary information for the clinic to make an accurate assessment of the need for surgical assessment. This is measured by the percentage of complete and correctly directed referrals.
- Efficiency: Optimal use of resources. This is measured by the clinic time spent per referral on specific processing tasks.

6.2.3 Research methodology

This study used mixed methods, including semi-structured interviews, time studies, and retrospective chart reviews to collect qualitative and quantitative data describing current referral processing performance at each clinic:

1) *Initial clinical visits*. At these visits, a semi-structured interview occurred between researchers and clinical staff. This produced a map of choices and the paths a patient referral

could follow, which were plotted using Microsoft Visio. A list was made of data variables which were electronically tracked at the clinics. After these clinical visits, performance measures were chosen.

2) *Time tracking*. At each clinic, personnel who process referrals were tracked using time studies. This timed clinic staff at various steps of referral processing, and gave researchers an opportunity to ask detailed questions regarding referral processing.

3) *Patient chart review*. Researchers reviewed information from a retrospective sample of clinical charts from January through October 2010 and extracted information using a standardized data template. This allowed for consistent timestamps to be collected for patients at each step in referral processing and determining information included on the referral form for each patient. Two outcomes were selected for determining sample size: improving the percentage of complete and correctly directed referrals (from an a priori estimate of 65% to 99%) and decreasing waiting times between the time a referral was first made and the time a first surgical consultation occurred (by 10%). To achieve 80% power, 127 patient charts at Clinic 1, 41 at Clinic 2, and 50 at Clinic 3, were sampled by researchers. Charts were chosen to maintain a 60%/40% knee-to-hip ratio.

6.2.4 Descriptive analysis

Means and medians for the accessibility, referral appropriateness, and efficiency variables were estimated. Graphs displaying the dispersion of these variables, as well as additional stratification and statistics such as standard deviations and ranges, are available upon request. Data was originally compiled on a Microsoft Excel worksheet, with analysis of results completed using

Stata 10. Ethics approval was received from the Conjoint Health Research Ethics Board at the University of Calgary (ethics number E-23601).

6.3 Results

A generalized referral processing map for the clinics is shown in Figures 11-12. Referrals are produced by a referring provider (*T_referral*), received (*T_received*) and triaged by the MSK clinics with incomplete information collected by staff at the clinics (*T_complete*), followed by patients potentially receiving MSK screenings from an MSK specialist that assessed patients for further treatment (*T_MSK*) and surgical consultations from an orthopaedic surgeon that screened patients for TJA candidacy (*T_surgeon*). All three clinics had a defined process for incoming referrals and rules for deeming referrals complete, however those rules were different between the clinics. The three clinics each employed surgeons, physiotherapists, occupational therapists, nurses, medical office administrators, and program administrators. Several differences exist among the clinics. MSK specialist triaging and next available surgeon options are unavailable at some clinics (Table 25), limiting patient accessibility. Multiple staff at each clinic process referrals, resulting in different processing times at each clinic.

Accessibility outcomes are listed in Table 26. The mean waiting time it took a referral to be acknowledged from a referring provider ranged from 3 to 8 days per clinic, with 252 days the maximum for any referral. Determining whether a referral is complete and correctly directed, and attaining information, ranged from 4 to 16 days, with 296 days the maximum for any referral. From when a referral was deemed complete to when a surgical consultation took place had a mean ranging from 42 to 131 days, with 293 days the maximum for a referral. At the two clinics where the option for a next available surgeon was given, it was chosen by 71% (n=90)

and 80% (n=40) of patients, respectively. Patients who selected a specific surgeon do wait longer, by 36% at Clinic 1 and 14% at Clinic 3.

Determining referral appropriateness depended on clinical requirements and rules, which differed at the three clinics, and are listed in Table 27. For Clinic 1, these required elements were originally completed in 100% (n=127) (demographics) and 90% (n=124) (x-ray report) of referrals, with 73% (n=93) (medical urgency) of referrals having optional requirements completed. This resulted in a total of 80% (n=102) of referrals accepted upon first receipt. At Clinic 2, 97% (n=40) (demographics and x-ray report), 42% (n=17) (height and weight) and 39% (n=16) (BMI) were originally completed. This resulted in a total of 46% (n=19) of referrals being accepted upon first receipt. At Clinic 3, 98% (n=49) (demographics), 94% (n=47) (x-ray report), and 65% (n=33) (previous patient medications) were originally completed. Due to software limitations, acceptance status could not be determined at Clinic 3. Fewer than one quarter of referral forms would have been considered as fully completed with respect to a standardized provincial referral. When given, validated Western Canada Waiting List (WCWL) urgency questions were not completed on the majority of referrals.[116] MSK physician screeners were used to differentiate between patients of low urgency who could be medically managed, and high urgency, possible surgical candidates. A total of 87% (n=110) and 38% (n=19) of patients at clinics 1 and 3, respectively, saw an MSK physician. Of those, 33% (n=36) of patients at Clinic 1 and 63% (n=12) at Clinic 3 were assessed as being nonsurgical at the screening. Patients with referrals first accepted saw 75% and 53% lower waiting times at Clinics 1 and 3 between *T_referral* and *T_complete*.

Efficiency measures estimate staff time for different referral processing steps (Table 28). A range of 6 to 80 referrals were processed per week, with initial processing occurring daily to

once a week, depending on staff availability. Deeming a referral complete took approximately 2 minutes by the initial reviewer. If a referral was deemed complete and correctly directed, follow-up time for a nurse to accept or deny the referral (based on evidence of OA) was 4 minutes. Incomplete information increased the time necessary to process a referral, with the processing time both increasing in variance and often not just incurred at one specific date, which increased patient waiting time further. Denied referrals required explanation in letters to referring providers, taking 1 to 5 minutes per referral.

6.4 Discussion

This chapter showed that current referral processing is subject to problems from inconsistent information on referrals that don't match the variable referral appropriateness criteria of the receiving clinic, with 20-54% of referrals initially denied upon arrival to clinics. Without the knowledge of the patient or their referring physician, patients are put in a holding pattern until missing information is sent and are thus not properly triaged to medical management, an MSK or multidisciplinary triage team assessment, or to a surgical consultation. The mean waiting time (per clinic) from *T_referral* to *T_surgeon* of 51 to 139 days, with one referral taking 486 days to result in a surgical consultation, is not currently tracked by publicly available measures. System-related reasons for waits – the interval between *T_referral* and *T_complete*, where a patient has no ability to influence the referral – account for at least 11% to 16% of the total waiting time. These waits included delays from staff not having time to immediately process referrals and delays in obtaining information to complete a referral. No further information on system-related, or patient-related waits, could be noted from patient charts. Put together, patients have no idea how long expected waiting times are from a first referral to a surgical consultation, and face

longer delays due to processing inefficiencies arising from incomplete and incorrectly directed referrals. Some options, such as a next available surgeon option, may reduce these uncertain waiting times when offered to patients. With the waiting times estimated above, proper benchmarks can now be set for this priority area, with the aim of reducing delays in receiving care and surgery. The usage of MSK screeners in the treatment pathway has been shown in this evaluation, and elsewhere, to increase accessibility and improve the ability of clinics to properly triage, giving patients correct treatment at the correct time.

These outcomes result in some interesting comparisons to previously published studies. The waiting times from *T_referral* to *T_surgeon* suggest that patients had to wait longer than maximum acceptable waiting times for *surgery*.[80] Patient uptake of a next available option was greater than some previous estimates, and implies patients do value accessibility.[77,81,170] The percentage of referrals initially not accepted due to lack of information or a patient not being appropriate for consultation reflects dissatisfaction previously noted by specialists regarding referral information.[93,94] Referrals that do not contain sufficient information do not allow patients to be triaged into medically managed and surgical groups, which potentially increases waiting times for both groups.[9] Correspondingly, poor feedback from surgeons to primary care might result in patients being lost and not receiving therapies when transitioning between providers.[14]

Several limitations exist in this analysis. The selection of patient charts, though intended to be representative, may not be, especially with some clinics eliminating patient records for denied referrals. The time studies may have resulted in improved productivity among clinical staff, due to third party observation. Voluntary causes of waiting were not tracked at any clinic, resulting in voluntary reasons for waiting, such as specific patient choices, not separated from,

current waiting time calculations. Finally, only three clinics were chosen for analysis, meaning the results may not be generalizable across Canada or elsewhere. However, as noted in the methodology and in Table 25, the clinics had characteristics which are representative of the nine clinics throughout Alberta and the findings may have relevance to other systems and countries.

A referral tool that incorporated several of these changes would produce better outcomes for both patients and the healthcare system. A non-passive intervention, such as an electronic tool, for processing referrals would be more effective at increasing the percentage of accepted referrals, confirming elements such as x-rays and BMI are on sent referral forms.[88] This would be accomplished by ensuring referrals are complete and correctly directed, eliminating multiple referral queues arising from different completion requirements. This would also increase efficiency by reducing clinical staff time needed to process the referrals.[102] Reducing inefficiencies also would reduce involuntary waiting times, with patients receiving treatment faster. The outcome measures, combined with changes in referral processing that are highlighted in this chapter, still need to be evaluated, either as a proof-of-concept or a simulation.

This chapter analyzed referrals for elective hip and knee arthroplasty, from initial referral to surgical consultation, using consistent definitions and performance measures to determine where possible gains could occur. Referral processing times make up a substantial percentage of total waiting times for patients. This chapter shows that referral processing can be improved, which could lower waiting times, increase the percentage of complete and correctly directed referrals, and improve patient management by clinics. Future work is needed to determine the quantifiable impact of these results under different policy and practice scenarios, and whether an electronic referral tool could produce these expected gains to system measures.

Table 24: Definition of waiting times from ABJHI

(adopted from Alberta Bone and Joint Health Institute)[163]

Abbreviation	Timestamp	Definition
T0	**T_referral**	The date on the referral form from a referring provider to the MSK clinic.
	T_received	The date a referral form is received by the MSK clinic. This is the date on the faxed referral form.
	T_complete	For Clinic 1, the date a patient was accepted and a notice was sent to the referring provider. For Clinic 2, the date the referral was screened with all required elements were present, and was sent to the surgeon for evaluation. For Clinic 3, the date the referral was evaluated by a clinic administrator and scheduled for a consult or MSK screening. *Not present in the BJSCN endorsed waiting times*
	T_MSK	The date a patient visited a MSK physician for screening to determine whether a patient is a surgical candidate, or is nonsurgical.
T1	**T_surgeon**	The date a patient first consulted with an orthopaedic surgeon for evaluation and determination for surgery for hip or knee OA.
T2	**T_surgery**	The date a patient has joint arthroplasty completed by an orthopaedic surgeon.

Table 25: MSK clinic pilot site characteristics

	Setting	Number of surgeons	MSK option available	Connectivity between surgeons and clinics	Complexity of patients	Technological use
Clinic 1 ~2000+ referrals per year	Urban	Multi-surgeon (10-20)	Yes	Highly integrated	Handle all complexities	Very advanced
Clinic 2 ~200-400 referrals per year	Rural	Single-surgeon	No	Moderate integration	Low complexities	Moderately advanced
Clinic 3 ~400-2000 referrals per year	Midsized city	Multi-surgeon (2-9)	Yes	Moderate integration	Handle all complexities	Moderately advanced
Alberta Total ~18,000 referrals per year	2 Urban 4 Midsized city 3 Rural	6 Multi-surgeon 3 Single-surgeon	-	-	-	-

Table 26: Summary statistics for clinics -- accessibility (measured in business days)

Processing Step		Clinic 1	Clinic 2	Clinic 3
(1) Receipt of referral	Mean days Median days 90th percentile	8 2 16	3 2 4	7 2 15
(2) Deeming referral complete and correctly directed	Mean days Median days 90th percentile	15 3 60	4 1 4	16 11 20
(3) Follow-up after referral is deemed complete		Next available option given	Next available option not applicable	Next available option given
(4) MSK Specialist Visit	Mean days Median days 90th percentile	MSK screening 40 41 74	Chart review 2 1 2	MSK screening 63 49 116
(5) Patient Feedback	-	-	-	-
(6) Surgical Consultation	Mean days Median days 90th percentile	81 76 129	42 32 50	131 134 198

Table 27: Summary statistics for clinics – referral appropriateness

Processing Step		Clinic 1	Clinic 2	Clinic 3
(1) Receipt of referral		-	-	-
(2) Deeming referral complete and correctly directed	Accepted: Pending: Denied: Unknown:	n=102 (80%) n=17 (13%) n=4 (3%) n=5 (4%)	n=19 (46%) n=20 (49%) n=0 (0%) n=2 (5%)	Unknown % accepted
(3) Follow-up after referral is deemed complete		87% of referrals directed to MSK	100% of referrals reviewed by surgeon	38% of referrals directed to MSK
(4) MSK Specialist Visit		Screened by surgeon-trained clinician	Chart review by MSK surgeon	Screened by surgeon
(5) Patient Feedback		71% of original referrals go to surgical consult	100% of original referrals go to surgical consult	76% of original referrals go to surgical consult
(6) Surgical Consultation		83% deemed surgical	83% deemed surgical	100% deemed surgical

Table 28: Summary statistics for clinics – efficiency

	(1) Evaluation of referral for completeness	(2) Entering referral into clinic electronic medical record	(3) Feedback to referring provider	(4) Scanning in information
Clinic 1 ~12-13 minutes per referral to process	~2 min (by the office admin)	~1 min (by office admin)	~1 min for accepted ~2 min for pending/denied (by office admin)	~8 min (by the office admin)
Clinic 2 ~9-14 minutes per referral to process	~2 min (by the surgeon administrator)	~2 min (by surgeon admin) ~ 3 min (by the clinic admin)	~2 min for accepted (by clinic admin) ~2-5 min for pending (by surgeon admin) ~5 min for denied (by surgeon admin)	<N/A> (records at the clinic are all paper based)
Clinic 3 ~11-15 minutes per referral to process	~2 min (by the clinic administrator) ~ 4 min (by the clinic nurse)	~2 min (by clinic admin)	~2 min for accepted (by clinic admin) ~5-7 min for pending (by surgeon admin) ~1 min for denied (by clinic admin)	<N/A>

Waits for clinic staff to retrieve information from elsewhere are included in patient waiting times (Table 26) for accessibility.

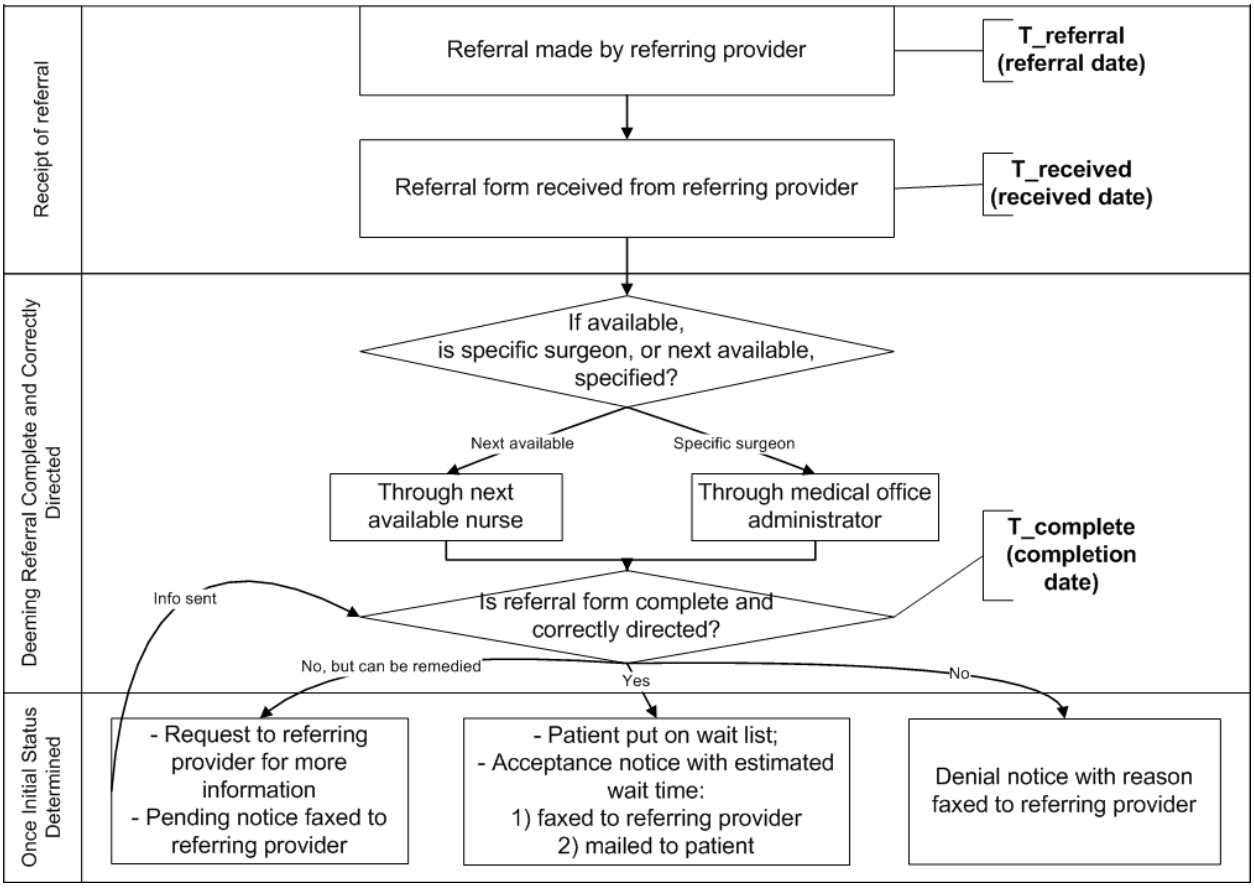


Figure 11: Generalized referral pathway from time referral is made to time referral status is determined

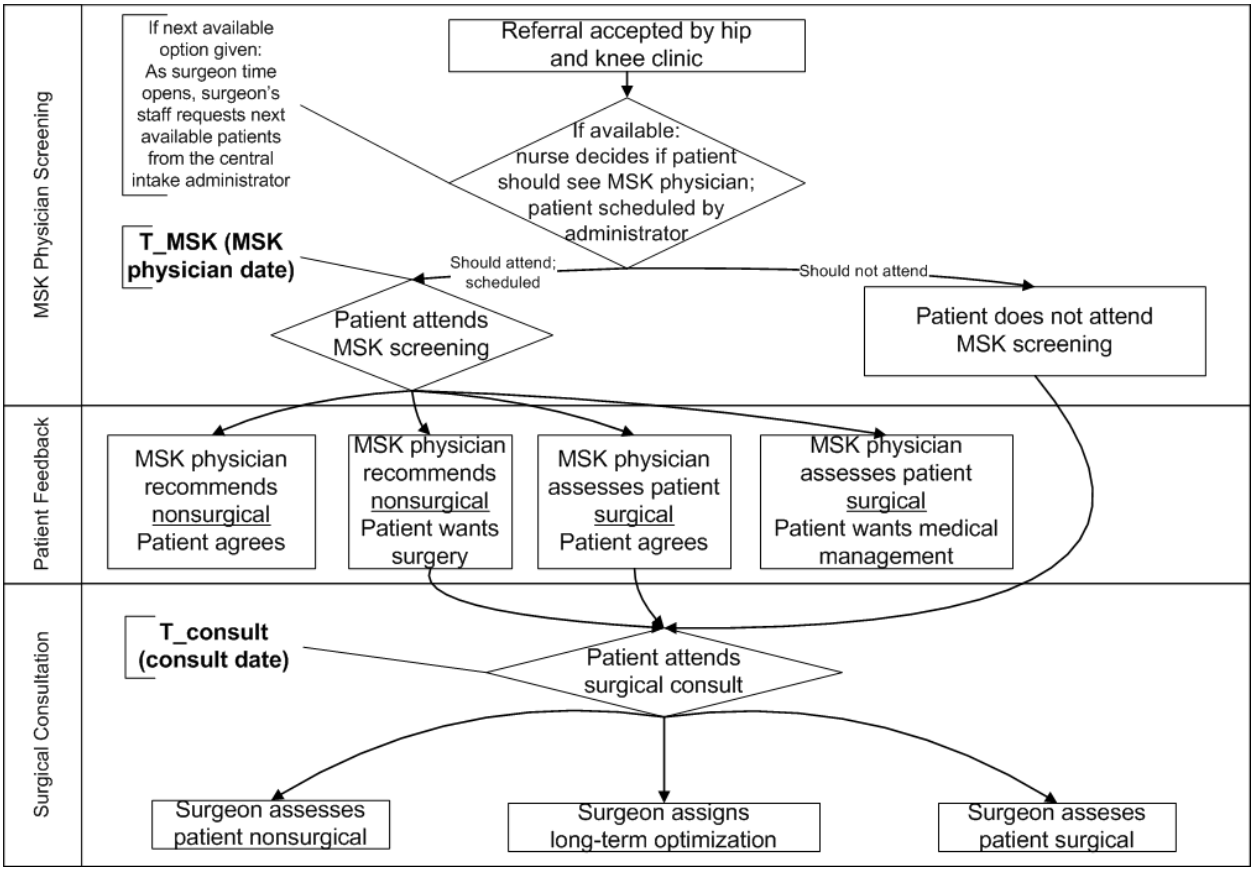


Figure 12: Referral pathway from acceptance of referral to surgical consultation

Chapter Seven: **Analysis Article 2: Potential Outcome Changes from Enhancements to the Primary-to-Specialist Hip and Knee Referral System in Alberta**

7.1 Introduction

Reducing waiting times as measured from referral date to specialist surgical consultations to operating time are a priority for Canadian First Ministers.[2] Long waiting times occur during the referral process for surgical consultations. Waiting times from when a referral is made by a referring provider to a consultation with an orthopaedic surgeon for total joint arthroplasty (TJA) ranged from 51 days to 139 days at three sampled hip and knee MSK clinics in Alberta (Chapter 6). Current benchmarks are focused on surgical waiting times, however, recent goals have been set to reduce consultation waiting times to one month.[54]

Several initiatives have been developed, are being implemented, or have been implemented, in an effort to reduce waiting times closer towards those benchmarks. Wait Times Rules are a set of rules developed and endorsed by Alberta Health Services (AHS) in 2011 that provide consistent measurement of steps in processing patients for musculoskeletal (MSK) TJA from diseases such as osteoarthritis (OA) (Chapter 5). Using these Rules to breakdown referral processing steps, areas where system-related waits occur can be determined. From the time a referral is generated by a referring provider to when a referral is received and accepted by the clinic and a surgical consultation occurs (Table 24), these rules highlight processing steps where an inconsistent referral process could lead to incomplete and incorrectly directed referrals causing access delays for patients.

Standardized referral forms provide a consistent, complete template for referral information to be transmitted to a specialist, minimizing variation in processing referrals and treating patients that result from incomplete or inappropriately directed referral form

documentation. When incorporated with the Wait Times Rules, referral processing times can be accurately tracked. This assists in dividing surgical consultation waiting time into involuntary, system-related delays and voluntary, patient-related delays. These elements, in addition to next available specialist or specific surgeon options, availability of MSK screening by surgeons or other trained providers at clinics, and electronic referral tools, have been incorporated elsewhere as standalone tools or in comprehensive referral tool enhancements.[81,88,154,171,172] Primary outcomes for these studies have been to measure the decrease in waiting times for surgery, or the increase in the percentage of appropriate referrals being sent from a referring provider to a specialist.

To determine if a standardized electronic referral tool for hip and knee arthroplasty could potentially improve current referral practices, this study first collected information from three Alberta MSK hip and knee clinics, developed scenarios where referral system elements could be enhanced, and applied the clinic data to the scenarios to measure the changes in outcome data. The impact upon the outcomes:

1) waiting time for surgical consultations, and

2) the number of incomplete and incorrectly directed referrals to specialists

were measured using four different scenarios:

1) increasing next available surgeon availability,

2) increasing the number of completed referral requirements,

3) increasing usage of alternative care providers such as surgeons, advanced practice physiotherapists (APPs) or nurses for MSK screening, and

4) measuring voluntary and involuntary surgical consultation waiting time.

The scenarios used data derived from an MSK referral project in Ontario as a comparator value. The results of the scenario analyses provide a picture of how Alberta could potentially reduce waiting times for TJA patients and increase system efficiency by using an electronic referral tool combined with the characteristics mentioned in each scenario.

7.2 Methodology

7.2.1 Intervention: An electronic referral tool

Referrals for patients seeking elective TJA for the hip or knee in Alberta are currently sent via fax from referring providers to orthopaedic MSK hip and knee clinics. The referrals often contain varying information about patients such as reasons for referral, medical status, and acuity data, but these data are often inconsistent. Referrals arrive in varying states of completeness, hampering efforts by clinic staff to triage patients and result in longer involuntary surgical consultation waiting queues.

A proposed electronic referral tool for Alberta aims to reduce the current wait for referral transfer to a clinic for screening and surgical consultation. This referral tool will introduce a consistent referral template with the objective of reducing the number of inappropriate referrals to orthopaedic surgeons, thus decreasing waiting times for patients through better tracking and processing of referrals. By separating waiting times into patient-related and system-related causes, reported waiting times will decrease, and a focus can be made on system-related issues which increase clinic time spent processing referrals. Four elements – next available surgeon selection, complete referrals, MSK assessments, and more accurate measurement of patient-related waiting time through the Wait Times Rules – could be implemented via an electronic referral tool into referral processing.

7.2.2 Primary data: Alberta MSK hip and knee clinics

Data collection from the Alberta MSK hip and knee clinics has been described previously in Chapters 3 and 6. Briefly, three representative MSK hip and knee clinics in Alberta volunteered to participate in this study. These clinics varied operationally as noted in Table 29. These data were collected through semi-structured interviews, a chart review of event dates for patients who had referrals accepted at the clinics, and a time studies tracking time spent processing referrals and the number of denied referrals at each clinic. Follow-up interviews with clinic staff took place after clinic analyses were completed to answer additional questions and receive face validity on the variables and their results. The data inputs used for the analyses are summarised in Table 30.

7.2.3 A comparator: Hamilton, Ontario

Data for providing comparator estimates of the analyses was courtesy of the Regional Joint Assessment Program (RJAP) in the Hamilton Niagara Haldimand Brant Local Health Integration Network (HNHB LHIN) in Southern Ontario.[150] Primary care providers referred patients with hip and knee pain and disability to one of three multidisciplinary clinics for review and triaging, with patients requiring surgical consult given a next available surgeon option. This is similar to the proposed referral system for Alberta. The referral was first assessed by clerks who obtained complete referral information from referring providers. Once accepted, advanced practice physiotherapists (APPs) took the lead as case managers in assessing patients, directing care and evaluating the appropriateness and acuity of the patient at the clinic. All patients were evaluated by the APPs: acute patients were forwarded onto orthopaedic surgeons for surgical review. The

goals were to reduce surgical consultation waiting times and to decrease the number of inappropriate referrals seen by a surgeon.

The 700,000 person region had a central intake clinic and advanced nurse practitioner triage structure introduced for TJA. Approximately 2800 people per calendar year were referred to the RJAP, which was started in 2007. Hamilton data from April 2009 through September 2010 were used as a reference comparator for the Alberta program: referral enhancements in Hamilton had been fully implemented by 2009, and the outcomes from the RJAP serve as a target reference point for implementation of the referral process enhancements in Alberta. Hamilton clinic information was extracted regarding waiting times, the percentage of patients attending a screening prior to a surgical assessment, the percentage of patients receiving surgical assessments from an orthopaedic surgeon, and the percentage of referrals with next available surgeon selected, as listed in Table 30.

7.2.4 Definition of outcomes

Two measures have been chosen to populate and use as outcomes for the analyses. These measures representing quality of care are adapted from the Institute of Medicine and the Health Quality Council of Alberta frameworks, and are system-based performance measures for primary-to-specialist referral processing:[13,17]

- **Referral appropriateness**. This variable measures whether a referral received by a specialist surgeon or clinic is complete and correctly directed for treatment at a hip and knee clinic, which potentially leads to a patient being accepted for consultation with an orthopaedic surgeon. This definition can also be expanded to triaging of patients: are patients who are highly urgent (according to the referral) being routed expeditiously for a

surgical consultation, and are patients who are less acute (according to the referral) being routed to an MSK screener, such as a surgeon or trained MSK clinician, for assessments to determine the surgical appropriateness of these patients.

- **Accessibility**. This measures waiting time, in total time from when a referral was made by a referring provider to a consultation with an orthopaedic surgeon by specific steps. Specific wait times analyzed in this chapter, endorsed by AHS (Figure 13 and Table 24) include:
    - Date referral was made by a referring provider (*T_referral)*
    - Date referral was received by an MSK clinic (*T_received)*
    - Date referral was accepted by an MSK clinic *(T_complete)*
    - Date patient was seen by an MSK screener for a preliminary assessment (*T_MSK)*
    - Date patient was evaluated by an orthopaedic surgeon (*T_surgeon)*

Some parts of the time interval from referral (*T_referral*) to the orthopaedic surgeon consultation (*T_surgeon*) can be considered 'involuntary waiting time' caused by health system referral processes over which a patient has no control. Of equal note, a portion of these times are voluntary waiting time, which is a part of the wait directly impacted by patient decisions (Chapters 3 and 5).

7.2.5 Development and design of scenarios

Four scenarios were designed for testing in the scenario analyses: province-wide next available surgeon, standardized referral forms, MSK screening, and separation of voluntary from involuntary-related waiting times for consultation with an orthopaedic surgeon. These scenarios represent potential referral system elements which, incorporated into an electronic referral tool,

would reduce waiting times via increased patient choice, more accurate referral information from the referring provider to the specialist, increased number of patients that are screened (and hence triaged), and more accurate waiting time measurement. These scenarios were created in consultation with project analysts and managers at the Alberta Bone and Joint Health Institute (ABJHI), which evaluates bone and joint practices in Alberta. These scenarios were discussed with clinicians in semi-structured interviews for face validity regarding their applicability to their practices. Scenarios included:

- Scenario 1: Next available surgeon option. This option, given on standardized referral forms in Alberta for hip and knee TJA referrals, provides patients and referring providers the choice of receiving a consultation (leading up to potential total joint arthroplasty) with the next available surgeon, as opposed to choosing a specific surgeon for the consultation. Patients who do not choose a next available surgeon or select a specific surgeon are automatically given the next available surgeon option at all clinics.
  A proposal exists to expand this option to a provincial-wide next available surgeon model. If family support is available for a patient through follow-up care, the patient should be allowed to choose any clinic across Alberta. With an electronic referral tool tied into EMRs and MSK clinic scheduling systems, waiting times for each clinic and surgeon would be provided to the patient and referring provider, facilitating the choice of clinic. Full access to waiting times is likely to lead a proportion of patients to choose a next available surgeon, unless patients wish to choose only surgeons with positive reputations, thereby resulting in a dichotomous pattern of waiting times: long for those with positive reputations, shorter for other surgeons. This would potentially lower

waiting times across Alberta. This is quantified by the current difference between those who specified a specific surgeon and all other patients.

- Scenario 2: Fully completed and standardized referral forms. Processing rules for patients at clinics vary, such that referring providers frequently provide incomplete or incorrectly directed referrals. As a result, clinical staff are burdened with the need to retrieve the appropriate information to process a referral, increasing patient waiting time. With an electronic referral tool, requirements for each clinic or each specialty could be highlighted on a standardized form. A referral could not be submitted to the specialist without having all required elements complete. Though this would not eliminate all errors, such as incorrect x-rays, it would markedly decrease omissions and errors on referral forms. Waiting times for surgical consultation will potentially be reduced. This is quantified by the current difference between initially completed accurate and initially incomplete referrals.
- Scenario 3: MSK screening of patients for triaging. Staff at MSK clinics who do not have MSK specialist screeners (APPs, nurses, or surgeons) who assess patients (primarily non-urgent, lower-grade osteoarthritis patients) are compelled to triage patients for treatment based on referral content and supporting documentation. This potentially leads to inconsistent triaging depending on referral quality, and as a consequence to nonsurgical patients unnecessarily waiting for a surgical consultation instead of receiving prompt medical management.

  With an electronic referral tool, standardized referral forms would contain urgency questions that are derived from the validated Western Canada Wait List consultation urgency questionnaire for hip and knee arthroplasty. This information can provide clinics

the information to properly triage and determine the urgency of a patient.[116] Combined with increased usage of clinic MSK screeners, it is expected that unnecessary surgeon consultations would be reduced. This would decrease waiting times for patients assessed surgical or deemed urgent, enable immediate routing to surgeons, and provide surgeons more time with complex patients and for surgeries. This is quantified by the difference in waiting times between patients who attend an MSK screening before a surgical consultation and patients who attend a surgical consultation directly.

- Scenario 4: Voluntary versus involuntary waiting time. Currently, waiting time is not divided and measured between voluntary and involuntary causes. Voluntary delays are patient-related causes of waiting such as personal and social reasons that lead the patient to choose to delay treatment or a surgical consultation for hip or knee pain. Involuntary delays are system-related causes where a patient is not choosing to delay treatment for hip or knee pain, for example caused by system delays where a referral was incomplete or incorrectly directed to a specialist office which could not treat the patient, or a clinical delay, where a patient could not proceed with a surgical consultation due to the need for a patient to first receive treatment from other clinicians.

  An electronic referral tool would be able to separate these delays, and track when and why patients choose to voluntarily delay treatment. These times would then be separated from system-related causes, leading to a more transparent understanding of the causes for waiting times, and the ability to target system interventions to reduce waiting times more accurately. This is quantified by estimates of the current percentage of current delays which are voluntary-related.

7.2.6 Computation of scenario analyses

Four scenarios were developed, as mentioned in the previous section. Each scenario required inputs and a choice of output(s). Each input was related to the estimated change listed in the scenario: for instance, in Table 31 (Scenario 1), the effect of a province-wide next available surgeon option on referral forms was estimated by changing the percentage of referrals with the next available surgeon option chosen. Estimated parameter inputs were discussed and chosen by the researchers using input from clinicians and health research analysts at ABJHI. In each scenario, one of the inputs was a value representing the current Alberta state. Each output(s) was (were) related to the metrics derived from the three quality dimensions mentioned in Section 7.2.4. For example, in Table 31 (Scenario 1), different waiting times were used: from *T_complete* to *T_surgeon* and *T_MSK* to *T_surgeon*. Both mean waiting time and 90th percentile time (the time in which 90% of patients were seen by) were reported.

For each scenario and the respective inputs, one-way sensitivity analyses were used. These took current system data from each clinic surveyed (Table 30), and weighted them by the percentage of all Alberta hip and knee referrals seen each year. For instance, of approximately 18,000 Alberta referrals seen, Clinic 1, representing urban clinics, was weighted by 9000/18000 (the estimated number of referrals seen at one urban clinic multiplied by two of those clinic types in Alberta, divided by the total number of referrals in Alberta). This weight was then applied to all inputs and outputs.

Using Microsoft Excel, the weighted inputs were then used to calculate the changes in each output. Each scenario used the finding that there were a percentage of patients at each clinic which had undergone each scenario and which had not undergone each scenario. For instance, in Table 31 (Scenario 1), some patients had chosen next available surgeon at the clinics

and some had requested a specific surgeon at the clinics, with the exception of single surgeon Clinic 2 where next available surgeon was not an option. These values for each choice were then weighted to produce a province-wide estimated, weighted output(s).

Data from Hamilton was used in two ways. First, an input value was used which approximated the current situation in Hamilton. This produced a comparator result which showed how, with Alberta implementing a program similar to Hamilton, the output(s) would change from the current Alberta state. These results are sensitive to potential bottlenecks in Alberta which may not be present in Ontario. Second, these newly estimated output(s) could then be compared to the current Hamilton output statistics, to see how wide the estimated variations between the Alberta estimates and the current Hamilton output statistics are. Hamilton, in essence, serves as a benchmark for estimating how Alberta might gain using an electronic referral tool.

No discounting was used since the model timeframe was restricted to one year. The analyses used current dependencies between variables to estimate results for each scenario: no forecasted changes in the relationships between the input and output(s) were estimated.

7.3 Results

Properties of the three pilot hip and knee MSK clinics in Alberta are provided in Table 29. The clinics reflect a range of characteristics with respect to the setting, number of surgeons, whether an MSK screening process is available, and the complexity of patients who are accepted. Characteristics of patient charts are similar to the Alberta population in 2010/11 having TJA: the knee-hip ratio is 61-39%, exactly the same as in the chart review. Females consisted of 52% of the sample, compared to 57% of the TJA population. The mean age of the sample was 74±6

years, compared to 68±14 for the TJA population. All results were based off linear relationships between output and input variables. Results for each scenario are:

7.3.1 Scenario 1: Next available surgeon option

Table 31 estimates the potential impact on waiting times from varying percentages of referrals selecting next available surgeon. Currently in Alberta, 70% choose next available surgeon status. Increasing this percentage to 100% will potentially decrease waiting times by approximately a week (4 business days, from 90 currently to 86) from when a referral is deemed complete and accepted to the time of consultation with a surgeon. This is based on referrals in Alberta choosing a next available surgeon currently waiting 86 business days, and those choosing a specific surgeon waiting 100 business days for surgical consultations after a referral has been accepted. Waiting times compared to the RJAP, where 3% chose the next available surgeon (rounded down to 0% for the analysis), are higher, with an estimate of 100 business days if implemented in Alberta compared to RJAP's 67 business days.

7.3.2 Scenario 2: Fully completed and standardized referral forms

Table 32 estimates the potential impact on waiting times from varying percentages of initially completed referral forms. Currently, 77% of referrals arrive initially complete. From current levels, having a system which increases the percentage of complete referrals to 99% potentially decreases waiting times for an accepted referral by a mean of 3 days, with a reduction of 1 week for the 90th percentile measure – a 13-14% reduction from the current waiting time. This is based off current referral processing, which takes on average 20 business days from when a referral is made to when a referral is deemed complete if the referral is initially fully complete,

versus 33 business days if a referral is initially not complete. The RJAP forces completion of all referrals before acceptance, and did not track the number of incoming referrals that were incomplete. As a result, no scenario for RJAP is listed.

7.3.3 Scenario 3: MSK screening of patients for triaging

Table 33 estimates the potential impact on waiting times, and the percentage of MSK patients assessed surgical, from varying percentages of patients attending an MSK screening for triaging. The net effect of changes is not significant – potentially a one day reduction from current *T_complete* to *T_surgeon* waiting time. High acuity patients are seen faster by a surgeon after an MSK screening than current practices where they are routed directly to a surgical consultation (39 mean days compared to 66 mean days). This is derived from current Alberta data, where patients who go through MSK on their way to a surgical consultation after the referral was initially accepted have a wait of 89 business days compared to 65 business days for those straight to surgical consultation. The wait for an MSK visit, however, took 55 business days on average after a referral was initially accepted. This matches the RJAP, where waiting time is higher for an APP screening compared to subsequent waits for a surgical consultation.

7.3.4 Scenario 4: Voluntary versus involuntary waiting time

Table 34 estimates the potential impact on waiting times from assuming a portion of surgical consultation waiting times were patient-related, voluntary reasons for delay. Current waiting time calculations assume all waiting time for a consultation is involuntary and system-related. It is not separated, either in Alberta or at the RJAP. At clinical visits, it was determined there was a percentage of patients which chose to delay consultations with orthopaedic surgeons.

By assuming 5% and 10% of waiting time is voluntary, waiting times potentially decrease by a total of one and two weeks, respectively.

7.4 Discussion

Scenario analyses were developed and applied to patient data derived from three MSK clinics located in Alberta for potential hip and knee TJA patients. The scenario analyses gave estimated results that changes to patient referral system elements, if implemented in an electronic referral tool, would produce better system outcomes for hip and knee referral processing.[123,133,173] Increasing the percentage of patients choosing a next available surgeon option by 30% potentially reduces waiting times for surgical consultations by 4 days. Having 99% of referrals meet all referral requirements potentially reduces waiting times to accept a referral by 2 days. Having all patients attend an MSK screening will potentially increase MSK screening waiting times, but potentially reduce waiting times for a surgical consultation. Differentiating voluntary and involuntary waiting times, though having no effect on the waiting times for a surgical consultation from the perspective of the patient, will potentially lead to reported waiting times for surgical consultations decreasing with voluntary-related causes of delays removed.

Several comparisons to previous literature and Hamilton RJAP can be made. 1) The RJAP had lower waiting times, even with the next available surgeon option not chosen as often. However, it cannot be determined if the patients choosing next available surgeons at the RJAP had lower waiting times. No matter the waiting times, some patients in single-surgeon locales in Alberta may not have family support or may have other reasons to not see another surgeon elsewhere quicker.[65,82] 2) Having fully completed referral forms will reduce *T_referral* to *T_complete* waiting times, though not to zero. Errant information such as incorrect x-rays may

still be sent, and clinical staff do not currently process referrals immediately upon receipt. The delays that arise can only be fully eliminated with workflow process changes.[133] 3) Due to MSK screener triaging, higher acuity patients are seen faster. MSK specialists have been shown to be effective at reducing the number of non-surgical patients being seen by a consultant, as well as getting treatment earlier to patients who just need medical management.[150] This aspect reduces waiting times for a surgical consultation. 4) This is the first study that applies a voluntary-versus-involuntary waiting time framework. Clinical chart audits completed by ABJHI indicate 5-10% of referrals have some form of voluntary waiting time. Clinics did not track this information systematically, resulting in the percentages for the scenarios being chosen from anecdotal clinical evidence. Tracking this information in the future would result in more accurate surgical consultation waiting time measures and transparency as to the causes of delays.

When information was available, values for the scenarios were included from the Hamilton RJAP. Several differences between the RJAP and both current and proposed Alberta referral tools were noted. The RJAP did not track the time it took to accept a referral. It cannot be determined if referrals were accepted faster, patients saw an APP faster, or both at RJAP compared to Alberta. The number of rejected referrals was not tracked: a variable that could not be immediately filled in, retrieved or estimated resulted in the referral being rejected. Second, all patients attended an MSK screening at the RJAP with an APP: it was not an option that was determined by nurses and other clinical administrators as in Alberta. The RJAP, though operationally different, shares similar goals as Alberta to reduce waiting times and assure triage appropriateness for all referred patients.

Several limitations must be noted with the analysis and results. First, the scenario analyses do not account for all complexities of the referral system. How other specialties interact

with MSK hip and knee clinics is not accounted for. Individual level modelling, which would allow for the use of queues and bottlenecks at specific referral processing steps, is not completed here. This study was intended to specifically serve as an exploratory analysis that can serve as the future foundation for a formal simulation model of the referral system.

The quality of some data inputs was mixed – current information on the percentage of accepted referrals and estimates of patient-related delays was incomplete. This is the first time data on referrals has been collected to the level of detail for waiting times. The clinics, as noted in Table 29, had different characteristics. This does not guarantee representativeness for Alberta or for Canada. The clinical characteristics vary enough to be representative of all Alberta clinics, in terms of location, number of surgeons, complexity of patients and usage of MSK screeners. The approximate number of referrals seen at these clinics – one-third of the yearly number of hip and knee TJA referrals in Alberta – is proportionate to the number of clinics surveyed (three) out of all MSK clinics (nine) in Alberta. This range of clinic characteristics is also seen at MSK clinics elsewhere throughout Canada (Chapter 3). Estimates from the scenario analyses may not hold when scaled up to the entire system. What differences existed in processing between the clinics allowed for the scenario analyses to be populated enough to generate results. Fuller statistics on current referral processes would allow estimation of the number of patients seeing a surgeon (and leaving the waiting queue), which could serve as another performance measure, as well as allowing introduction of nonlinearities in the delays which patients face. Nonlinearities would allow for the impact from a system operating at full capacity (where there is an accumulation of individuals waiting due to lack of surgical consultation times) on average waiting times to be magnified compared to the impact from a system operating at a lower capacity.

7.4.1 Policy impact

Timely access to specialist services in Alberta is monitored using waiting time benchmarks. Previous studies have estimated that a breakdown of total TJA waiting time resulted in 60% of waiting time was spent between decision date and surgery, 10% between consultation and decision date, and 30% between referral date and consultation.[174] From a sample of charts reviewed of patients which went onto surgery (103 of 218 patients) in this study, approximately 40-80% of waiting time from referral made (*T_referral*) to surgery date (*T_surgery*) occurred between the time a referral was made (*T_referral*) and surgical consultation date (*T_surgeon*). The benchmark by 2015/2016 in Alberta is 14 weeks (70 business days, 98 total days) for hip and knee replacements.[54] This implies a surgical consultation waiting time, using the 60%-30% ratio, of 7 weeks (35 business days, 49 total days). Though hard to achieve, implementation of the individual elements noted above into referral processing will produce waiting times closer to these benchmarks than current practices, though care must be taken to account in the connection between the delays for surgical consultation and for surgery. Efforts to reduce delays for surgical consultation might result in an increase in delays for surgery, and vice versa.

An electronic referral tool would efficiently allocate clinic staff time better than current practices. At some clinics, up to 20 hours a week is spent scanning and managing paper records. Using an average of 12-15 minutes of clinical staff time to ensure each referral is accepted, the 18,000 hip and knee referrals per year in Alberta need at least 3600 hours per year of clinical staff time to process. While startup costs such as design, implementation, operating and training costs should be considered, it is likely that costs will be offset by staff time that can be allocated towards other clinical tasks benefiting patients. Integration with electronic medical records and

scheduling software along with standardized referral forms providing complete information for accurately triaging patients can address inaccurate referrals, further reduce clinic staff time for processing patients and lower waiting times for patients to get referrals accepted and to attend a surgical consultation.

Implementation of these four initiatives successfully will involve some policy considerations. To expand the use of a next available surgeon option means all surgeons in Alberta must cooperate and agree to share patient lists. Patients may not necessary choose a next available surgeon: accessibility concerns may limit some patients, while other patients might choose a surgeon with a long waiting time on the grounds that it indicates quality. Full completion of referral forms is subject to both referring provider and specialist satisfaction with the data requirements: both to obtain from the patient before a referral is sent, and to triage a patient once a referral is sent. Expanding MSK clinics will be subject to available funds and staff, and the patients seen by these clinics will be subject to proper triaging to sort between those of highly acuity (and should be seen by a surgeon directly) or lower acuity (and can be seen by an MSK specialist). Though not necessary for an electronic referral tool, consistent priority scores and questions from an electronic referral tool would allow for MSK screening – shown here to potentially reduce surgical consultation times – to be implemented easier, and with less time needed to triage patients, by clinics. Separating voluntary, patient-related waits from involuntary, system-related waits means that each step of referral processing must be attributed to a specific person or cause: whether there should be an expectation for specialists to inquire and attribute a delay to a patient choice is a question that must be answered by MSK clinics before this initiative can be completed.

7.5 Conclusion

This chapter describes scenario analyses, using data from three clinics in Alberta, to test how different policy elements would change system outcomes for hip and knee referrals. With elements such as expanded next available surgeon choice, accurate completed referrals, and expanded MSK screening combined into an electronic referral tool, waiting time would likely decrease since the percentage of complete and correctly directed referrals would increase. This results in a more efficient usage of system resources, which can then be allocated to other important clinical functions.

Table 29: Alberta MSK pilot site hip and knee clinic characteristics

	Setting	Number of surgeons	MSK screening option available	Complexity of patients
Clinic 1 ~4200 referrals per year	Urban	Multi-surgeon (10-20)	Yes	Handle all complexities
Clinic 2 ~300 referrals per year	Rural	Single-surgeon	No	Low complexities
Clinic 3 ~425 referrals per year	Midsized city	Multi-surgeon (2-9)	Yes	Handle all complexities
Alberta Total ~18,000 referrals per year	2 Urban 4 Midsized city 3 Rural	6 Multi-surgeon 3 Single-surgeon	At 2 urban and 2 midsized clinics	-

Table 30: Data inputs for scenario analyses

Variable	Clinic 1	Clinic 2	Clinic 3	Weighted average for Alberta	HNHB HLIN*
# of referrals sampled (of total number of referrals received per year)	127 charts reviewed by researcher (of ~4500 referrals per year)	41 charts reviewed by researcher (of ~400 referrals per year)	50 charts reviewed by researcher (of ~500 referrals per year)	(based on three clinics)	(based on 3199 patients at Hamilton and Brampton programs)
# previously seen by an orthopaedic surgeon	27%	29%	34%	28%	N/A
T_referral --> T_received (in business days)					
Mean	8	3	7	8	-
90th Percentile	23	6	26	23	-
Next available chosen on referral form	71%	Not Applicable	80%	71%	3%
Specific surgeon chosen on referral form	21%	100%	20%	23%	97%
Rules for clinics to accept referrals (% of referrals initially completing requirements)	Xrays attached: 90%	Xrays attached: 97%	Xrays attached: 94%		N/A
	Demographics: 100%	Demographics: 97%	Demographics: 98%		

		BMI: 42%	Past medications: 65%		
% of referrals accepted upon first receipt	80%	46%	-	78%	100%
% of referrals denied upon first receipt	3%	0%	-	2%	0%
% of referrals pending upon first receipt	13%	49%	-	20%	0%
T_received --> T_complete (business days)					
Mean	15	4	-		-
90th Percentile	108	9	-		-
T_referral --> T_complete (business days)					
Mean	23	7	23	23	-
90th Percentile	60	29	46	56	-
	MSK available	100% screened by surgeon	MSK available		MSK required
MSK option given	87%	Not applicable	38%		100%
T_complete --> T_MSK (business days)					
Mean	40	2	63	43	-
90th Percentile	93	5	159	103	-
T_referral --> T_MSK (business days)					
Mean	55	8	70	53	65
90th Percentile	113	25	121	108	127

Assessed Surgical by MSK	67%	100%	32%	61%	31%
Assessed Nonsurgical by MSK	33%	0	63%	38%	69%
T_complete --> T_surgeon (business days)					
Mean	81	42	131	89	Not applicable
90th Percentile	129	51	182	137	Not applicable
T_MSK --> T_surgeon (business days)					
Mean	45	40	107	57	2
90th Percentile	124	55	173	131	8
Patient rescheduled original consult date	3%	5%	8%	4%	N/A
Assessed Surgical by Surgeon	83%	83%	100%	86%	20%
Given LT Optimization by Surgeon	6%	7%	0%	5%	N/A
Assessed Nonsurgical by Surgeon	11%	10%	0%	9%	N/A
% of Total Wait (referral to consult) that is fully involuntary	15%	14%	11%	14%	N/A
	23 days	7 days	~23 days		
	out of 148 w/ MSK	out of 51 w/ screening	out of 217 w/ MSK		

N/A: information not available

- : information not collected at clinic

Not applicable: variable does not apply to clinic

* : Hamilton Niagara Haldimand Brant Local Health Integration Network

Table 31: Scenario 1 -- Differing percentages of referrals with next available surgeon selected

Changing Input Variable:						
% choosing next available surgeon on referrals		**100%**	**90%**	**70% [current state]**	**25%**	**0% [RJAP]**
Outcome Variables (business days):						
T_complete --> T_surgeon	Mean	86	87	90	96	100
T_complete --> T_surgeon	90th %ile	131	133	137	146	152
T_MSK --> T_surgeon	Mean	54	55	57	61	63
T_MSK --> T_surgeon	90th %ile	125	127	131	140	145

Table 32: Scenario 2 -- Changing the percentage of referrals initially completed

Changing Input Variable:				
Rules		**Forced completion of all requirements [RJAP]**	**Increased awareness, but not forced completion, of all referral requirements**	**Current state**
% of referrals accepted		99%	85%	77%
Outcome Variables (business days):				
T_referral --> T_complete	mean	20	22	23
T_referral --> T_complete	90th %ile	48	53	56

Table 33: Scenario 3 -- Changing use of MSK screening

Changing Input Variable:			
MSK option		**For all patients [RJAP]**	**For low urgency patients everywhere [current state]**
% of patients receiving MSK		100%	70%
Outcome Variables (business days):			
T_complete --> T_MSK	Mean	55	43
(for patients seeing MSK)	90th %ile	109	103
T_MSK --> T_surgeon	mean	39	57
(for patients seeing MSK)	90th %ile	73	131
T_complete --> T_surgeon	mean	-	66
(for direct consults)	90th %ile	-	108
T_complete --> T_surgeon	mean	89	90
(for all patients)	90th %ile	142	137
% of MSK screenings resulting in surgical assessments		54%	61%

Table 34: Scenario 4 -- Involuntary waiting times separated

Changing Input Variable:								
Track involuntary wait times			**No [current state and RJAP]**		**Yes**		**Yes**	
			All T_complete --> T_surgeon wait is involuntary		5% of T_complete --> T_surgeon is voluntary		10% of T_complete --> T_surgeon is voluntary	
Outcome Variables (in business days):								
			Vol.	Invol.	Vol.	Invol.	Vol.	Invol.
T_referral --> T_received	Involuntary	mean		8		8		8
		90th %ile		23		23		23
T_received --> T_complete	Involuntary	mean		23		23		23
		90th %ile		56		56		56
T_complete --> T_MSK	Involuntary and voluntary	mean		43	2	41	4	39
		90th %ile		103	5	98	10	93
T_MSK --> T_surgeon	Involuntary and voluntary	mean		57	3	54	6	51
		90th %ile		131	7	124	13	118
Total voluntary wait		mean			5		10	
		90th %ile			12		23	
Total involuntary wait		mean		131		126		121
		90th %ile		313		301		290

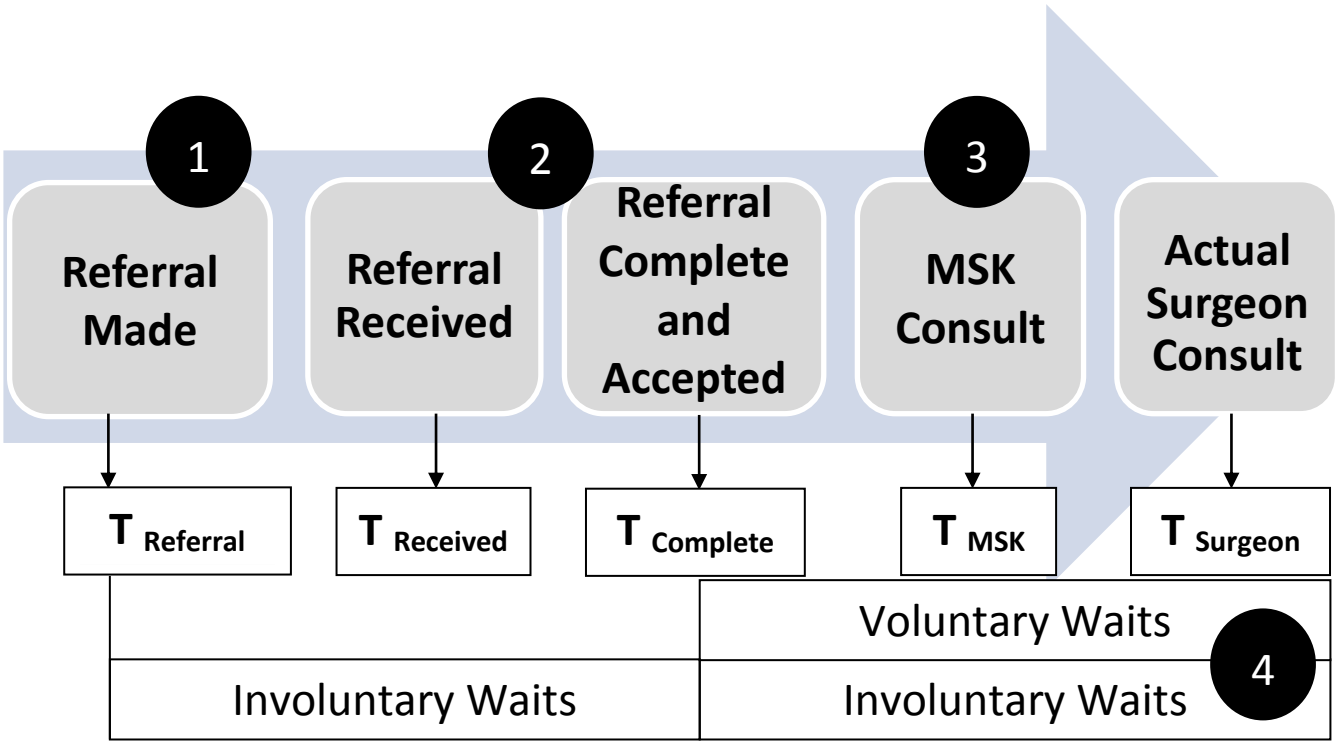


Figure 13: Generalized process of referrals in Alberta. The point at which each scenario occurs in the process, and the scenario number, is displayed in black dots

(adapted from Marshall et al. (Chapter 5 and [1]))

Chapter Eight: **Discussion**

The objective of this thesis was to evaluate current referral practices and processing from referring providers to specialists for elective hip and knee arthroplasties in Alberta. The primary research question of this thesis was to evaluate whether implementing an electronic referral tool would positively impact referral processing for elective hip and knee arthroplasty from a primary care provider to an orthopaedic surgeon. Using three quality dimensions to measure outcomes – accessibility, referral appropriateness, and efficiency – this thesis explored whether an electronic referral tool, incorporating specific referral enhancements, could improve those outcomes. To do this, semi-structured interviews, chart reviews, and time studies tracking staff at clinics was conducted at three different MSK clinics, informing analyses of current referral processing and providing data to conduct scenario analyses measuring the impact of referral system enhancements. Outcomes for this thesis were chosen in a collaborative process between bone and joint health researchers and staff at participating clinics, and were illustrated by the introduction of Wait Times Rules (Chapter 5). The three clinics differed in multiple dimensions – size, location, whether MSK screening was available, clinic-surgeon interaction, complexity of patients, and degree of electronic record usage – as described in Chapters 4 and 6. Despite these differences, clinics processed referrals similarly as noted in the referral pathways for each clinic in Chapter 4 – receiving referrals, accepting referrals, and triaging patients for surgical consultations and, if available, MSK screening for patients. Once a referral was accepted, clinic staff determined an urgency level for the patient. If available, an MSK screening would assess primarily lower urgency patients. Higher urgency patients were routed directly to an orthopaedic surgeon for a consultation. The details of this process varied, in part due to differences in

characteristics of each MSK clinic. These included variation in clinical rules for accepting referrals, whether multiple surgeons allowed a next available surgeon option, how initially incomplete or incorrectly referrals were dealt with, and how triaging occurred. These variations have not been noted elsewhere: they were accepted practices at the three MSK clinics, which had not been seen as issues impacting referral care or patient quality previously.

This thesis found that waiting times from the time a referral was made (*T_referral*) by a referring provider such as a GP to when a consultation occurred with a surgeon (*T_surgeon*) ranged on average from 51 to 139 days (7 to 31 weeks) at the three pilot MSK clinics if an MSK screening occurred: clinic 1 had a mean number of business days from *T_referral* to *T_surgeon* of 97, clinic 2 a mean of 51, and clinic 3 a mean of 139. From *T_referral* to *T_complete*, all waiting time is involuntary, system-related. This accounts for 11-15% of *T_referral* to *T_surgeon* waiting time. Time from *T_complete* to *T_surgeon* could not be separated between voluntary and involuntary waiting time in this thesis. Approximately 71-80% of referrals had selected a next available surgeon option. Incomplete referrals accounted for most of the approximately 20-50% of referrals initially deemed incomplete or incorrectly directed upon initial receipt by a clinic. MSK screenings assessed approximately 40-90% of referred individuals, with approximately 30-70% of those assessed deemed surgical. Each referral took on average 9-15 minutes to process, depending on what actions needed to be completed for the referral.

With an electronic referral tool, several referral processing elements could be implemented, potentially improving system level outcomes. These elements include: a) province-wide next available surgeon selection, b) full completeness of referral forms, c)

consistent MSK screening and triaging options, and d) separating voluntary from involuntary waiting times. It was found that allowing a next available surgeon option across Alberta and requiring complete referrals were two elements which would lower waiting times on average by 4 days and 3 days, respectively. Having an MSK screening option available across the province would decrease waiting time by 1 day: though lengthening waiting times for an MSK screening, it would concurrently lower waiting times to see a surgeon directly. Separating voluntary and involuntary waiting times would give a more accurate view of system-related waiting for patients, with 5-10% of waiting times estimated to be voluntary.

8.1 Accessibility: waiting times

Previous studies on waiting times focused primarily on the time from when a decision for surgery is made to the time surgery actually occurs. For elective hip and knee surgery in Alberta, these times have recently ranged from 43 to 49 weeks for the 90th percentile.[175] Currently in Alberta, only waiting time from the decision date for surgery to surgery (T1-T2, *T_ready* to *T_surgery*) is recorded. Any time spent awaiting a surgical consultation, and the decision for surgery (T0-T1, *T_referral* to *T_surgeon*) is not included in publicly reported waiting times. By reporting only T1-T2 waiting time in Alberta, what is missed is a substantial waiting time just to see a surgeon for a consultation. *T_referral* to *T_surgeon* times range from from 10 to 28 weeks (assuming a 5 day business week), which can account for up to 40-80% of waiting time from first referral (*T_referral*) to surgery date (*T_surgery*). This thesis found that the few papers that report waiting time to consultation (*T_referral* to *T_surgeon*) have shown a trend upwards: Coyte et al. in 1994 found median waiting times of 4 weeks in Ontario (28 days),

while Snider et al. in 2005 found waiting times of 1.13 months (~34 days) in rural and 3.47 months (~104 days) in urban clinics.[4,5] This thesis estimated median wait-to-consult times of 35 to 145 business days, or approximately 1.62 to 6.74 months (~49 to 202 *total* days), with the rural clinic representing the smallest and a midsized city representing the longest waiting time. As a significant percentage of waiting time for elective surgery, the time from *T_referral* to *T_surgeon* should be included in subsequent waiting time indicators.

Total waiting times at each clinic depended on clinical practice variations, which are likely not accounted for in other studies. Clinic 3, for instance, would usually wait to schedule a consultation with a surgeon until surgical space for the patient could be booked. This decreased the time from decision date to surgery, but at the cost of increasing time from referral date to consultation. Clinics 1 and 2 would book a surgical consult date, and if deemed surgical and the patient chose to have surgery, would then book a surgical time, which would lengthen surgical waiting times. Since the timeframe of study did not look at surgical dates, this aspect of dividing waiting times was not explored in this thesis. Used here, the timestamps were retrospectively collected consistently directly from charts, eliminating inconsistent measurement as a source of waiting time variation. For these timestamps to be used in real-time, efforts will have to be made to incorporate these into workflows, with reasons given when discussing clinic efficiency.

Total waiting times also depended on the statistical measure used to report waiting times. Once a referral was accepted to a surgical consultation, mean waiting days ranged from 42-131, while the median wait was from 32-134 days, and the 90th percentile was from 50-198 business days. This suggests that at the clinics, there are a few patients who wait substantially longer than the majority of referrals. One of the causes for this extended delay, as noted in Chapter 6, is

when a referral arrives either initially incomplete or incorrectly directed. It is then a question for policymakers to decide whether to implement referral policies which reduce the number of waiting days for everyone, or whether to focus just on the reasons which cause referrals to be delayed to the 90th percentile time.

Cancer care, as noted in Chapter 2, has some of the only other reported pre-consultation waiting times in Canada. While the means for consultation time are not significantly different compared to cancer care, the upper percentiles for TJA surgical consultations are much less than exist here – the 95th percentile for Nova Scotia cancer care was 48-70 days, depending on severity, compared to more than 100 days for orthopaedic care.[61] This is to be expected, given cancer care is usually more critical than an elective surgery.

Some issues regarding waiting times arose during the research. The waiting times in this thesis were estimated using consistent waiting time datestamps as defined by ABJHI and endorsed by the Alberta Health Services Bone and Joint Strategic Clinical Network (Chapter 5). There is no guarantee that the waiting times estimated in this thesis measured the same points of time as the other papers, especially with regards to the starting point. Other specialists may not use similar timestamps. The referral made time was potentially subject to some measurement error, depending on whether a faxstamp was made inaccurately, or a date was included (or not) on the letter or template to the specialist.

This thesis shows waiting times for a surgical consultation are a significant waiting time, which has not been tracked. This finding has not been highlighted as thoroughly as waiting times for surgery in the literature. Reported waiting times for elective hip and knee arthroplasty

should include both the time from referral to surgical consultation (*T_referral* to *T_surgeon*, T0-T1) in addition to the time spent awaiting surgery (*T_ready* to *T_surgery*, T1-T2).

8.2 Accessibility: voluntary versus involuntary waiting

One aspect of the research question was determining which delays were related to voluntarily or involuntary reasons, and quantifying those delays. In an idealized system, the time up to when a referral is deemed initially accepted (*T_referral* to *T_complete*) will always be a system-related time. The patient should not be expected to know what is necessary for inclusion on a referral form, nor expected to confirm the referral is directed to the correct specialist. The estimate of this involuntary waiting time, as a percentage of the *T_referral* to *T_surgeon* waiting time, was 11-15%, or approximately 7 to 23 business days (1 to 3 weeks, .23 to .76 months) on average.

However, the time after a referral was deemed completed was not separated at any clinic into voluntary or involuntary reasons for delays. No EMR had a consistent notation, and no clinic had consistent definitions for staff, to denote scheduling issues. Rescheduling referrals was tracked relatively consistently, and occurred in approximately 3% of initially sent referrals. If an accepted patient initially denied the next available time for a consultation, and instead received an appointment further in the future, this additional action and the time delay from it was not tracked at any clinic. Unpublished clinical chart audits conducted by ABJHI estimated approximately 5-10% of referrals to hip and knee clinics included voluntary delays waiting for a surgical consultation, and this is likely a similar percentage for patients undergoing TJA.

This thesis shows that there is a lack of literature and estimates surrounding the division of waiting time into involuntary and voluntary categories. System-related delays, such as those

in waiting for a surgical consultation after a referral was accepted, are a substantial problem and driver of increased surgical consultation waiting times for patients. The delays are currently seen as a cost of business, and are not the focus of any reduction efforts. It is the involuntary delays where efforts should be focused to reduce waiting times, by streamlining referral practices. Voluntary delays, though anecdotally suggested to be an issue, especially in rural clinics with patients in seasonal occupation such as ranchers and farmers or with lots of retirees, are not tracked consistently. By accounting for these, a more accurate view of system-related and reported wait-for-consult times could be produced. The reasons for differentiating waiting time between voluntary and involuntary times, such as differentiating the impact of patient choices to delay surgery, and determining areas where policymakers can improve system aspects (and lower involuntary-related waiting times), are incorporated into the proposed definitions in this thesis.[69,70] While an estimate of involuntary delays can be made, what happens after *T_complete* could not be estimated, and thus the *T_complete* to *T_surgeon* timeframe has an indeterminate impact upon reported consultation waiting times.

This is one of the first projects aimed at differentiating voluntary, patient-related from involuntary, system-related waiting time. While current data cannot track voluntary delays precisely, some waiting time (*T_referral* to *T_complete* for instance) are completely involuntary, which was estimated to be 11-15% of total surgical consultation waiting time. Involuntary waiting time, as mentioned in Chapters 1 and 5, includes:

- System delays: These delays occur due to inefficiencies in referral processing that cannot be controlled by the patient. Examples of these delays include incorrectly directed referrals, when a referral is sent to an office which cannot treat the patient. Treatment

involves either management of symptoms, providing therapies, or setting appointments with specialists or surgeons for hip or knee OA related issues. These incorrectly directed referrals must be denied and sent back to a referring provider, with or without knowledge of the patient.

A referral may also be sent unnecessarily. Patient with low acuity and urgency may not need treatment by a specialist, and as a result a referral would be sent back to a referring provider, sometimes with a treatment recommendation. A patient should not be expected to know whether their treatment can be directed by one type of clinician or another. This type of delay can only be reduced with referring provider knowledge of how to treat OA related hip and knee pain. This is an educational expectation that may be challenging to meet.

A referral may also arrive incomplete to an MSK clinic. If incomplete, so that a clinic cannot determine whether a patient has OA related pain, or (in some cases) cannot allow triaging of the patient, the referral is rejected. This results in the need for additional documentation, from referring providers, which may or may not be able to be provided quickly. This adds a delay which cannot be, and should not have the expectation of being, affected by patient actions.

A referral may also be delayed due to system-related management of patients. For instance, if operating room time, inpatient beds, consultation room space, or other required equipment or staff (such as MSK screeners or specialists) are not available for a surgery or surgical consultation, a patient will be delayed through no fault of their own.

- Clinical delays: These delays occur when a patient cannot proceed with a surgical consultation (or surgery) for hip or knee pain due to the need for a patient to first receive treatment from other clinicians for therapies not directly related to the hip or knee arthroplasty. These clinicians would include anyone who is necessary (from a treatment perspective or a patients perspective) to treat a patient, such as nurses, surgeons, or physiotherapists, among others. A medical reason, though it may be due *in part* to the actions of a patient (e.g. obesity or smoking), would lead to the need for treatment beyond what an orthopaedic surgeon could provide (e.g. weight loss or smoking-cessation counselling, cardiac care, or dental care). Patients would therefore enter a separate queue, in which different referral steps and delays may occur, before they can proceed with orthopaedic treatment at an MSK clinic. This introduces delays which are beyond the scope of control by both the patient and MSK clinics, though all delays are still under the healthcare system domain. The patient, as a result, is *unable* to continue to further treatment.

Incorporating a voluntary waiting time flag in a future electronic referral tool will help determine whether the estimated voluntary waiting time amounting to 5-10% of total surgical consultation waiting time is accurate. As mentioned in Chapters 1, 3 and 5, voluntary delays are caused by the patient choice to postpone treatment, for example:

- Social reasons: These reasons regard a patient choosing not to continue with treatment, not necessarily through the fault of the patient, but *not* related to any system factors. These include the choice to vacation instead of seeking treatment when first offered,

work responsibilities, or the need to care for others. In essence, the patient is not willing to continue with treatment.

- Functional reasons: These reasons regard the support a patient needs to continue with treatment. For instance, if home support is not arranged, or transportation is not made available to get into an MSK clinic, surgeon, prehabilitation or rehabilitation, then a patient is not *ready* to continue with treatment.

These types of delays have not been defined elsewhere. The specific definitions are general enough to encompass different specialties and locations beyond MSK care in Alberta.

8.3 Accessibility: next available surgeon option

This thesis found that depending on the clinic, a next available surgeon option was chosen on 71-80% of referrals, with 20-21% of the referrals having a specific surgeon noted, and the remaining percentage not having either option chosen on the referral form. These percentages are much higher than reported elsewhere. Dawson et al. in London found 63% of orthopaedic patients chose a provider with a shorter waiting time.[76,77] Conner-Spady, with patients in Saskatchewan, found that 63% of patients were not willing to change surgeons; 37% were.[81] Though different than choosing a specific surgeon initially, Conner-Spady's findings suggest that, once chosen and scheduled, patients will wait out any delays, no matter how long they get, and not seek quicker treatment from other specialists.

These findings highlight substantial variation between studies in seeking faster access that could be due to several factors, as noted by others.[65,67,81,82] Distance to care might reduce the willingness to select a next available surgeon: this could not be shown in the thesis, since the

rural site did not have a next available option. Patient preferences and EQ-5D statuses as a measure of patient outcomes and their impact upon accessibility were not collected in the thesis, and could not be tested. Women were slightly more likely to have next available selected on the referral form compared to men (63% compared to 58%, including those going to the single-surgeon clinic 2), but the difference between the two genders was not statistically significant.

One issue raised at the clinical semi-structured interviews was levels of trust among physicians and specialists. Several MSK clinics reported good relationships between referring providers in the primary care field and specialists. This has two potential effects. First, this might have increased the chances that referring providers felt their patient would receive quality care from any specialist, leading to the next available surgeon option being selected more often than in other studies. Second, the patient might have, from the media spotlight on long waiting times for other areas such as emergency care in Alberta, told the referring provider to find the quickest way to receive care. Given no negative feedback from referring providers, this would lead to increased use of the next available surgeon option. Referrals did not make it clear which party – the referring provider or the patient – made the choice to select a next available or a specific surgeon, so these two effects cannot be differentiated.

Findings in this thesis are consistent with prior literature. The number of referrals with next available surgeon selected is greater than seen elsewhere, but the effect on surgical consultation waiting time – a decrease as more referrals select this option – is seen. Efforts should be made to expand the next available surgeon option province-wide for all patients if family support is available at the city of choice.

8.4 Referral appropriateness: incomplete and incorrectly directed referrals

When referrals arrived to the clinics, every central intake administrator or nurse checked for both completeness and whether the referral was correctly directed for TJA. This entailed checking to see if pain was a) related to the hip and knee, and b) caused by osteoarthritis. At clinics 1 and 2, 16%-49% of referrals were initially denied or put on a pending queue. This proportion has not been quantified before in Alberta. The primary reason for referrals not being accepted was incomplete referral elements. At Clinic 1, missing x-rays were the primary reason, while at Clinic 2 missing height/weight/BMI figures were the primary reason. Clinic 3 had no electronic tracking (and only inconsistent paper tracking) of reasons for non-accepted referrals. Some of this missing information could be quickly retrieved from an option such as NETCARE, an electronic medical record used by some regions. Other missing information required calls back and forth between specialist clinics and referring providers. The percentage of missing and/or incomplete referral elements is higher than seen elsewhere. For example, Weiner et al. note that 8% of referrals in his sample were sent twice due to various reasons.[123] Denied referrals, as noted in Chapters 4 and 6, were not a large percentage of all referrals. These included only one incorrectly directed referral. During the time studies, there were a larger percentage of denied referrals – 2 of 30 at Clinic 1 – but one was a physician requesting a patient be removed from a waiting list, which was done by creating a denied referral. This left 1 of 30, or 3% of referrals, denied for the reason of not showing signs of OA or being hip or knee related. At Clinic 2, none were denied in either the chart review or time study, and at Clinic 3 none were denied in the time study.

The incompleteness impact was related to two factors. The first was clinical variations in accepting referrals. Each clinic, as noted in Chapter 4, had different requirements for judging whether a referral was acceptable. These requirements, and the differences between the clinics, have not been recorded in the literature previously. It turned out that the relationship between medical office administrators at both the referring provider and the specialist office – whether the surgeon or the MSK clinic – was very important. If a relationship between referring providers and specialists had been established over time, the medical office manager of a referring provider would know the unwritten requirements for each clinic, and would provide the correct data the first time. This unobserved characteristic had a large impact upon waiting times: incomplete referrals took significantly longer to process, by 32 median business days at Clinic 1 (1.46 months) and 6 median business days at Clinic 2 (.28 months). This impact has not been quantified before elsewhere, nor have the varied clinical rules. This will have an impact if province-wide selection of surgeons and clinics by patients and referring providers occurs. If requirements and the speciality of the surgeon are not known, and patients choose exclusively by time, then the number of patients facing delays is likely to increase, as referrals will be sent to surgeons who may not necessarily have expertise or the capability for handling a specific patient. The time needed to process referrals will likely increase on average, since rejected referrals take longer to process. Knowledge about specific requirements at clinics and for surgeons must be incorporated into any referral system improvement.

The second factor was in feedback between referring providers and specialists either after a referral was accepted, or during the process to complete missing information on a referral. This was not explored in the thesis, due to lack of consistent recordkeeping, and the actions of

the referring provider being outside the scope of the thesis. Westerman et al. and Gandhi et al. both demonstrate that there exist issues in correspondence sent between primary care providers and specialists, with 43% of specialists not satisfied with the information they received.[15,176] Though this was not explored, part of this dissatisfaction was likely due to the quality of the referral. Rupp makes a case that incorrect diagnoses by primary care are an additional cause of specialist dissatisfaction.[126] This problem was minimal in this thesis; long waiting time did result from the few cases of incorrectly referred referrals that were eventually sent back to the MSK clinics. Most referrals were related to hip and knee OA, suggesting misdiagnosis by the referring provider was not a problem. Nor was the degree of OA – no referral was rejected, and no clinic administrator expressed dissatisfaction that too many low acuity patients were being forwarded to the specialist MSK clinics. It will be important that referring providers, in addition to specialists, be engaged in incorporating changes to the referral system.

The percentage of incomplete and incorrectly directed referrals was shown to be a significant percentage in Alberta, slightly more than in other studies. The effects seen in other studies, such as longer waiting times for patients, are also observed at the pilot MSK clinics. An electronic referral tool which reduces initially incomplete referrals, while not guaranteeing acceptance (for instance, if incorrect x-rays, or x-rays with no sign of osteoarthritis are sent), will reduce patient waiting time for surgical consultations and save staff processing time.

8.5 Referral appropriateness: prioritization and MSK screening

Referral information, for a surgical consultation, is intended to provide information that a) the patient is likely to be suffering from a hip and knee OA-related problem, and b) how urgent the

ailment is. With this information, an administrator determined whether to schedule the patient immediately for a consultation, or whether the patient should be assessed by an MSK screener such as a practicing or retired surgeon, trained physiotherapist or nurse, if MSK screening was available. If an MSK screener was not available, the best option was to schedule a patient that appeared to have low urgency from the referral for a consult, but at a later date. No clinic involved had a quantifiable method of prioritizing patients. In fact, patient prioritization varied by clinic. This led to inconsistencies in triaging that a policymaker may eventually choose to standardize across clinics.

As a result, the pre-consultation process related to referral appropriateness can be broken into two parts. First, initial triaging was conducted by a clinical administrator, determining whether OA was present and determining the severity of the OA. This would then be used for scheduling a surgical consultation, and for determining if a patient should attend an MSK screening, if available. Second, if an MSK screener was available, determining from that screening whether a patient was highly acute, and should attend a surgical consultation quickly, or whether a patient was not as acute, in which case medical management could be applied.

What is notable is that MSK screening directed many low urgency patients for medical management. At the same time, the triaging allowed those who were urgent to be proceed to a surgeon consultation. This saved surgeon time evaluating patients which may not have been immediately surgical. Of the MSK patients seen, 33% at Clinic 1 and 68% at Clinic 3 were assessed nonsurgical. While these may be seen as inappropriate referrals, the patients assessed nonsurgical received medical management and long-term optimization plans from the specialists.

How best triaging and screening should be completed has not been conclusively determined in previous literature, and no judgment on the best techniques to accomplish these is made in this thesis. MSK screening can be done with an specific MSK screener, as is done in other jurisdictions such as Ontario where MSK screening by trained advanced practice physiotherapists (APPs) has reduced waiting times and resulted in more acute patients being forwarded to surgical consultations.[150,170] This resource requires a dedicated MSK screener at each clinic, which will be a cost incurred by a stakeholder. This first method may in fact shift waiting times, as is seen in the scenario analyses. There, the wait for an MSK screening grows as more patients are screened, but the subsequent wait for a surgical consult is reduced and slightly offsets any increased time spent waiting for a screening.

The second method asks what can be completed on the referral form that would help to triage a patient. Prioritization via tools such as the Western Canada Wait List questionnaire for surgical consultations can provide questions that judge the urgency of a patient. These questions can either be scored to provide an explicit urgency score to triage patients, or can be used as supportive evidence by a clinical administrator to determine the urgency of a patient. Evidence provided by these questions can be used for both determining whether to send a patient to an MSK assessment versus straight to a surgical consultation, or to determine the scheduling order for surgical consultations. Currently, triaging varies substantially, both between and within clinics: different clinical administrators use different evidence to judge acuity and urgency of the patient. Evidence currently used, in part or in full by a clinical administrator, includes 1) the WCWL questions on the current AHS standardized referral form, 2) x-ray evidence for OA, and

3) an evaluation of any letter attached to the referral by a referring provider to see if there is mention by the referring provider of a patient appearing in need of urgent care.

Standardizing the evidence used to triage patients, though producing consistency across all clinics with Alberta, would be fraught with reducing the ability of each clinic to use their own clinic-specific judgments. This shift into clinical practices is not likely to be well-received by independent surgeons and their offices. A focus on providing more information that is complete and relevant to the triaging decision, while still allowing the surgeon and clinical staff final decision-making on how to triage a patient, is likely to produce best results for getting patients to see a specialist or surgeon quicker.

Evidence from both Alberta and other jurisdictions suggests triaging, in addition to preventing low acuity and urgency patients from waiting to see a surgeon for consultation, reduces waiting time for highly acute and urgent patients to see a surgeon. While the time for MSK visits does increase for lower acuity patients, relative to current surgeon consultation waiting times for low acuity patients, the estimated MSK times are lower. If resources are available, MSK options should be given at each MSK clinic to reduce patient delays.

8.6 Efficiency: clinic staff time spent processing each referral

The time studies found that the time to process referrals did not vary significantly by clinic. Each referral took 9 to 15 minutes to process, with longer processing times for referrals that were rejected or put in a pending queue. For those, customized notices had to be prepared and sent back to the referring provider by the clinic, and additional time would be spent subsequently answering further questions from the referring provider. This is the first detailed look at

specialist clinic practices for evaluating referrals. Primary care physicians have been studied before in direct observation similar to the time studies, with average visits for primary care physicians taking 10 minutes, with additional time – not necessarily spent by the physician and not quantified specifically – preparing a referral.[19,85]

The total time for referral processing imposes a burden on MSK clinic and surgeon staff. When estimated by week, Clinic 1 needed approximately 16 hours of staff time per week to process referrals, in addition to scheduling and answering further queries from physicians regarding waiting time. Clinic 2 required approximately 2 hours per week to process referrals, and Clinic 3 required approximately 3 hours per week. This burden had not been quantified previously at the specialist level. This time included items such as scanning in records, which with electronic transmission of referrals could be reduced significantly. Time spent by MSK clinic staff preparing notices to send back to referring providers, especially if referral forms are required to be completed in full, will be significantly reduced as well.

The time spent processing incoming referrals at the clinics was not consistent every week. If a clinic administrator handling referrals was busy with other tasks, referrals would not be processed the same day or even the same week. The dual tasks completed by administrators and clinicians have been an underreported aspect of the literature. In addition to processing referrals, staff at each clinic had other tasks to attend to, ranging from nursing evaluation of patients, providing physiotherapy for patients, and managing office staff. Opportunity cost – the price of a service (referral processing) expressed in terms of the next best alternative that is given up (other tasks) – was present in all referral processing work by every staff member evaluated.

An electronic referral tool may come with a large upfront cost, but cost savings will result from utilizing staff at other tasks, reducing the opportunity cost resulting from referral processing.

This is among the first studies that quantify the specific time needed at each step to process referrals. Several steps in referral processing, with a well-designed electronic referral tool, can be eliminated. This will reduce staff time processing referrals, time which can then be allocated elsewhere.

8.7 An electronic referral tool: using scenario analyses to estimate potential referral system gains

With an electronic referral tool, there is an opportunity to improve referral system processing by reducing the number of incomplete and incorrectly directed referrals, improving access by expanding next available surgeon options, and standardizing and expanding triaging and MSK screening options. The benefits of an electronic referral tool to improve outcomes such as accessibility, referral appropriateness, and efficiency have been reported by previous studies, and are highlighted here:

- A well designed electronic referral tool can improve referral system outcomes.

As Wootton et al. note, an electronic referral tool can produce outcomes that are better for clinicians and staff members tracking referrals, in terms of waiting times, reduced inappropriate referrals, and savings in clinic staff time – both at a referring provider and a specialist level.[84] Electronic referral tools have the ability to a) consistently measure clearly defined performance indicators, b) track requests made about a referral or a patient throughout the system, and c) change clinical work processes.

Alberta has already incorporated many elements that can be eventually implemented electronically for hip and knee TJA at MSK clinics, such as central intake clinics, defined and standardized waiting time measures, a standardized referral template, and an option for choosing the surgeon or a next available surgeon. These standardized tools will result in better and more accurate measurement of referral processes. By pinpointing processes that are problematic changes aimed at reducing patient waiting time for surgical consultations can be implemented.

Patel et al. found that electronic referral reduced the referral processing time of clinical staff by 44%, and similar savings in Alberta seem likely, given the tasks currently completed (scanning time, duplicate data entry, typing out formal referral acceptance and denial notices).[129] Weiner et al. found that an electronic referral tool, with reminders, would decrease the median referral-to-consult waiting time.[132] The scenarios from Chapter 7 show that, with these initiatives implemented, positive referral system results could be obtained.

- Interactive interventions, such as structured referral templates which must be completed, will improve referral appropriateness and increase accuracy in triaging patients.

In a systematic review, Akbari et al. found that referral appropriateness, the primary outcome of study, was improved with non-passive interventions.[88] Effective non-passive interventions included structured referral sheets with new guidelines and organizational changes to processing referrals. An electronic referral tool that required complete referrals using a standardized referral template – a non-passive intervention – would likely increase referral appropriateness and decrease the number of incomplete and/or inappropriate referrals from the current 20-54%. This was shown in the scenario estimating full completion of referrals (Chapter 7), and would occur

by improving accounting of clinical variation in triaging and processing rules, as was noted in Chapter 4.

- Centralized Intake, allowing the use of next available surgeon options, will potentially decrease patient referral waiting time.

At some multiple surgeon clinics in Alberta, centralized intake was used to process all incoming hip and knee related patients. Once accepted by the centralized intake, staff then routed the patients to a specific surgeon if listed, or kept the referral and filled in next available slots with the patient. The cost of centralized intake might not offset the savings resulting from a single intake queue, as has been argued by Davies and Elwyn.[177] When incorporated with other electronic referral elements, further cost savings may result. With centralized intake already operating throughout most of Alberta, the costs have already been incurred. Centralized intake province-wide (or an electronic referral tool accounting for variations) would then allow for one common queue with common referral requirements completed with a common referral template, which would open up a next available option for patients at the time a referral is made to any participating surgeon. This common queue would reduce waiting list sizes since patients can be routed to the shortest waiting time, if no surgeon preference has been given.[102] The first scenario regarding the percentage of referrals selecting next available surgeon in Chapter 7 showed that a next available option would reduce waiting times in Alberta, though no statement can be made directly on costs.

- More accurate waiting times can be estimated.

In addition to consistent timestamps across clinics defined by the BJSCN Waiting Time Rules, a well-designed electronic system would allow the reasons for delays to be tracked. This would track involuntary waiting times separately from patient-related voluntary waiting times. This is seen in the fourth scenario of Chapter 7 analyzing the relative proportion of voluntary waiting on total surgical consultation waiting time. There, reported waiting times for a surgical consultation decreased. Accurate waiting time reporting through an electronic referral tool, in addition to reducing the burden on clinical staff to spend resources calculating waiting times, is an important aspect of any future tool. Compared to the current situation, where a) timestamps have been measured inconsistently, b) substantial staff time is needed to produce reports and audit results (2 days per quarter at one clinic), and c) voluntary patient-related waiting time has been combined with involuntary system-related waiting time to make system-related waiting times appear longer than they are, improvements will allow for performance measures to be accurately estimated with less clinical staff input, in an output form that can be used by healthcare policymakers, clinics, referring providers, and patients.

8.8 Limitations

This thesis has several limitations which need to be highlighted to ensure the results are interpreted in the correct context. In addition to specific limitations mentioned in the results chapters (Chapters 6 and 7):

- The size of the sample is small (n=218 charts and 3 clinics).

As mentioned earlier, having a small sample size – for estimating supply related issues (clinics) and characteristics of demand (patients) – will result in estimates that may vary more when expanded to all clinics in Alberta. These wide confidence intervals do not lead to precision that may be needed when making decisions related to implementing referral process enhancements.

This sample size was chosen to allow hypothesis testing (Chapter 3) and the number of clinics aimed to be representative of the MSK clinic population in Alberta (Chapter 4). However, this sample size was selected to still allow for enough statistical power for the scenario analysis estimation in Chapter 7 (80% power to estimate a 66% to 99% change in the percentage of complete referrals and a 10% reduction in waiting times from *T_referral* to *T_surgeon*) while minimizing the chances of calculating an estimate that is not statistically relevant.

- The thesis may not be generalizable to other referral systems, in specialties other than hip and knee TJA, to all Alberta clinics, to clinics in other provinces, or clinics in other countries.

One potential critique of the thesis is that while the findings regarding Wait Times Rules, referral system evaluation, and system enhancements may be applicable for Alberta hip and knee TJA referrals, the findings cannot be applied to other medical specialists or other jurisdictions. This would include generalizability issues to other MSK hip and knee clinics in Alberta, much less in Canada or worldwide for hip and knee OA referrals.

The three clinics sampled, as noted in Chapter 4, are a cross-sectional sample representing the range of clinic properties across Alberta. Approximately one-third of hip and knee TJA referrals in Alberta arrive at the three sampled clinics, which represented one-third of the nine MSK clinics in Alberta. These clinics were in different locales and had different

numbers of surgeons practicing at them, ranging from rural one-surgeon practices to urban multi-surgeon practices. The use of electronic records at each clinic varied, matching offices elsewhere that use electronic records or primarily use paper records. The complexity of the patients varied, from low-complex cases to highly-complex cases. The degree of cooperation between different participating staff also varied, highlighting whether a clinic is managed closely or is a loose collection of participants. As noted in Chapters 2 and 3, these characteristics are seen elsewhere throughout both Canada and the world: initiatives involving central intake clinics, surgeon and hospital choice, rules for calculating waiting times, standardized referral forms, and urgency priority scoring for triaging and surgery have been implemented in different jurisdictions. Characteristics of clinics around the world mirror Alberta too: locations of clinics vary from rural to urban, the number of surgeons practicing at clinics varies from single to multi-surgeon, the ability to handle complex patients vary, and whether MSK screening occurs varies as well. Efforts being made in Alberta to improve referrals are being mirrored by Alberta, and the potential enhancements to the TJA referral system. Alberta itself, with 3.7 million patients and over 18,000 referrals per year, is a comprehensive system that is present in many different settings. From these, the results of this thesis inform basic findings on what is currently happening in referral processing, and suggests some initial efforts that can be made to enhance referral processing in the future.

- The entire referral process is not tracked: referring providers and patients are not analyzed.

The initial project scope was limited to specialist clinics. Not as much research has occurred with specialist clinics, and the original NO WAITS project was tied into referrals once received

by a specialist office. Referring providers, specifically general practitioners as noted earlier, have concerns about adequate information being received back from specialists. Referring providers may also be unsure about what makes up adequate information for a specialist to process a referral. Understanding these processes will allow for more efficient design of an electronic referral tool. This will inform specialist expectations both about how much referring providers can provide on a referral, as well as how much triaging is usually completed by a referring provider before patients are referred to a specialist.

One other area this thesis does not address regards questions about allocative efficiency. Technical efficiency is defined as making efficient use of resources to achieve the maximum benefit in health or in a health system, opposed to allocative efficiency, which focuses on reallocation of resources to other specialties that maximize gains to society from limited resources.[178] This thesis shows that there are opportunities for efficiency gains – technical efficiency – when improving referral processing. Once these technical efficiency enhancements are made, resources can be freed for other tasks – a *decrease* in the intensive margin. How these resources can be allocated efficiently is not determined in this thesis. The effects upon outcomes such as waiting times from adding these newly freed resources back to referral processing and treatment of hip and knee patients are likely to be similar as what has been analyzed here. Increased follow-up of patients, since most processing is done by therapists and nurses, would be one potential gain. These resources, though, could be allocated to other areas such as different medical specialties, or areas such as population health initiatives. A cost-effectiveness analysis would be the best method to determine where to allocate these resources so that allocative efficiency is attained, but such an analysis is beyond the scope of this thesis. Instead, this thesis

provides a first step in determining where referral processing can be improved within specialist clinics, and provides outcomes which can be measured to determine the effectiveness of future proposed interventions.

Chapter Nine: **Conclusion**

Long waiting times for elective surgical procedures in Canada are a concern for the public and Canadian governments. Previous studies have investigated the causes of delays, and the impact upon accessibility arising from delays, from when a decision was made to have surgery through the date of surgery. However, these studies have not thoroughly investigated the causes of delays to receive a surgical consultation or to the effect of delays on accessibility, referral appropriateness, and efficiency. I examined elective hip and knee arthroplasty referrals from primary care-to-specialist (*T_referral* to *T_surgeon*) as an example of how system-wide improvements can improve quality of care for patients.

One potential approach to improve system outcomes – accessibility, referral appropriateness, and efficiency – is an electronic referral tool, including elements such as a standardized referral form with a requirement to complete all referral form questions, the option for all referred patients to choose a next available surgeon, a system of MSK screening and triaging, and separating voluntary, patient-related surgical consultation waiting times from involuntary, system-related surgical consultation waiting times, measured consistently according to standardized rules. The information needed to determine whether an electronic referral tool for elective hip and knee total joint arthroplasty is effective has not been collected previously. Current performance indicators regarding referral processing from *T_referral* to *T_surgeon* have similarly been unmeasured and unavailable to inform efforts to improve system and patient outcomes.

This thesis asked if implementing an electronic referral tool could potentially improve patient outcomes for primary-to-specialist care for elective hip and knee total joint arthroplasty.

To do this, I evaluated current referral practices and processing at MSK clinics and developed scenario analyses to estimate potential changes to the outcomes from enhanced referral processing elements: standardized complete referral forms, choice of next available surgeon, increased use of MSK triaging and screening, and separating voluntary, patient-related waiting times from total waiting times. Information was gathered from clinics using semi-structured interviews of at least two staff members at each pilot clinic, 218 patient chart reviews of referrals, and time studies of at least two clinic staff. The findings suggest that are potential gains in the current referral processing system that could be achieved from implementing an electronic referral tool as measured by the following three outcome measures:

- Accessibility: The time from when a referral is made to when a referral is deemed complete, correctly directed, and accepted by an MSK clinic could be reduced using an electronic referral tool. Based on patient chart reviews, reductions of about 11-15% (from patient charts, the total waiting time from *T_referral* to *T_surgeon*) could occur: this time is involuntary waiting time that, with instantaneous receipt of a complete standardized referral through an electronic referral tool, could be reduced significantly. Based on an estimate from patient charts of 70% choosing a next available surgeon, patients in Alberta are willing to choose a next available surgeon for faster access to care. Referral enhancements would potentially lower surgical consultation waiting times closer to target benchmarks of 14 weeks total for patients to receive both surgical consultations and surgery for elective hip and knee replacements.

  This thesis provides evidence that the wait for a surgical consultation is substantial: mean waiting times range from 51 business days at Clinic 2 to 97 business days at Clinic 1 to

139 business days at Clinic 3. Excluding this waiting time greatly underestimates the time a patient must wait for total joint arthroplasty: up to 80% of the time spent waiting for surgery after a referral is first made by a referring provider occurs *before* a surgical consultation. This thesis also finds that information on involuntary-related waits and voluntary-patient waits is not tracked: voluntary, patient-related delays are hence likely to be contributing to overestimation of total waiting times due to the health system, and the timing of involuntary delays, which is unknown, results in more challenging system-led efforts to reduce waiting times.

- Referral appropriateness: Clinic requirements varied for accepting referrals. These requirements, unless known to referring providers, could result in referrals being initially denied or put on a pending queue – as happened for 20% of referrals at Clinic 1 and 54% at Clinic 2, while this variable was not tracked at Clinic 3. An electronic referral tool which requires completion of all referral elements would provide all information needed by the clinics the first time for staff to determine if a patient was correctly directed and if so the urgency level of a patient. The urgency level could be determined more consistently through consistent referral information, and could lead to better MSK screening and triaging options. If resources are available, MSK screeners, such as advanced practice physiotherapists or other trained clinicians, are effective at reducing waiting times and low urgency patients consulting with surgeons, and should be used in more clinics.
- Efficiency: Staff processing time is consistent across clinics, but varies depending on the status of the referral. Each referral takes 9-15 minutes to process. Denied or pending

referrals that arise due to clinical requirements that may not be known by referring providers lengthen processing time. Time to contact referring providers for incomplete referral information also takes away time from other tasks staff could be completing. Currently, at least 3000 hours are needed across Alberta to process referrals at MSK clinics. An electronic referral tool, with reminders and feedback to all clinicians and administrators who handle referrals, will increase efficiency by reducing time needed to handle incomplete referrals.

Using scenario analyses that estimated the changes from implementing referral enhancements using an electronic referral tool, supported by data from a referral system implemented in Hamilton, Ontario, it was demonstrated how an electronic referral tool could potentially reduce waiting times for a surgical consultation. First, with 30% more referrals selecting a next available surgeon option (to 100% next available), it was estimated that the overall surgical consultation waiting times from *T_referral* to *T_surgeon* would be reduced by 4 days. Second, completion of all referral requirements by 22% (to 99% of referrals) would reduce surgical consultation waiting times by 3 days. Third, increased MSK screening (by 30% to all patients) could decrease surgical consultation waiting times slightly by 1 day, but substantially more for patients of higher urgency. Fourth, removing voluntary, patient-related waiting times from the calculation of overall waiting times will – though not *changing* total patient waiting time – will result in lower reported system-related surgical consultation waiting times. If voluntary, patient-related waiting times were 5-10% of total waiting time, then mean surgical consultation waiting times estimates would be reduced by 5-10 days.

The aim of any system changes in referral processing should be better outcomes for patients. Surgical consultation waiting times are the key outcome measure from a patient perspective. These waiting times are influenced by several system processes for handling referrals, including referral appropriateness, clinical time spent processing referrals, and MSK triaging of patients after a referral is accepted (using information from the referral forms). There are opportunities to improve these system processes. An electronic referral system for hip and knee arthroplasties could increase the number of complete and correctly directed referrals received by hip and knee clinics. These will consequently reduce clinical staff time needed to process these referrals, allowing clinical resources to be used elsewhere. The reduction in waiting time, combined with better triaging using more accurate information, would be expected to lower substantially waiting times for surgical consultations, and result in better outcomes for patients.

Bibliography

(1) Marshall D, Christiansen T, Smith C et al. Voluntary versus Involuntary Waiting for Joint Replacements: New Alberta Wait Times Rules for Hip and Knee Arthroplasty with Provincial Consensus. *Healthcare Quarterly.* 2012;15:36-42.

(2) Pollara. Health Care in Canada: 10th Annual Edition Survey Results. 2007.

(3) Canadian Institute for Health Information. Wait Times Tables -- A Comparison by Province, 2009. 2009. Analysis in Brief.

(4) Coyte PC, Wright JG, Hawker GA et al. Waiting Times for Knee-Replacement Surgery in the United States and Ontario. *New England Journal of Medicine.* 1994;331:1068-1071.

(5) Snider MG, MacDonald SJ, Pototschnik R. Waiting times and patient perspectives for total hip and knee arthroplasty in rural and urban Ontario. *Can J Surg.* 2005;48:355-360.

(6) Alberta Health Services. Alberta Health Services Q4 Performance Report 2011/12. 7-6-2012.

(7) Kopec JA, Rahman MM, Berthelot JM et al. Descriptive epidemiology of osteoarthritis in British Columbia, Canada. *The Journal of Rheumatology.* 2007;34:386-393.

(8) Arnett G, Hadorn DC, Steering Committee of the Western Canada Waiting List Project. Developing priority criteria for hip and knee replacement: results from the Western Canada Waiting List Project. *Can J Surg.* 2003;46:290-296.

(9) Cipriano LE, Chesworth BM, Anderson CK, Zaric GS. An Evaluation of Strategies to Reduce Waiting Times for Total Joint Replacement in Ontario. *Medical Care.* 2008;46:1177-1183.

(10) Tuominen U, Sintonen H, Hirvonen J et al. Is Longer Waiting Time for Total Knee Replacement Associated with Health Outcomes and Medication Costs? Randomized Clinical Trial. *Value in Health.* 2010;13:998-1004.

(11) Willcox S, Seddon M, Dunn S, Edwards RT, Pearse J, Tu JV. Measuring and reducing waiting times: A cross-national comparison of strategies. *Health Affairs.* 2007;26:1078-1087.

(12) Kinnersley P, Rapport F, Owen P, Stott N. In-house referral: a primary care alternative to immediate secondary care referral? *Family Practice.* 1999;16:558-561.

(13) Health Quality Council of Alberta. Alberta Quality Matrix for Health User Guide. 2005. Calgary, Alberta, Health Quality Council of Alberta.

(14) Bourguet C, Gilchrist V, McCord G. The consultation and referral process - A report from NEON. *Journal of Family Practice.* 1998;46:47-53.

(15) Gandhi TK, Sittig DF, Franklin M, Sussman AJ, Fairchild DG, Bates DW. Communication breakdown in the outpatient referral process. *Journal of General Internal Medicine.* 2000;15:626-631.

(16) Sobolev B. Linking operations and health services research. *Clinical and Investigative Medicine.* 2005;28:305-307.

(17) Institute of Medicine. *Envisioning the National Health Care Quality Report*. Washington, DC: National Academy Press; 2001.

(18) Britten N. Qualitative Research: Qualitative interviews in medical research. *BMJ.* 1995;311:251-253.

(19) Crabtree BF, Miller WL, Stange KC. Understanding practice from the ground up. *Journal of Family Practice.* 2001;50:881-887.

(20) Kim S, Losina E, Solomon DH, Wright J, Katz JN. Effectiveness of clinical pathways for total knee and total hip arthroplasty - Literature review. *Journal of Arthroplasty.* 2003;18:69-74.

(21) Canadian Institute for Health Information. Wait Times in Canada -- A Summary, 2012. 2012.

(22) Ellwood PM. Shattuck Lecture - Outcomes Management - A Technology of Patient Experience. *New England Journal of Medicine.* 1988;318:1549-1556.

(23) Krumholz HM. Outcomes Research: Myths and Realities. *Circ Cardiovasc Qual Outcomes.* 2009;2:1-3.

(24) Clancy CM, Eisenberg JM. Health Care Policy: Outcomes Research: Measuring the End Results of Health Care. *Science.* 1998;282:245-246.

(25) Smith PC. Performance measurement in health care: History, challenges and prospects. *Public Money & Management.* 2005;25:213-220.

(26) Poolman RW, Swiontkowski MF, Fairbank JCT, Schemitsch EH, Sprague S, De Vet HCW. Outcome Instruments: Rationale for Their Use. *Journal of Bone and Joint Surgery-American Volume.* 2009;91A:41-49.

(27) Rothman KJ, Greenland S, Lash TL. *Modern Epidemiology, 3rd Edition*. Lippincott Williams & Wilkins; 2008.

(28) Ohman-Strickland PA, Orzano AJ, Nutting PA et al. Measuring organizational attributes of primary care practices: Development of a new instrument. *Health Services Research.* 2007;42:1257-1273.

(29) Lindsay CM, Feigenbaum B. Rationing by Waiting Lists. *The American Economic Review.* 1984;74:404-417.

(30) Cullis JG, Jones PR. Rationing by Waiting Lists: An Implication. *The American Economic Review.* 1986;76:250-256.

(31) Iversen T. A theory of hospital waiting lists. *Journal of Health Economics.* 1993;12:55-71.

(32) National Collaborating Centre for Chronic Conditions. Osteoarthritis: National clinical guideline for care and management in adults. 2008. London, Royal College of Physicians.

(33) Cushnaghan J, Dieppe P. Study of 500 patients with limb joint osteoarthritis. I. Analysis by age, sex, and distribution of symptomatic joint sites. *Annals of the rheumatic diseases.* 1991;50:8.

(34) Frankel S, Eachus J, Pearson N et al. Population requirement for primary hip-replacement surgery: a cross-sectional study. *Lancet.* 1999;353:1304-1309.

(35) Hoogeboom TJ, van den Ende CHM, van der Sluis G et al. The impact of waiting for total joint replacement on pain and functional status: a systematic review. *Osteoarthritis Cartilage.* 2009;17:1420-1427.

(36) Hirvonen J, Blom M, Tuominen U et al. Health-related quality of life in patients waiting for major joint replacement. A comparison between patients and population controls. *Health and Quality of Life Outcomes.* 2006;4.

(37) Kili S, Wright I, Jones RS. Change in Harris hip score in patients on the waiting list for total hip replacement. *Annals of the Royal College of Surgeons of England.* 2003;85:269-271.

(38) Bachrach-Lindstrom M, Karlsson S, Pettersson LG, Johansson T. Patients on the waiting list for total hip replacement: a 1-year follow-up study. *Scandinavian Journal of Caring Sciences.* 2008;22:536-542.

(39) Mahon JL, Bourne RB, Rorabeck CH, Feeny DH, Stitt L, Webster-Bogaert S. Health-related quality of life and mobility of patients awaiting elective total hip arthroplasty: a prospective study. *CMAJ.* 2002;167:1115-1121.

(40) Kirwan JR, Currey HLF, Freeman MAR, Snow S, Young PJ. Overall Long-Term Impact of Total Hip and Knee Joint Replacement Surgery On Patients with Osteoarthritis and Rheumatoid Arthritis. *Rheumatology.* 1994;33:357-360.

(41) Bozic KJ, Saleh KJ, Rosenberg AG, Rubash HE. Economic evaluation in total hip arthroplasty - Analysis and review of the literature. *Journal of Arthroplasty.* 2004;19:180-189.

(42) Chang RW, Pellissier JM, Hazen GB. A cost-effectiveness analysis of total hip arthroplasty for osteoarthritis of the hip. *Jama-Journal of the American Medical Association.* 1996;275:858-865.

(43) Quan H, Lafreniere R, Johnson D. Health service costs for patients on the waiting list. *Can J Surg.* 2002;45:34-42.

(44) Montin L, Suominen T, Katajisto J, Lepisto J, Leino-Kilpi H. Economic outcomes from patients' perspective and health-related quality of life after total hip arthroplasty. *Scandinavian Journal of Caring Sciences.* 2009;23:11-20.

(45) Fielden JM, Cumming JM, Horne JG, Devane PA, Slack A, Gallagher LM. Waiting for Hip Arthroplasty: Economic Costs and Health Outcomes. *The Journal of Arthroplasty.* 2005;20:990-997.

(46) Noseworthy, T., Sanmartin, C., Bohn, E., Conner-Spady, B., De Coster, C., Dunbar, M., Lorenzetti, D., McLaren, L., and McGurran, J. Towards Establishing Evidence-Based Benchmarks for Acceptable Waiting Times for Joint Replacement Surgery – Report #2 October 2005. 2. 14-10-2005.

(47) Hurst, Jeremy and Siciliani, Luigi. Tackling Excessive Waiting Times for Elective Surgery: A Comparison of Policies in Twelve OECD Countries. 6. 7-7-2003. OECD Publishing. OECD Health Working Papers.

(48) Williams JI, Llewellyn Thomas H, Arshinoff R, Young N, Naylor CD. The burden of waiting for hip and knee replacements in Ontario. Ontario Hip and Knee Replacement Project Team. *Journal of Evaluation in Clinical Practice.* 1997;3.

(49) Alberta Health Services. How Long Are Patients Waiting For Acute Care Services? 2011.

(50) Canadian Institute for Health Information. Hip and Knee Replacements in Canada—2011 Annual Statistics (Clinical Data). 2012.

(51) Siciliani, Luigi and Hurst, Jeremy. Explaining Waiting-Time Variations for Elective Surgery Across OECD Countries. 38. 2004. OECD Economic Studies.

(52) Sobolev B, Levy A, Hayden R, Kuramoto L. Does wait-list size at registration influence time to surgery? Analysis of a population-based cardiac surgery registry. *Health Services Research.* 2006;41:23-39.

(53) Hamilton BH, Ho V, Goldman DP. Queuing for surgery: Is the US or Canada worse off? *Review of Economics and Statistics.* 2000;82:297-308.

(54) Alberta Health Services. Becoming the Best: Alberta's 5-Year Health Action Plan: 2010-2015. 2010.

(55) Siciliani L, Hurst J. Tackling excessive waiting times for elective surgery: a comparative analysis of policies in 12 OECD countries. *Health Policy.* 2005;72:201-215.

(56) Lundström M, Stenevi U, Thorburn W. Assessment of waiting time and priority setting by means of a national register. *Int J Technol Assess Health Care.* 1996;12:136-140.

(57) Sanmartin CA. Toward Standard Definitions for Waiting Times. *Healthcare Management Forum.* 2003;16:49-53.

(58) Cancer Care Ontario. Target Wait Times for Cancer Surgery in Ontario. 2006.

(59) Alberta Health Services and Alberta Health and Wellness. Indicator Definition: Wait Time for Knee Replacement Surgery. 2010.

(60) Munt BI, Humphries KH, Moss RR, Thompson CR. True versus reported waiting times for valvular aortic stenosis surgery. *Canadian Journal of Cardiology.* 2006;22:497-502.

(61) Saint-Jacques N, Younis T, Dewar R, Rayson D. Wait times for breast cancer care. *British Journal of Cancer.* 2006;96:162-168.

(62) Alberta Bone and Joint Health Institute and Alberta Health Services. Wait Times Rules: Gaining Provincial Consensus. 2010.

(63) NHS Department of Health. Referral to Treatment Consultant-Led Waiting Times Rules -- Definitions. 2010.

(64) NHS Department of Health. Referral to Treatment Consultant-Led Waiting Times Rules -- National Clock Rules. 2010.

(65) De Coster C. Non-clinical factors associated with variation in cataract surgery waiting times in Manitoba. *Canadian Journal on Aging-Revue Canadienne du Vieillissement.* 2005;24:47-58.

(66) Hilkhuysen GLM, Oudhoff JP, Rietberg M, der Wal Gv, Timmermans DRM. Waiting for elective surgery: a qualitative analysis and conceptual framework of the consequences of delay. *Public health.* 2005;119:290-293.

(67) Lofvendahl S, Eckerlund I, Hansagi H, Malmqvist B, Resch S, Hanning M. Waiting for orthopaedic surgery: factors associated with waiting times and patients' opinion. *Int J Qual Health Care.* 2005;17:133-140.

(68) Ontario Ministry of Health and Long-Term Care. Ontario Wait Times: Frequently Asked Questions about Surgical and Diagnostic Imaging Wait Times. 2011.

(69) Amoko DHA, Modrow RE, Tan JKH. Surgical Waiting Lists I: Definition, Desired Characteristics and Uses. *Healthcare Management Forum.* 1992;5:17-22.

(70) Manitoba Health. Manitoba Wait Time Information: Understanding Wait Times. 2011.

(71) Kreindler SA. Policy strategies to reduce waits for elective care: a synthesis of international evidence. *British Medical Bulletin.* 2010;95:7-32.

(72) Kenis P. Waiting lists in Dutch health care: an analysis from an organization theoretical perspective. *Journal of health organization and management.* 2006;20.

(73) Gooch KL, Smith D, Wasylak T et al. The Alberta hip and knee replacement project: A model for health technology assessment based on comparative effectiveness of clinical pathways. *Int J Technol Assess Health Care.* 2009;25:113-123.

(74) Bridgman S, Li X, Mackenzie G, Dawes P. Does the North Staffordshire slot system control demand of orthopaedic referrals from primary care? A population-based survey in general practice. *British Journal of General Practice.* 2005;55:704-709.

(75) García-Lacalle J. A bed too far - The implementation of freedom of choice policy in the NHS. *Health Policy.* 2008;87:31-40.

(76) Dawson D, Gravelle H, Jacobs R, Martin S, Smith PC. The effects of expanding patient choice of provider on waiting times: Evidence from a policy experiment. *Health Econ.* 2007;16:113-128.

(77) Dawson D, Jacobs R, Martin S, Smith P. Is patient choice an effective mechanism to reduce waiting times? *Applied Health Economics and Health Policy.* 2004;3:195-203.

(78) Siciliani L. Does more choice reduce waiting times? *Health Econ.* 2005;14:17-23.

(79) Ho E, Coyte PC, Bombardier C, Hawker G, Wright JG. Ontario Patients Acceptance of Waiting-Times for Knee Replacements. *Journal of Rheumatology.* 1994;21:2101-2105.

(80) Conner-Spady B, Sanmartin C, Johnston G, McGurran J, Kehler M, Noseworthy T. 'There are too many of us to fix.' Patients' views of acceptable waiting times for hip and knee replacement. *Journal of Health Services Research & Policy.* 2009;14:212-218.

(81) Conner-Spady B, Sanmartin C, Johnston G, McGurran J, Kehler M, Noseworthy T. Willingness of patients to change surgeons for a shorter waiting time for joint arthroplasty. *Canadian Medical Association Journal.* 2008;179:327-332.

(82) Birk HO, Henriksen LO. Why do not all hip- and knee patients facing long waiting times accept re-referral to hospitals with short waiting time? Questionnaire study. *Health Policy.* 2006;77:318-325.

(83) Bodenheimer T, Lo B, Casalino L. Primary care physicians should be coordinators, not gatekeepers. *Jama-Journal of the American Medical Association.* 1999;281:2045-2049.

(84) Wootton R, Harno K, Reponen J. Organizational aspects of e-referrals. *Journal of Telemedicine and Telecare.* 2003;9:S76-S79.

(85) Stange KC, Zyzanski SJ, Jaen CR et al. Illuminating the 'black box' - A description of 4454 patient visits to 138 family physicians. *Journal of Family Practice.* 1998;46:377-389.

(86) Piterman L, Koritsas S. Part II. General practitioner-specialist referral process. *Internal Medicine Journal.* 2005;35:491-496.

(87) Faulkner A, Mills N, Bainton D et al. A systematic review of the effect of primary care-based service innovations on quality and patterns of referral to specialist secondary care. *British Journal of General Practice.* 2003;53:878-884.

(88) Akbari A, Mayhew A, Al-Alawi MA et al. Interventions to improve outpatient referrals from primary care to secondary care [Systematic Review]. *Cochrane Database of Systematic Reviews 2010.* 2008.

(89) Clarke A, Blundell N, Forde I et al. Can guidelines improve referral to elective surgical specialties for adults? A systematic review. *Quality and Safety in Health Care.* 2010;19:187-194.

(90) Musila N, Underwood M, McCaskie AW, Black N, Clarke A, van der Meulen JH. Referral recommendations for osteoarthritis of the knee incorporating patients' preferences. *Family Practice.* 2011;28:68-74.

(91) Roland MO, Porter RW, Matthews JG, Redden JF, Simonds GW, Bewley B. Improving care: a study of orthopaedic outpatient referrals. *British Medical Journal.* 1991;302:1124-1128.

(92) Richardson B, O'Driscoll L, Poland F, McCullagh M. An investigation of an orthopaedic referral system: implications for clinical governance. *QUAL PRIM CARE.* 2005;13:205-212.

(93) Chen AH, Yee HF. Improving the Primary Care-Specialty Care Interface Getting From Here to There. *Archives of Internal Medicine.* 2009;169:1024-1026.

(94) O'Malley AS, Reschovsky JD. Referral and Consultation Communication Between Primary Care and Specialist Physicians Finding Common Ground. *Archives of Internal Medicine.* 2011;171:56-65.

(95) Bichel A, Erfle S, Wiebe V, Axelrod D, Conly J. Improving patient access to medical services: preventing the patient from being lost in translation. *Healthcare Quarterly.* 2009;13 Spec.

(96) Cloutier P, Cappelli M, Glennie JE, Charron G, Thatte S. Child and youth mental health service referrals: physicians' knowledge of mental health services and perceptions of a centralized intake model. *Healthcare policy = Politiques de sante.* 2010;5.

(97) Guydish J, Woods WJ, Davis T, Bostrom A, Frazier Y. Does centralized intake improve drug abuse treatment outcomes? *Journal of Substance Abuse Treatment.* 2001;20:265-273.

(98) Spanswick C. Organization of pain management services. *Anaesthesia & Intensive Care Medicine.* 2008;9:59-60.

(99) Sved-Williams A, Poulton J. Primary care mental health consultation-liaison: a connecting system for private psychiatrists and general practitioners. *Australasian Psychiatry.* 2010;18:125-129.

(100) Sanmartin C, Shortt SED, Barer ML, Sheps S, Lewis S, McDonald PW. Waiting for medical services in Canada: lots of heat, but little light. *Canadian Medical Association Journal.* 2000;162:1305-1310.

(101) Chand S, Moskowitz H, Norris JB, Shade S, Willis DR. Improving patient flow at an outpatient clinic: study of sources of variability and improvement factors. *Health Care Management Science.* 2009;12:325-340.

(102) Cattani K, Schmidt GM. The Pooling Principle. *INFORMS Transactions on Education.* 2005;5:17-24.

(103) Bowers JA. Simulating waiting list management. *Health Care Management Science.* 2011;14:292-298.

(104) Bailey NTJ. A Study of Queues and Appointment Systems in Hospital Out-Patient Departments, with Special Reference to Waiting-Times. *Journal of the Royal Statistical Society Series B (Methodological).* 1952;14:185-199.

(105) Worthington DJ. Queuing Models for Hospital Waiting Lists. *J Oper Res Soc.* 1987;38:413-422.

(106) Cayirli T, Veral E. Outpatient scheduling in health care: A review of literature. *Production and Operations Management.* 2003;12:519-549.

(107) Gupta D, Denton B. Appointment scheduling in health care: Challenges and opportunities. *IIE Transactions.* 2008;40:800-819.

(108) Davies M, Elwyn G. Health policy - Referral management centres: promising innovations or Trojan horses? *British Medical Journal.* 2006;332:844-846.

(109) Escobar A, Quintana JM, Gonzalez M, Bilbao A, Ibanez B. Waiting list management: priority criteria or first-in first-out? A case for total joint replacement. *Journal of Evaluation in Clinical Practice.* 2009;15:595-601.

(110) MacCormick AD, Collecutt WG, Parry BR. Prioritizing patients for elective surgery: A systematic review. *Anz Journal of Surgery.* 2003;73:633-642.

(111) Testi A, Tanfani E, Valente R, Ansaldo GL, Torre GC. Prioritizing surgical waiting lists. *Journal of Evaluation in Clinical Practice.* 2008;14:59-64.

(112) Sampietro-Colom L, Espallargues M, Rodriguez E et al. Wide social participation in prioritizing patients on waiting lists for joint replacement: A conjoint analysis. *Medical Decision Making.* 2008;28:554-566.

(113) Escobar A, Quintana JM, Espallargues M, Allepuz A, Ibanez B. Different hip and knee priority score systems: are they good for the same thing? *Journal of Evaluation in Clinical Practice.* 2010;16:940-946.

(114) Naylor CD, Williams JI, Schatzker J et al. Primary hip and knee replacement surgery: Ontario criteria for case selection and surgical priority. *Quality in Health Care.* 1996;5:20-30.

(115) Gauld R, Derrett S. Solving the surgical waiting list problem? New Zealand's 'booking system'. *International Journal of Health Planning and Management.* 2000;15:259-272.

(116) De Coster C, McMillan S, Brant R, McGurran J, Noseworthy T, Primary Care Panel of the Western Canada Waiting List Project. The Western Canada Waiting List Project: development of a priority referral score for hip and knee arthroplasty. *Journal of Evaluation in Clinical Practice.* 2007;13:192-197.

(117) Escobar A, Gonzalez M, Quintana JM, Bilbao A, Ibanez B. Validation of a prioritization tool for patients on the waiting list for total hip and knee replacements. *Journal of Evaluation in Clinical Practice.* 2009;15:97-102.

(118) Conner-Spady B, Estey A, Arnett G et al. Prioritization of patients on waiting lists for hip and knee replacement: Validation of a priority criteria tool. *Int J Technol Assess Health Care.* 2004;20:509-515.

(119) Bowling A, Redfern J. The process of outpatient referral and care: the experiences and views of patients, their general practitioners, and specialists. *British Journal of General Practice.* 2000;50:116-120.

(120) Gran JT, Nordvag BY. Referrals from general practice to an outpatient rheumatology clinic: Disease spectrum and analysis of referral letters. *Clinical Rheumatology.* 2000;19:450-454.

(121) Earwicker SC, Whynes DK. General practitioners' referral thresholds and choices of referral destination: an experimental study. *Health Econ.* 1998;7:711-722.

(122) Bertakis KD, Callahan EJ, Azari R, Robbins JA. Predictors of patient referrals by primary care residents to specialty care clinics. *Family Medicine.* 2001;33:203-209.

(123) Weiner M, Perkins AJ, Callahan CM. Errors in completion of referrals among older urban adults in ambulatory care. *Journal of Evaluation in Clinical Practice.* 2010;16:76-81.

(124) Forrest CB, Shadmi E, Nutting PA, Starfield B. Specialty referral completion among primary care patients: Results from the ASPN referral study. *Annals of Family Medicine.* 2007;5:361-367.

(125) McPhee SJ, Lo B, Saika GY, Meltzer R. How Good Is Communication Between Primary Care Physicians and Subspecialty Consultants. *Archives of Internal Medicine.* 1984;144:1265-1268.

(126) Rupp RE. Evaluation of knee consultations to a referral-only orthopedic clinic in a managed care system. *Orthopedics.* 2001;24:153-156.

(127) Haukipuro K, Ohinmaa A, Winblad I, Linden T, Vuolio S. The feasibility of telemedicine for orthopaedic outpatient clinics - a randomized controlled trial. *Journal of Telemedicine and Telecare.* 2000;6:193-198.

(128) Bergus GR, Emerson M, Reed DA, Attaluri A. Email teleconsultations: well formulated clinical referrals reduce the need for clinic consultation. *Journal of Telemedicine and Telecare.* 2006;12:33-38.

(129) Patel VP, Mathew R, Raptis D, Christofi T, Youngman J. Overcoming barriers to secondary prevention in hip fracture patients: An electronic referral and management system for osteoporosis. *Injury-International Journal of the Care of the Injured.* 2010;41:1249-1255.

(130) Patterson V, Humphreys J, Chua R. Email triage of new neurological outpatient referrals from general practice. *Journal of Neurology Neurosurgery and Psychiatry.* 2004;75:617-620.

(131) Patterson V, Humphreys J, Henderson M, Crealey G. Email triage is an effective, efficient and safe way of managing new referrals to a neurologist. *Quality & Safety in Health Care.* 2010;19:e51.

(132) Weiner M, El Hoyek G, Wang L et al. A Web-based Generalist-Specialist System to Improve Scheduling of Outpatient Specialty Consultations in an Academic Center. *Journal of General Internal Medicine.* 2009;24:710-715.

(133) Dennison J, Eisen S, Towers M, Clark CI. An effective electronic surgical referral system. *Annals of the Royal College of Surgeons of England.* 2006;88:554-556.

(134) Heimly V. Standardization, innovation and deployment of electronic referral software in Norway. *Journal of Telemedicine and Telecare.* 2008;14:359-363.

(135) Morrison J, Lindberg P. When no one has time: measuring the impact of computerization on health care workers. *AAOHN J.* 2008;56:373-378.

(136) Heimly, V. and Nytro, O. Clinical guidelines as decision support for referrals from primary care. IEEE IFI Conference, Las Vegas, NV, 2011; 406-411.

(137) Hailey D. The need for cost-effectiveness studies in telemedicine. *Journal of Telemedicine and Telecare.* 2005;11:379-383.

(138) Dávalos M.E., French MT, Burdick AE, Simmons SC. Economic Evaluation of Telemedicine: Review of the Literature and Research Guidelines for Benefit-Cost Analysis. *Telemedicine Journal and E-Health.* 2009;15:933-948.

(139) Harno K, Paavola T, Carlson C, Viikinkoski P. Patient referral by telemedicine: effectiveness and cost analysis of an intranet system. *Journal of Telemedicine and Telecare.* 2000;6:320-329.

(140) Cooper K, Brailsford SC, Davies R. Choice of modelling technique for evaluating health care interventions. *J Oper Res Soc.* 2006;58:168-176.

(141) Bozic KJ, Chiu V. Emerging Ideas: Shared Decision Making in Patients with Osteoarthritis of the Hip and Knee. *Clinical Orthopaedics and Related Research.* 2011;469:2081-2085.

(142) Quintana JM, Bilbao A, Escobar A, Azkarate J, Goenaga JI. Decision trees for indication of total hip replacement on patients with osteoarthritis. *Rheumatology.* 2009;48:1402-1409.

(143) Bensley DC, Watson PS, Morrison GW, Abramson S. Pathways of coronary care -- a computer-simulation model of the potential for health gain. *Mathematical Medicine and Biology.* 1995;12:315-328.

(144) Cipriano L, Chesworth B, Anderson C, Zaric G. Predicting joint replacement waiting times. *Health Care Management Science.* 2007;10:195-215.

(145) Brennan A, Chick SE, Davies R. A taxonomy of model structures for economic evaluation of health technologies. *Health Econ.* 2006;15:1295-1310.

(146) Barton P, Bryan S, Robinson S. Modelling in the economic evaluation of health care: selecting the appropriate approach. *Journal of Health Services Research & Policy.* 2004;9.

(147) Weidenhaupt K, Pohl K, Jarke M, Haumer P. Scenarios in system development: current practice. *Software, IEEE.* 1998;15:34-45.

(148) Schoemaker PJH. Multiple scenario development: Its conceptual and behavioral foundation. *Strat Mgmt J.* 1993;14:193-213.

(149) Goodwin P, Wright G. Enhancing Strategy Evaluation in Scenario Planning: a Role for Decision Analysis. *Journal of Management Studies.* 2001;38:1-16.

(150) Woodhouse, L., Petruccelli, D., Wright, J., Elliott, W., Toffolo, N., Patton, S., Samanta, S., Sardo, A., MacMillan, D., Johnson, G., and Anderson C. Reducing Total Hip and Knee Surgical Wait Times: A Model That Works. Canadian Orthopaedic Association 64th Annual Meeting. 2009.

(151) MacLeod AM, Gollish J, Kennedy D, McGlasson R, Waddell J. Toward a Joint Health and Disease Management Program: Toronto Hospitals Partner to Provide System Leadership. *Healthcare Quarterly.* 2009;12:56-65.

(152) Mantler, Edward. Access to Medical Specialist Services in the Calgary Health Region. 2009.

(153) Alberta Health and Wellness, Alberta Wait Times Management Initiative, Conly, John, Glassford, Jodi, Guebert, Nancy, Lapins, Janet, Schultz, Kathy, and Barrington, Gail V. Medical Access to Service Project -- Calgary Zone: Phase 2 -- Outcome Assessment -- Final Report. 1-9-2009.

(154) Manitoba Health. Bridging General and Specialist Care (BGSC): Presented to Alberta Health and Wellness. 2010.

(155) Huang X, Lin J, Demner-Fushman D. Evaluation of PICO as a knowledge representation for clinical questions. *AMIA Annu Symp Proc.* 2006.

(156) Royal College of General Practitioners -- Birmingham Research Unit. Weekly Returns Service: Annual Prevalence Report 2006. 2006.

(157) Hawker GA, Wright JG, Coyte PC et al. Differences between Men and Women in the Rate of Use of Hip and Knee Arthroplasty. *N Engl J Med.* 2000;342:1016-1022.

(158) Helmick CG, Felson DT, Lawrence RC et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States: Part I. *Arthritis & Rheumatism.* 2008;58:15-25.

(159) Lawrence RC, Felson DT, Helmick CG et al. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States: Part II. *Arthritis & Rheumatism.* 2008;58:26-35.

(160) Rindfleisch JA, Muller D. Diagnosis and management of rheumatoid arthritis. *American Family Physician.* 2005;72:1037-1047.

(161) Government of Alberta, Seniors Support. A Profile of Alberta Seniors. 2010.

(162) Newfoundland and Labrador Department of Health and Community Services. A Strategy to Reduce Hip and Knee Joint Replacement Surgery Wait Times in Newfoundland and Labrador 2012. 2012.

(163) Alberta Bone and Joint Health Institute and Alberta Health Services. Wait Times Rules: Gaining Provincial Consensus. 3-6-2011.

(164) Hsia P, Samuel J, Gao J, Kung D, Toyoshima Y, Chen C. Formal approach to scenario analysis. *Software, IEEE.* 1994;11:33-41.

(165) Waddell JP. Wait times and health care resources. *Can J Surg.* 2004;47:405-406.

(166) Arden N, Nevitt MC. Osteoarthritis: Epidemiology. *Best Practice & Research Clinical Rheumatology.* 2006;20:3-25.

(167) Bone and Joint Decade. The Global Economic and Healthcare Burden of Musculoskeletal Disease - Executive Summary. 2001. Bone and Joint Decade.

(168) Zhang W, Moskowitz RW, Nuki G et al. OARSI recommendations for the management of hip and knee osteoarthritis, Part I: Critical appraisal of existing treatment guidelines and systematic review of current research evidence. *Osteoarthritis Cartilage.* 2007;15:981-1000.

(169) Zhang W, Moskowitz RW, Nuki G et al. OARSI recommendations for the management of hip and knee osteoarthritis, Part II: OARSI evidence-based, expert consensus guidelines. *Osteoarthritis Cartilage.* 2008;16:137-162.

(170) Robarts, Susan, Kennedy, Deborah, Clark, Susan, Flynn, Jan, Gollish, Jeffrey, and MacLeod, Anne Marie. New Assessment Model for Hip and Knee Replacement. 2007.

(171) Oldmeadow LB, Bedi HS, Burch HT, Smith JS, Leahy ES, Goldwasser M. Experienced physiotherapists as gatekeepers to hospital orthopaedic outpatient care. *Medical Journal of Australia.* 2007;186:625-628.

(172) Kim-Hwang JE, Chen AH, Bell DS, Guzman D, Yee HF, Kushel MB. Evaluating Electronic Referrals for Specialty Care at a Public Hospital. *Journal of General Internal Medicine.* 2010;25:1123-1128.

(173) Augestad K, Revhaug A, Vonen B, Johnsen R, Lindsetmo RO. The One-stop trial: Does electronic referral and booking by the general practitioner (GPs) to outpatient day case surgery reduce waiting time and costs? A randomized controlled trial protocol. *BMC Surgery.* 2008;8:14.

(174) Bone & Joint Canada. Hip & Knee Replacement Surgery Toolkit: A Living Document. Waddell, James P. and Frank, Cy. 30-4-2009.

(175) Alberta Health Services. Alberta Health Services Performance Report: March 2011. 2011.

(176) Westerman RF, Hull FM, Bezemer PD, Gort G. A Study of Communication Between General-Practitioners and Specialists. *British Journal of General Practice.* 1990;40:445-449.

(177) Davies M, Elwyn G. Referral management centres: promising innovations or Trojan horses? *BMJ.* 2006;332:844-846.

(178) Palmer S, Torgerson DJ. Definitions of efficiency. *BMJ.* 1999;318:1136.

Appendix A: Terms and Definitions

Places and Individuals	
• Hip and Knee clinic	• A site that provides care for hip and knee pain, from initial consultation (a patient having been referred by a qualified referring provider) to follow-up after surgery for hip or knee replacement or revision. • The clinic is an intake centre for patients referred for pain, and consists of at least one surgeon(s), office support such as a medical office administrator, and at least one or more nurses, physiotherapists, and case managers to carry out central intake assessments and manage patient flows.
• Referring provider	• A qualified medical physician who can refer a patient to an orthopaedic specialist. This individual must have a valid Alberta practitioner identification number (PRAC ID). • In Alberta, this is usually a general practitioner (GP), though it can also be another orthopaedic surgeon or specialist.
• Orthopaedic surgeon	• A specially trained surgeon dealing with conditions related to the musculoskeletal (MSK) system.
• Specialist	• A surgeon working at a clinic in a given specialty, not involved in general practice.
• Musculoskeletal (MSK) physician	• A physiotherapist, surgeon, or nurse with MSK training who conducts an assessment of some patients with hip and knee pain.
• AHS	• Alberta Health Services. • Runs hospitals in the province where arthroplasties take place, as part of the Alberta publicly funded health system.
• AHW	• Alberta Health and Wellness. • The ministry overseeing AHS and compensation to physicians and surgeons in the province.
• ABJHI	• Alberta Bone and Joint Health Institute. • A not-for-profit organization for bone and joint health care, research and education throughout Alberta.

Places and Individuals	
• NO WAITS	• New Opportunities to Reduce Unnecessary Waiting for Hip and Knee Arthroplasty through Information Technology Systems • A project designed to develop and evaluate electronic referral for hip and knee arthroplasty patients in Alberta (see Appendix A).
Osteoarthritis and Terms to Describe Osteoarthritis and its Effects	
• Osteoarthritis (OA)	• Deterioration of joint tissue, causing mobility limitations and reduced quality of life. • Commonly seen in the hip and knee, it is diagnosed by doctor-measured joint pain scales and x-ray evidence.
• Acuity	• Describes the physiological state of a patient.
• Severity	• A synonym for acuity – the physiological state of osteoarthritis of a patient.
• Urgency	• The severity of a disease for a patient, including other contextual factors. • These factors are the threat of disease progression, and the change in health that can occur due to a therapy.
• Comorbidities	• Other disorders or diseases present in addition to the primary joint related disease.
• Complexity	• The degree to which comorbidities or other joint related symptoms affect a patient seeking treatment for osteoarthritis.
• ASA categories	• Categories intended to rate patients based on morbidity and mortality. • Level 1 is healthy patients. • Level 2 is patients with mild systemic disease. • Level 3 is patients with severe systemic disease. • Level 4 is patients with systemic disease that is a threat to life.
Referrals and Related Terminology	
• Referral form	• A document containing information about a patient who is referred from a referring provider to a hip and knee clinic or orthopaedic surgeon.
• Letter	• A referral form that consists of a written or dictated letter, either mailed or faxed.

Referrals and Related Terminology	
• ABJHI Template	• A referral form that consists of the ABJHI Referral Template (see Appendix C).
• Other Template	• A referral form that consists of a standard template, other than the ABJHI template.
• EMR	• Electronic Medical Record.
Relevant Dates to Track a Patient Referral	
• Wait Times Rules	• A set of rules defining consistently measured wait times, endorsed by the Bone and Joint Clinical Network.
• Referral made	• The date on the referral form from a referring provider to the hip and knee clinic.
• Referral received	• The date a referral form is received by the hip and knee clinic. • This is the date on the faxed referral form. Depending on the clinic, if the fax date was not available or in error, it is either the date on the referral note, or the date the referral is processed at the clinic.
• Referral deemed complete	• For Clinic 1, the date an acceptance notice was sent to the referring provider. • For Clinic 2, the date the referral was screened, all required elements were present, and was sent to the surgeon for evaluation. • For Clinic 3, the date the referral was evaluated by a clinic administrator and scheduled for a consult or MSK screening.
• Musculoskeletal (MSK) visit	• The date a patient visited a MSK physician for screening.
• Surgical Consult visit	• The date a patient first consulted with an orthopaedic surgeon for hip or knee OA.
• MSK Screening	• A visit with an orthopaedic surgeon or MSK physician, intended to determine whether a patient is a surgical candidate, or is nonsurgical. • The availability of a surgeon for screening, the physician conducting the screening, and the number of patients given this option, vary by clinic. • At Clinic 2, the patient does not visit with the orthopaedic surgeon for the screening. The surgeon evaluates the referral alone as the screening process.

Relevant Dates to Track a Patient Referral	
• Surgical Consultation	• A visit with an orthopaedic surgeon, to fully evaluate the patient and determine whether surgery is necessary. • Treatment options include a recommendation for surgery, a recommendation for further medical management, or referral back to the referring provider.
• Surgical	• A patient who is ready, willing, and able to have joint replacement surgery for their hip or knee OA immediately.
• Long-term optimization	• A patient who would be surgical, but cannot have a joint replacement within the next year. • This would be due to other comorbidities or conditions the patient needs to have treated before surgery can take place.
• Nonsurgical	• A patient who is not immediately surgical. • Pharmacological-based therapy, physical therapy and therapeutic aids, are among the nonsurgical interventions recommended for patients who are nonsurgical.
• Medical Management	• Used as a synonym for nonsurgical.
Outcome Measures	
• Appropriateness	• This defines when a patient receives relevant health treatment. • This will be assessed on whether a referral form is complete, and correctly directed.
• Accessibility	• The ability of a patient to obtain treatment in a reasonable time. • This will be measured by wait time durations.
• Efficiency	• The ability of a hip and knee clinic to use resources optimally. • This will be measured by the functions and time needed to process an individual referral.
• Complete	• When a hip and knee clinic decides all elements on a referral form required for processing are present. • This is compared to the ABJHI referral template, in which ideally all elements on the template are filled out.

Outcome Measures	
• Correctly directed	• When a referral form is sent from the referring provider to a hip and knee clinic which is qualified and able to handle a case. • Incorrectly directed referrals would include non-hip or -knee related cases sent to a clinic handling only hip or knee procedures, or a highly complex orthopaedic patient referred to a clinic that cannot handle complex patients.
• Referral documentation incomplete	• When a component of the referral form, deemed essential for processing at the hip and knee clinic, is not filled out.

• X-rays not appropriate	• When an incorrect x-ray report is included in the referral form or available electronically.
	• This includes wrong angles or wrong joints noted in the x-ray report. Correct x-rays/x-ray reports include:
	  ○ Knee: AP weight bearing, lateral of knee with knee flexed, Skyline
	  ○ Hip: AP pelvis centered at pubis, AP and lateral of proximal half of affected femur.

• Inappropriate referral	• Incorrectly directed referrals to hip and knee clinics, including non-hip, non-knee, or non-OA related patients.
• Relevant medical history	• Comorbidities that influence the complexity of a patient.

Appendix B: Initial NO WAITS grant proposal

New Opportunities to Reduce Unnecessary Waiting for Hip and Knee Arthroplasty through Information Technology Systems ("NO WAITS")

Two complimentary hSITE Partnered Research Projects sponsored by AHS Deb Gordon

Tracy Wasylak (Alberta Bone and Joint Health Network Co-Chair)

and

Deborah Marshall + Cy Frank (University of Calgary and Alberta Bone and Joint Institute)

1. Introduction

The burgeoning clinical demand for Hip and Knee joint replacement (arthroplasty) has created internationally recognized issues of long patient waits for care and stimulated many calls for potential solutions. Despite being a national target for increased funding aimed at prioritized wait times reduction, as of January 2010, thousands of potential Canadian arthroplasty patients are (apparently) waiting months for a surgical opinion after the time of referral (called "T0 - T1") and many more months from the time of their surgical consent to the time they receive surgery (called "T1- T2"). In Alberta, despite major system improvements since 2004, with detailed care mapping and new provincial practice approaches (central intake clinics with case managers), median T0-T2 wait times still exceed 36 weeks. Since current Alberta care path execution and tracking is still almost purely paper-based, technology enhancements with improved 'on-line' referral of appropriate patients plus subsequent tracking and feedback to enhance workflows and eliminate waste would offer obvious advantages. *Even simply eliminating patients from wait lists that are not due to system failures would have a major impact*. As one example, appropriately classifying subsets of patients who voluntarily "choose to wait" for specific surgeons (despite being given options to see others with shorter lists) or those

who voluntarily defer appointment or surgery dates for non-medical reasons and listing them as being distinct from those suffering 'involuntary waits', would achieve significant reductions in the "involuntary waiting lists". Further, enhanced care map tracking and real-time electronic 'alerts' of waiting times exceeding benchmarks could significantly enhance care path flows, improve timely decision-making and reduce these waiting times even further. The same strategy across the whole care path would ultimately improve efficiency and eliminate waste.

Summary of the AHS Problem: *Like many other areas of the health system, the Bone and Joint Network of AHS currently lacks a system to accurately measure arthroplasty wait times at each stage of care delivery or to classify those waiting times into appropriate categories that will inherently reduce involuntary queues and define some previously unknown reasons for waiting as a significant step toward their eventual elimination. This proposal addresses this need with a focus on the 'front end' (intake of patients into specialty care) as a starting point with the greatest opportunity for improvement.*

2. Proposed Research (1 page for each sub-project)

Under the auspices of the partnership-focused AHS "Alberta Bone and Joint Health Clinical Network", we propose an 18-month overall project with two integrated sub-projects to design and pilot test (Subproject 1) and measure the efficiency and cost implications (Subproject 2) of a provincial program of wait-times redefinition and reduction with a specific new electronic referral system and tool. In addition to having value to wait time reductions in Alberta (our main focus), we make note that the algorithms and tools developed here will almost certainly have commercial potential, as they will be solutions needed in many other systems. As the first step, a more appropriate lexicon of waiting times will be determined by our Network that will leave no doubt as to where the patients are on the care path, and those definitions embedded within a new privacy-compliant web-based system of patient referral from primary care to specialty care.

Subproject 1 aims to eliminate the current wait for referral transfer, screening and acceptance by a specialist's office, we will specifically design, test and validate a Network developed and approved electronic (web-accessed) referral tool that, when fully completed by the referring physician will, by definition, trigger the acceptance of that 'appropriate patient', and start the clock at "t-referral" to the Network. That web-system will trigger an automated response to the referring physician as to the patient’s disposition (which clinic has taken the patient) and then be used by the Network to identify, manage and track all patients with automated (time-benchmark) alerts to their specific case managers of their exact care-path location and status in the Network. Referring physician and patient choices will be respected in the process, vis-a-vis access to their surgeon of choice, but the referral would have to reject the "next available surgeon (shortest time offered)" before being given access to any other specific surgeon. At that decision point, the referring physician will be given accurate wait times for all options before having to select one. Patients will be classified accordingly (voluntary wait versus involuntary wait) from that point forward. Beyond referral, steps along the Alberta care

path are already very well defined and will be registered and tracked electronically, creating potential 'time-marks' on each patients record, with similar tracking of involuntary versus voluntary waiting times. Each step will have a 'shortest time' option offered. If rejected by the patient, they will move into a voluntary waiting category.

This method will facilitate an understanding of how long each step on the care path is taking in the system (with some time being totally appropriate from a medical point of view and some not: e.g. a trial of conservative treatment overseen by the Network versus a patient choosing to wait for a particular season of the year to have surgery), and thus which waits are truly due to system failures and which are not. We will specifically classify those 'waiting voluntarily' as being distinct from those being subjected to any 'involuntary waiting periods' and track (with electronic alerts to specific case-managers) when their 'appropriate time benchmarks" are exceeded. This new approach will thus be much more 'granular' that the current, highly ambiguous "T0-T2" system, which lacks accurate or reproducible "triggers" (missing standard definitions) and fails to define or track the health system steps that take time along an appropriate care path. In this way, the reporting of patient wait times more accurately represents the waiting time inherent in the Alberta health care system and is not influenced by factors outside the control of the health care system such as selective patient waiting, patient deferrals and voluntary waiting for a specific provider. Figure 1 visually demonstrates the involuntary waiting period as defined above. Technology will shorten this period and will eliminate (into a new category) all those who choose to wait (voluntarily) for particular surgeons.

One community health sciences/business school graduate student will make this design, testing and validation of the electronic referral (decision support) tool their thesis topic.

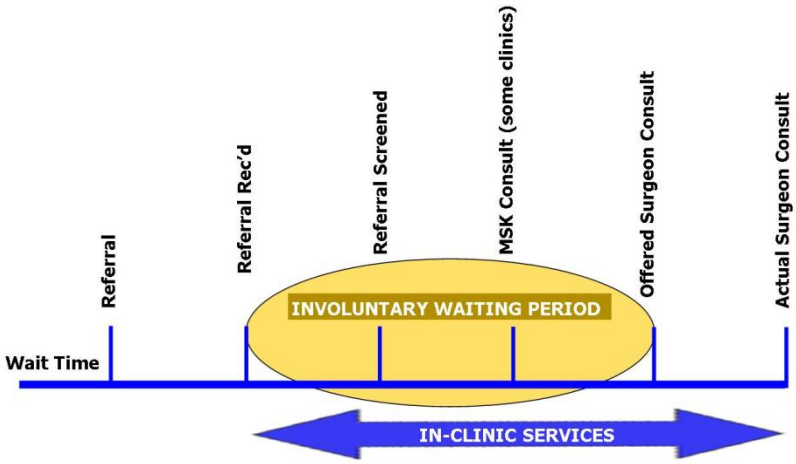


Figure 1 -The Current Involuntary Waiting Period to see the next available surgeon.

Appendix C: ABJHI Hip and Knee referral form

This is the ABJHI Hip and Knee Referral Form, in use as of May 2010. After this version, a new referral template was endorsed by Alberta Health Services and was implemented in September 2011. The substance of the referral form itself is very similar to the one used when referrals were being tracked, and charts were read, at each MSK clinic.

ALBERTA BONE AND JOINT CLINICAL NETWORK - HIP & KNEE REFERRAL

Instructions: For optimum accuracy please...
Print in capital letters & avoid contact with the edges of the box:
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Mark boxes with an 'X' or checkmark in the middle of the box, or fill in the box: Correct Marks: ☒ ☑ ■ Incorrect Marks: ⊗ ☑ ◪

Please place Patient Identification Label here

PLEASE ATTACH RELEVANT HISTORY/EMR RECORD

PLEASE NOTE: Patients must be on appropriate non-surgical treatment prior to evaluation (e.g. medication, walking aids, shoe inserts, physiotherapy).

REASON FOR REFERRAL

What is the primary reason you are referring this patient? _____

Primary Affected Joint(s): Hip: ☐ Right ☐ Left ☐ Bilateral Type of Problem: ☐ Primary ☐ Revision
Knee: ☐ Right ☐ Left ☐ Bilateral Duration of Symptoms: ____ ☐ Weeks ☐ Years ☐ Months ☐ Unknown

Assign Patient to Next Available Surgeon?
☐ Yes ☐ No → If no: _____ Surgeon Last Name _____ Surgeon First Name

If WCB, Claim Number: _____

Height ___.___ cm Weight ___.___ kg BMI ___.___

**** X-RAY REPORT TO BE ATTACHED WITH REFERRAL** NOTE: MRI IS NOT REQUIRED FOR THESE REFERRALS**

Knee: AP weight bearing, lateral of knee with knee flexed, Skyline ☐ X-ray report available on PACS
Hip: AP pelvis centered at pubis, AP and lateral of proximal half of affected femur

PREVIOUS ORTHOPAEDIC SURGERIES

SURGERY	SURGEON	YEAR	SURGERY	SURGEON	YEAR

Current Pain Management: ☐ Narcotics ☐ Over-the-counter ☐ NSAID/COXIB ☐ Other: _____

Comments: _____

ANSWER ALL QUESTIONS IN THIS SECTION

Pain on motion (e.g. Walking, bending):	☐ None/mild ☐ Moderate ☐ Severe
Pain at rest (e.g. while sitting, lying down, or causing sleep disturbance):	☐ None ☐ Mild ☐ Moderate ☐ Severe
Other functional limitations (e.g. putting on shoes, managing stairs, sitting to standing, sexual activity, bathing, cooking, recreation or hobbies):	☐ None ☐ Mild ☐ Moderate ☐ Severe
Abnormal findings on physical exam related to affected joint (e.g. deformity, instability, leg length difference, restriction of range of motion on examination):	☐ None/mild ☐ Moderate ☐ Severe
Potential for progression of disease documented by radiographic findings (e.g. recurrent dislocation, x-ray evidence of protrusion, significant bone loss, component wear, impending fracture):	☐ None ☐ Mild ☐ Moderate ☐ Severe
Ability to walk without significant pain:	☐ Over 5 blocks ☐ 1-5 blocks ☐ <1 block ☐ Household ambulator

Threat to patient role and independence in society i.e. ability to work, give care to dependants, live independently (difficulty must be related to affected joint): ☐ Not threatened but more difficult ☐ Threatened but not immediately ☐ Immediately threatened or unable

Rate the level of medical complexity (number and/or severity of key comorbid conditions) of the patient, excluding hip or knee condition:
- ☐ No medical problems
- ☐ Current mild medical problems or past significant medical problems
- ☐ Moderate medical disability or morbidity/requires "first line" therapy
- ☐ Severe/ constant significant disability/ "uncontrollable" constant medical problems
- ☐ Extremely severe/ immediate treatment required/ end organ failure/ severe impairment of function

REFERRING PHYSICIAN INFORMATION

LAST Name: _____ FIRST Name: _____ PRACID _____

Address: _____ City: _____ Postal Code: _____

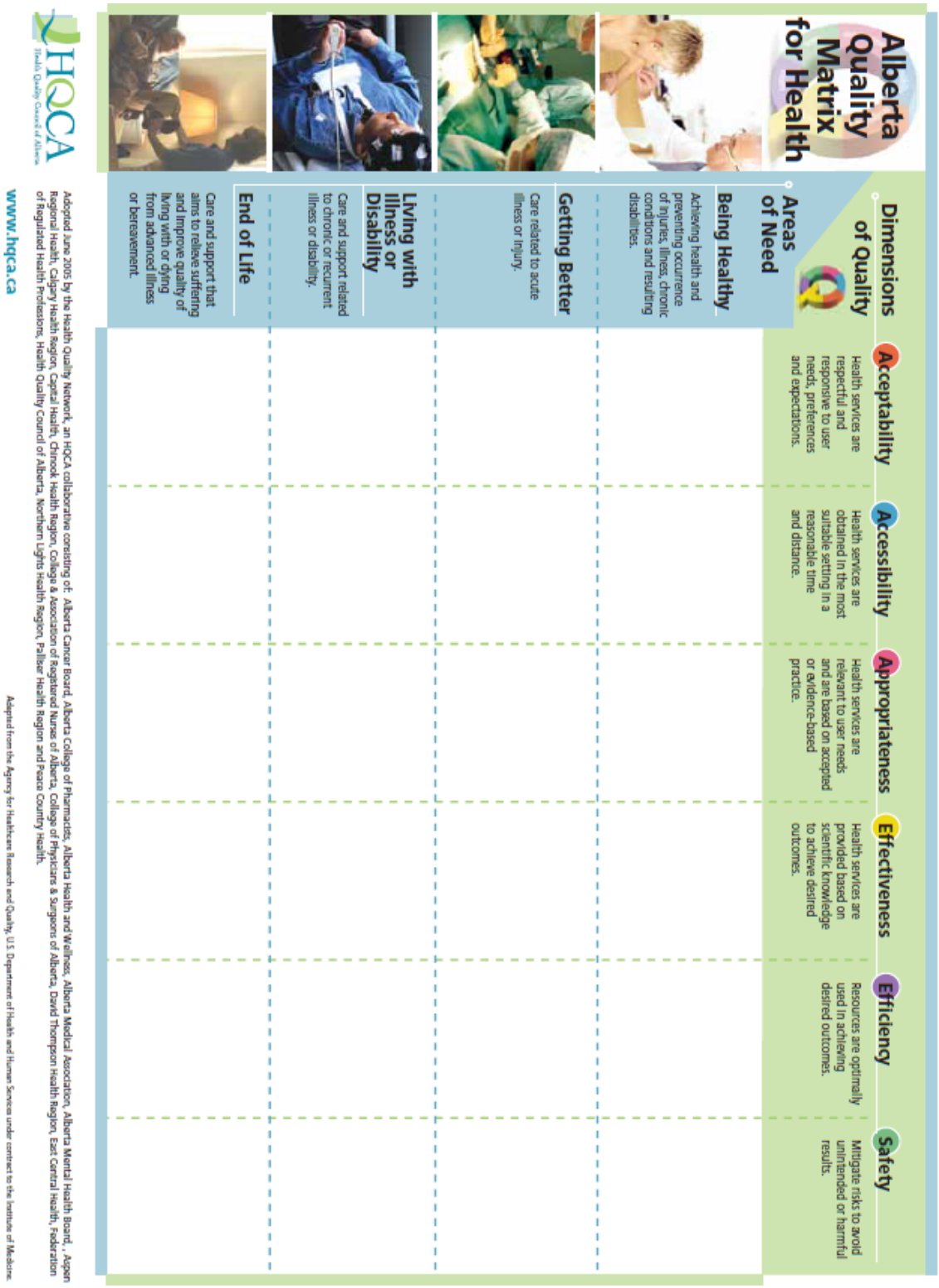
Phone: (____) ____ - _____ Fax: (____) ____ - _____ E-Mail: _____

Referring Physician Signature: _____ Date: ___ / ___ / ____ (D D / M M / Y Y Y Y)

2364073937

Complete the form and fax to **ONE** of:
Grande Prairie: (780) 357-2506 **Edmonton:** (780) 432-6395 **Red Deer:** (403) 358-5808 **Calgary:** (403) 221-4387 **Camrose:** (780) 679-2630

Appendix D: HQCA quality matrix – six dimensions of quality for health



Appendix E: Data extraction form

The data extraction form for patient chart reviews is given in this appendix. Once data availability and outcome information were collected from the clinics, the data extraction form was designed to retrieve standardized information for accessibility and referral appropriateness. This was completed at all three clinics as noted in Chapter 4.

Patient # ___ ___ -- ___ ___ ___ Patient # cannot be the PHN

Review Date: _____/_____/_____ (DAY MONTH YEAR) **Reviewer Name:** _____

Clinical Site: ☐ Calgary (0) ☐ Camrose (1) ☐ Red Deer (2)

I) Information on Patient

1) **Gender:** ☐ Male (0) ☐ Female (1) 2) **Age at referral:** _____

3) **Postal Code:** ___ ___ ___ X X X

4) **Reason for referral:**

a) Location

☐ Right knee (00) ☐ Right hip (01) ☐ Bilateral knee (20)

☐ Left knee (10) ☐ Left hip (11) ☐ Bilateral hip (21)

b) Type

☐ Primary joint (0)

☐ 2nd joint (1) ☐ Revision (2)

II) Referral Processing

1) **Was there a date on the referral?** (t_Referral as per the wait times rules)

☐ Yes (1) _____/_____/_____ (DAY MONTH YEAR) ☐ No (0)

a) Who was the referral received from?

☐ GP (0) ☐ Orthopaedic surgeon (1)

☐ Other: (2) _____

b) Had the patient been seen by an orthopaedic surgeon previously?

☐ Yes, same surgeon (1) ☐ Yes, different surgeon (2)

☐ No (0) ☐ Unknown (96)

i) If yes, by same or different surgeon, when was the last visit?

_____/_____/_____ (DAY MONTH YEAR)

ii) If yes, by different surgeon, did the patient ever visit the current surgeon?

☐ Yes: (1) _____/_____/_____ (DAY MONTH YEAR)

☐ No (0) ☐ Unknown (96)

2) **Was there a date noted when the referral was received?** (t_Received as per the wait times rules)

☐ Yes: (1) _____/_____/_____ (DAY MONTH YEAR)

☐ No (0) ☐ Unknown (96)

Patient # ___ ___ - ___ ___ ___

II) Referral Processing

3) **What was the initial status of the referral?**

- ☐ Accepted (0) _____/_____/_____ (DAY MONTH YEAR)
- ☐ Denied (1) _____/_____/_____ (DAY MONTH YEAR)
- ☐ Pending (2) _____/_____/_____ (DAY MONTH YEAR)
- ☐ Unknown (96)

a) If denied or pending, what was the reason(s) given?

- i) Xrays not appropriate ☐ Yes (1) ☐ No (0)
- ii) Referral documentation incomplete ☐ Yes (1) ☐ No (0)
- iii) Doctor not qualified or able to provide treatment ☐ Yes (1) ☐ No (0)
- iv) Patient re-referred elsewhere ☐ Yes (1) ☐ No (0)
- v) Inappropriate referral ☐ Yes (1) ☐ No (0)
- vi) Other ☐ Yes (1) ☐ No (0)

_____

4) **Was the referral deemed complete upon first receipt by the clinic?** ☐ Yes (1) ☐ No (0) ☐ Unknown (96)

(was a comment made about the referral being complete?)

a) When was the referral completed and received? _____/_____/_____ (DAY MONTH YEAR) ☐ Same as referral received date

III) Completeness of the Referral Template

1) **What was the type of referral used?**

- ☐ a) ABJHI template (1 yes, 0 no)
- ☐ b) Other template (1 yes, 0 no)
- ☐ c) Letter (1 yes, 0 no)
- ☐ d) Other: (1 yes, 0 no) _____

2) **What information was included on the referral?**

- a) Patient demographics ☐ Yes (1) ☐ No (0)
- b) Referring physician information ☐ Yes (1) ☐ No (0)
- c) Reason for referral ☐ Yes (1) ☐ No (0)
- d) Relevant medical history ☐ Yes (1) ☐ No (0)
- e) Previous orthopaedic surgery ☐ Yes (1) ☐ No (0)
- f) Preferred physician specified ☐ Yes (1) ☐ No (0)
- g) Next available surgeon specified ☐ Yes (1) ☐ No (0)
- h) Height ☐ Yes (1) ☐ No (0)
- i) Weight ☐ Yes (1) ☐ No (0)
- j) BMI ☐ Yes (1) ☐ No (0)
- k) X-ray film ☐ Yes (1) ☐ No (0)
- l) MRI report or MRI film ☐ Yes (1) ☐ No (0)

Patient # ___ ___ -- ___ ___ ___

III) Completeness of the Referral Template

2) **What information was included on the referral?**

m) Relevant comorbidity history/ complexity ☐ Yes (1) ☐ No (0)

o) Medical acuity (explicit WCWL questions) ☐ Yes (1) ☐ No (0)

n) Medical acuity (lifestyle questions) ☐ Yes (1) ☐ No (0)

p) Medication list ☐ Yes (1) ☐ No (0)

q) X-ray report ☐ Yes (1) _____/_____/_____ (DAY MONTH YEAR) ☐ No (0)

r) Other ☐ Yes (1) ☐ No (0) _____

3) **Was nonsurgical treatment(s) for the hip or knee attempted by the referring physician?** ☐ Yes (0) ☐ No (1) ☐ Unknown (96)

a) If so, was the treatment(s) listed directly on the referral template or letter? ☐ Yes (0) ☐ No (1) ☐ Unknown (96)

i) Weight loss ☐ Yes (1) ☐ No (0)

ii) Weight gain ☐ Yes (1) ☐ No (0)

iii) Acetaminophen ☐ Yes (1) ☐ No (0)

iv) NSAID/COXIB ☐ Yes (1) ☐ No (0)

v) Injections (steroids) ☐ Yes (1) ☐ No (0)

vi) Injections (other): ☐ Yes (1) ☐ No (0) _____

vii) Physiotherapy ☐ Yes (1) ☐ No (0)

viii) Other: ☐ Yes (1) ☐ No (0) _____

4) **Did the patient accept the next available surgeon option?** (as per the wait times rules)

☐ Yes (1) ☐ No (0) ☐ Originally offered next available (2)

☐ Not offered (3) ☐ Unknown (96) ☐ Not applicable (98)

a) Comments: _____

b) If yes or no, when was the next available option given? ☐ Yes (1) _____/_____/_____ (DAY MONTH YEAR) ☐ No (0) ☐ Unknown (96)

c) If yes or no, was a reason given for accepting/rejecting? _____

IV) MSK Specialist Consultation

1) **Did an MSK specialist visit occur? (if so, date of first?)** (t_MSK as per the wait times rules)

☐ Yes: (1) _____/_____/_____ (DAY MONTH YEAR) (If no or unknown, go to section V)

☐ No (0) ☐ Unknown (96)

Patient # ____ ____ -- ____ ____ ____

IV) MSK Specialist Consultation

2) **Was the first MSK visit on the same date as the originally scheduled date?** ☐ Yes (1) ☐ No (0) ☐ Unknown (96)

a) If no, what date was it originally scheduled? _____/_____/_____ (DAY / MONTH / YEAR)

b) If no, when was it rescheduled? _____/_____/_____ (DAY / MONTH / YEAR)

c) If no, why was it rescheduled? _____

3) What was the recommendation from the MSK specialist visit? ☐ Nonsurgical (0) ☐ Long term optimization (1) ☐ Surgical (2) ☐ Unknown (96)

a) If nonsurgical, did the patient request to see a surgeon? ☐ Yes (1) ☐ No (0) ☐ Unknown (96)

b) If surgical, did the patient request nonsurgical treatment? ☐ Yes (1) ☐ No (0) ☐ Unknown (96)

	IV.3.c) MSK Specialist Visit Treatment Recommendations		**V.3.a) Surgical Consult Treatment Recommendations**	
i) Aerobic exercise	☐ Yes (1)	☐ No (0)	☐ Yes (1)	☐ No (0)
ii) Weight reduction	☐ Yes (1)	☐ No (0)	☐ Yes (1)	☐ No (0)
iii) Medications	☐ Yes (1)	☐ No (0)	☐ Yes (1)	☐ No (0)
iv) Nutriceuticals	☐ Yes (1)	☐ No (0)	☐ Yes (1)	☐ No (0)
v) Brace/orthotics	☐ Yes (1)	☐ No (0)	☐ Yes (1)	☐ No (0)
vi) Viscosupplementation	☐ Yes (1)	☐ No (0)	☐ Yes (1)	☐ No (0)
vii) Physiotherapy	☐ Yes (1)	☐ No (0)	☐ Yes (1)	☐ No (0)
viii) Resistance Training	☐ Yes (1)	☐ No (0)	☐ Yes (1)	☐ No (0)
ix) Other	☐ Yes (1)	☐ No (0)	☐ Yes (1)	☐ No (0)

_____ _____

d) What was the outcome after MSK treatments? ☐ To see surgeon for consult (0) ☐ Further nonsurgical treatments (1) ☐ Unknown (96)

V) Surgical Consult

1) **Did a surgical consult occur? (if so, date of first?)** (t_consult as per the wait times rules)

☐ Yes: (1) _____/_____/_____ (DAY / MONTH / YEAR)

☐ No (0) ☐ Unknown (96)

(If no or unknown, go to section VII)

Patient # ___ ___ -- ___ ___ ___

V) Surgical Consult

2) **Was the first surgical consult on the same date as the originally scheduled date?** ☐ Yes (1) ☐ No (0) ☐ Unknown (96)

a) If no, what date was it originally scheduled? _____/_____/_____ (DAY MONTH YEAR)

b) If no, when was it rescheduled? DAY MONTH YEAR

c) If no, why was it rescheduled? _____

3) **What was the recommendation from the surgical consult visit?** ☐ Nonsurgical (0) ☐ Long term optimization (1) ☐ Surgical (2) ☐ Unknown (96)

a) Surgical Consult Treatment Recommendations — Treatments for L-T optimization and nonsurgical are listed on page 4

VI) Surgical Information

(If surgical consult has not occurred, go to section VII)

1) **If surgical, was a surgical decision date given?** (t_Decision as per the wait times rules)
☐ Yes: (1) _____/_____/_____ (DAY MONTH YEAR)
☐ No (0) ☐ Unknown (96)

2) **Was a patient ready date given?** (t_Ready as per the wait times rules)
☐ Yes: (1) _____/_____/_____ (DAY MONTH YEAR)
☐ No (0) ☐ Unknown (96)

3) **Were there any comments on the ready date?** _____

4) **Were there any notes in the record from IM or anesthesia?** _____

5) **Did a surgery take place?** (t_Surgery as per the wait times rules)
☐ Yes: (1) _____/_____/_____ (DAY MONTH YEAR)
☐ No (0) ☐ Unknown (96)

a) If yes, what joints were operated upon? (see section I.4 for types of joints) _____ ☐ Same as question I.4

b) If yes, what type of hip or knee was used?
☐ BHR (resurface) (0) ☐ THAMOM (metal on metal) (1) ☐ THACOP (ceramic on poly) (2)
☐ THCOC (ceramic on ceramic) (3) ☐ THAMOP (metal on poly) (4)
☐ Knee (5) _____
☐ Other (6) _____
☐ Unknown (96)

Patient # ____ ____ -- ____ ____ ____

VII) Other orthopedic office interactions with the patient between: when the referral was received and the surgical date

This includes other pre-op visits or consultation visits and their reasons. Phone calls are not to be included.

_____/_____/_____ _____
DAY MONTH YEAR

_____

_____/_____/_____ _____
DAY MONTH YEAR

_____

_____/_____/_____ _____
DAY MONTH YEAR

_____

VIII) Other comments and other visits before surgery date

_____

_____

_____

_____

_____

_____

Appendix F: Example of semi-structured interview question form

This is an anonymized semi-structured interview form for a clinic. The questions used here were initially asked of the clinic staff. Answers to these questions led in some cases to further follow-up questions.

Data Questions (in approximate order of the current decision tree):
The # of referrals (XXXX) -- does this population just represents the # of complete referrals received?
Does this estimate represent the number of unique patients, or the total number of referrals?
If the XXXX does represent only the # of complete referrals, are the total # of referrals (complete or incomplete) received tracked?
What are the # of referrals accepted?
What are the # of referrals denied (is this known?)
The # of incomplete referrals -- this is not tracked?
Is there a more precision estimate other than ~XX% on those referred to MSK clinic?
All patients (XX) who were no-shows to MSK physician rescheduled?
Does this estimate represent the number of unique patients, or the total number of reschedules?
The number of patients referred onto physician (XXX): this is from MSK clinic, or does this include patients who do not see MSK physician, or does this include patients who have previously seen a surgeon and skip MSK visit?
If it includes all three, is there a breakdown available?
The number of patients who need a surgeon assessment is XXX?
Data Questions (regarding wait times):
Do we have mean wait times now, or median? Can we get the other as well?
How are the wait time dates tracked:
t0: t_referral
t_received
t_MSK
t1: T_surgeon
Is t_surgery tracked and available?
What is the patient population for the wait times? (patients who have referrals received? Patients who have been referred? Does this differ for each wait time?)

Do wait times change depending on whether a patient sees an MSK physician, versus those who are referred directly to the 'surgeon assessment needed' pathway? (i.e. After the MSK consult, is t_MSK --> T_surgeon the same as t_received --> T_surgeon for those who don't see an MSK physician? in other words, do those who see MSK physicians get put in the back of the queue of patients awaiting scheduling for a surgeon consult?)
Methodological Questions:
What data is currently tracked for internal use? What measures are used for effectiveness evaluation?
What are the specific dates for the six month pre-NO WAITS collection period?
Who enters patient data? (assn't, scheduler, nurse, MSK physician)?
Who maintains scheduling of referrals? (assn't to surgeon, scheduler?)
How are patient referrals tracked (what software, paper)?
What are constraints in gathering real-time data?
Have there been major changes in the last two years to referral collection or organization?
Is there tracking of correct or incorrect referral forms?
Clinic X-specific methodological questions:
Who keeps track of nonsurgical patient information? Where does the information go after MSK physician determines patient is nonsurgical?
Nonsurgical patients are all sent back to referring provider, or do they continue to be seen by MSK physician?
Who keeps track of surgeon appointment information (no-shows, reschedules)?
Is there an estimate on the time, average, that referrals spent in the 'pending' queue?
Is scheduling of patients evened out among the different surgeons?
Clarification on the path a patient chart takes within the clinic, according to the current tree (who has it at what phase? When does it bounce back? What is added at each phase? Where is it entered?)

Appendix G: Copyright Permission Letters

This appendix contains the copyright permission letter sent to the publisher of Chapter 5 (Longwoods Publishing) and the copyright permission letter sent to each co-author for the article in Chapter 5.

a) To the publisher:

Kenneth Fyie
Department of Community Health Sciences
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University of Calgary
Calgary, AB T2N 4Z6

August 24, 2012

Longwoods Publishing
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Toronto, ON M5A 1N1

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"Voluntary versus Involuntary Waiting for Joint Replacements: New Alberta Wait Times Rules for hip and knee arthroplasties, with provincial consensus" by Deborah Marshall, Tanya Christiansen, Christopher Smith, Jane Squire Howden, Jason Werle, Ken Fyie, and Cy Frank, that will appear in Healthcare Quarterly, published by Longwoods Publishing, Volume 15, Number 3, pages 37-42.

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Sincerely,

_____

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Signature: _____

Name & Title: _____

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b) To the co-authors:

Kenneth Fyie
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Calgary, AB T2N 4Z6

August 27, 2012

To whom it may concern:

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"Voluntary versus Involuntary Waiting for Joint Replacements: New Alberta Wait Times Rules for hip and knee arthroplasties, with provincial consensus" by Deborah Marshall, Tanya Christiansen, Christopher Smith, Jane Squire Howden, Jason Werle, Ken Fyie, and Cy Frank, that will appear in Healthcare Quarterly, published by Longwoods Publishing, Volume 15, Number 3, pages 37-42.

This request is for your permission, as co-author, to include the above content as part of the thesis that I am preparing entitled: "An Evaluation of the Primary-to-Specialist Referral System for Elective Hip and Knee Replacements in Alberta." I will, in the preface to the chapter, confirm that your name is credited in the reference to the published manuscript.

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Sincerely,

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Signature: _____

Name: _____

Date: _____