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The development and evaluation of resources to improve the quality of care for patients with knee osteoarthritis

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A thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree in Health and Rehabilitation Sciences

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Abstract

Purpose: The non-operative management of patients with knee osteoarthritis (OA) is often considered suboptimal. Sub-optimal management includes inadequate use of non-surgical treatments, misuse of diagnostic imaging, and non-operative referrals to surgeons in consideration of total knee replacement (TKR). These inefficiencies result from an interplay of factors involving primary care physicians, patients, and the systems in which they function. The overall purpose of this thesis is to develop a means to optimize the management of patients with knee OA, and the timing and quality of referrals to TKR.

Methods: This thesis includes three studies. In study 1, we identified and cross-validated patient self-reported predictors of being scheduled for TKR using multivariate logistic regression (Chapter two). We followed this work by creating five educational whiteboard videos for patients with knee OA to encourage responsible use of health care resources and guide decision making regarding primary care and operative management. In study 2, we conducted a mixed methods evaluation of our videos using a qualitative descriptive approach. We conducted in-depth semi-structured interviews with patients to garner patients' experiences and perspectives regarding interacting with the videos (Chapter three). In study 3, we conducted a qualitative descriptive investigation of physicians' perspectives regarding our education videos (Chapter four).

Results: In study 1 (n=406), patients' willingness to undergo surgery, having greater pain, better physical function, having tried injections, and older age were predictive of being offered and electing to undergo TKR. At its optimal efficiency, this model can reduce the proportion of non-operative referrals made to a surgeon from 45% to 25%, while identifying the vast majority of surgical candidates (>90%). In study 2, participants (n=13) felt that the videos enhanced their confidence and clarity about their decision to undergo TKR and addressed knowledge gaps in their understanding. Our findings suggest that educating patients regarding best practice may improve the quality of OA management. In study 3, physicians (n=10) indicated interest in using our education videos to support patient buy-in regarding appropriate management, enhance patient understanding, and felt that the videos would improve their own practice.

Conclusion: A web-based platform including resources informed by our predictive model and our educational videos will educate and guide referring clinicians and patients to understand appropriate management of knee OA including when specialist consultation is the appropriate next step. A concerted effort between primary care physicians, the patient and surgeons will create huge efficiencies toward the management of this growing population.

Keywords

Knee osteoarthritis, Non-operative management, Referral, Total knee replacement, Total knee arthroplasty, Predictors, Patient education.

Co-authorship Statement

With the guidance of my supervisors and advisory committee (Dr. Bryant, Dr. Giffin, and Dr. MacDonald) we conceptualized and designed three separate studies for this thesis. This thesis contains one published manuscript (Chapter 2) and two manuscripts that will be submitted for publication (Chapter 3 and 4). Laura Churchill is the primary author on all chapters of this thesis. Chapter 2 was co-authored by Samuel J. Malian, Dr. Bert M. Chesworth, Dr. Dianne Bryant, Dr. Steven J. MacDonald, Dr. Jacquelyn D. Marsh, and Dr. J Robert Giffin. Co-authors provided feedback and edits to the first draft of the manuscript prepared by Laura Churchill. The remaining chapters (1, 3, 4, 5) were written by Laura Churchill. All supervisors/ committee members (Dr. Bryant, Dr. Giffin, Dr. MacDonald), and two graduate students (Michael Lukacs, and Yekaterina Lebedeva) reviewed these chapters and provided critical feedback and suggestions which contributed to the final version of this thesis.

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List of Abbreviations

- BMI- Body mass index
CI- Confidence interval
CIAC- Central intake and assessment center
CPG- Clinical practice guideline
DCS- Decisional conflict scale
HA- Hyaluronic acid
HCP- Health care professional
HRQOL- Health related quality of life
HTO- High tibial osteotomy
IA- Intra-articular
LHIN- Local health integration network
METER- Medical term recognition test
MRI- Magnetic resonance imaging
MSK- Musculoskeletal
NRS- Numeric rating scale
NSAIDS- Non-steroidal anti-inflammatories
OA- Osteoarthritis
OR- Odds ratio
PGY (1, 2, 3)- Post-graduate year
PT-Physiotherapy/Physiotherapist
QOL- Quality of life
RJAP-Regional joint assessment program
SD- Standard deviation
SF-12- Short-form 12-item survey
TJR- Total joint replacement
TKR- Total knee replacement

Chapter 1

1 Introduction: Background and Rationale

Osteoarthritis (OA) represents the highest-ranked economic and physical burden of all musculoskeletal conditions, affecting one in eight Canadians.¹ As of 2010, 4.4 million Canadians are living with this degenerative joint disease, and this number is expected to more than double as our population ages. It is estimated that by 2040, 10.4 million Canadians, thirty percent of which will be in the employed labour force, will be living with OA. Expectantly, OA presents a significant economic burden to patients and society considering the associated direct and indirect costs of the disease.¹ The cumulative costs of the disease are currently estimated at \$27 billion, with projections estimated at a staggering \$550 billion and \$909 billion in direct and indirect health care costs respectively.¹

The knee is the most commonly affected weight-bearing joint, resulting in pain, stiffness, and disability among a large percentage of our population.² In early stages of the disease, when pain and its impact on mobility and quality of life (QOL) is only mildly or moderately severe, conservative treatment including non-pharmacological and pharmacological options are recommended as the mainstay of treatment.³ Several evidence-based national and international clinical practice guidelines (CPGs) exist outlining appropriate interventions to manage knee OA.⁴⁻⁸ The most widely supported recommendations are summarized in CPGs from the following groups: OA Research Society International (OARSI)^{4,9}, the European League Against Rheumatism (EULAR)⁵, the National Institute for Health and Care Excellence (NICE) in the United Kingdom⁶, the American Academy of Orthopedic Surgeons (AAOS)⁷, and the American College of Rheumatology (ACR) in the United States (US).⁸ The aforementioned guidelines consistently recommend that in early OA when symptoms are mild and manageable, patients should receive education regarding activity modification, self-management, weight loss, and exercise. As the disease progresses and these strategies no longer provide acceptable relief, pharmacological interventions such as non-steroidal anti-

inflammatories (NSAIDS), acetaminophen, tramadol, and intraarticular (IA) corticosteroid or hyaluronic acid (HA) joint injections should be considered.⁴⁻¹⁰

While referral to physiotherapy (PT) is only explicitly mentioned in 2 out of the 5 guidelines^{4,8}, a systematic review¹¹ and large cohort study¹² (n=9825) have demonstrated the positive effects of PT on outcomes in this population throughout all stages of disease progression. Physiotherapists (PTs) can offer self-management advice, activity modification strategies, manual therapy, gait aids, and bracing options. Most importantly, PTs are considered experts in exercise prescription and can offer individualized exercise programming based on the best available evidence for knee OA. This may include a combination of aerobic exercise, resistance training, neuromuscular reeducation and balance training, tailored to patients' unique abilities and preferences.^{11,12}

When conservative measures have been exhausted, and patient's symptoms, function, and QOL are no longer acceptable, treatment of end-stage knee OA includes total knee replacement (TKR). This highly successful procedure often eliminates patient's pain while improving their function and QOL leading to high rates of patient satisfaction with the procedure (85%).¹³

Although TKR is a highly cost-effective procedure in patients with end-stage knee OA¹⁴, increased demand for surgery and constrained resources hinder its timely delivery. In 2003, the "First Minister's Accord on Health Care Renewal" indicated that all Canadians should have timely access to care and that this would be a national priority moving forward. In 2004, Canada's First Ministers published the "Ten-Year Plan to Strengthen Health Care", identifying total joint replacement (TJR) as one of five priority areas to target in reducing wait times. This plan indicated minimally clinically acceptable benchmarks to access TJR, indicating that patients should wait no more than three months to receive first consultation with an orthopaedic specialist after initial referral (Wait one), and no more than six months to receive TJR after first specialist consultation (Wait two).¹⁵ Despite these benchmarks, a nationwide approach to meeting these targets was not established, which led to provincial governments adopting different initiatives to

reduce wait times including central intake and assessment centers, prioritization of waiting lists, and clinical appropriateness guidelines.¹⁶

Ten years later, in 2014, the Wait Time Alliance report indicated some improvements had been made in reducing wait times for TKR. The report found that 70%–79% of patients received a TJR within the six-month benchmark, improving from only 60-69% of patients in 2012.¹⁷ Ontario was among the higher ranked provinces with 80-89% of the population receiving surgery within this benchmark.

Most recently, the 2017 Canadian Institutes for Health Information (CIHI) report indicated that overall wait times across Canada for joint replacement remain unchanged over the past five years with only 73% of knee replacement patients undergoing TKR within the target six months (182 days). While some provinces have demonstrated improvements, there are large discrepancies nationwide; between 38% to 81% meeting the Wait two benchmark among provinces. This variation also exists within provinces. For example, in Ontario from 2012-2016, some local health integration networks (LHINs) had 95% of their patients meeting the Wait two benchmark, while only 50% of patients in our South-West LHIN received TKR within the benchmark.¹⁸

Unfortunately, long wait times for TKR may have negative consequences for patient health as some studies have demonstrated health-related quality of life (HRQOL) deteriorates during the pre-surgery period.^{19,20} Furthermore, pre-operative health status is one of the most powerful predictors of post-operative outcomes, with patients with worse HRQOL experiencing poorer post-operative outcomes.²¹⁻²³ From a patient perspective, the results of these studies implicate the importance of reducing wait times for patients undergoing TKR. Moreover, several studies have demonstrated that patients with greater OA severity incur substantially higher disease-related costs, which place an economic strain on the patient, their caregiver, and the health care system.²⁴⁻²⁶

There are two underlying strategies to alleviate the burden of waiting for TKR: 1) optimize patient access to specialist care (Wait One) by ensuring a greater proportion of patients referred to orthopaedic specialists are indeed candidates for surgery (i.e., decreasing demand), or 2) increasing capacity and resources downstream to offer a

greater volume of surgery to better meet the current demand (i.e., removing ceilings on number of TJRs allowed, increasing number of operating theaters, increased surgical staff etc.), which would help alleviate Wait Two.

Anecdotally, surgeons at our center expressed that new referrals are often not optimal candidates for TKR, do not have the appropriate imaging to diagnose OA, or have not yet exhausted conservative treatments. The literature supports this notion as several studies demonstrate that a large proportion of patients (~50%) referred to TKR are not suitable candidates for the procedure at the time of initial referral.²⁷⁻²⁹ Among these studies, the most commonly cited reasons that patients are not scheduled for surgery is that the patient is not willing to undergo surgery, is only mildly symptomatic, lacks advanced OA, or has not yet exhausted conservative treatment options. Other studies highlight that many patients are referred for expert diagnosis or general management advice.²⁹ This has important implications to wait list efficiencies as referring non-operative candidates to surgery may: 1) increase Wait One, delaying the time to consultation for more appropriate candidates', and thus their access to the surgery itself, 2) delay the provision of appropriate conservative treatment options and the benefits they offer for patients who are not yet eligible for surgery.

Furthermore, a recent systematic review demonstrated that less than 40% of knee OA patients receive appropriate non-pharmacological and pharmacological care in accordance with current guidelines.³⁰ In addition, current literature suggests a lack of clarity in the role of diagnostic imaging for knee OA.^{31,32} Specifically, many physicians are not aware that weight-bearing radiography is the most appropriate form of imaging to accurately diagnose OA³¹. In addition, the inappropriate use of MRI in the diagnosis of knee OA continues to persist³² propagated from several causes or explanations; the referring physicians, patient demand, and systems that do not facilitate optimal decision making surrounding the ordering of advanced imaging.

Primary care physicians play a crucial role in the diagnosis and management of knee OA. Primary care physicians provide education, interventions and monitor a program of conservative treatment, ultimately deciding when their patient should be referred to an

orthopaedic specialist for TKR. The high rate of non-operative referrals, underutilization of conservative treatments in primary care, and the misuse of diagnostic imaging, indicate a breakdown of the current management of patients with knee OA.

From the primary care physicians, barriers to effective management may include a lack of clinical applicability of current CPGs^{10,33}, insufficient training in musculoskeletal (MSK) topics during family medicine residency³⁴, and a lack of transparency or agreement surrounding indications for TKR³⁵⁻³⁷. Further, a lack of shared decision making between patients and providers, where patients' preferences and values are considered before a referral is made may partly explain non-operative referrals.

System-level barriers also exist including time constraints during primary care consultations which may limit physicians' ability to deliver appropriate education or treatments. Furthermore, physicians and their patient population may have varying levels of access to allied health care practitioners including dietitians, PTs, occupational therapists, and sport medicine physicians who can help to facilitate optimal care for patients with OA. Other organizational and system-level limitations may also contribute, including inefficient referral processes and models of care that do not facilitate implementation of CPGs.³⁸

The contribution from patients lies in their beliefs and behaviours which are complex and rooted in both social and cultural contexts as well as their own cognitive, emotional and motivational thought processes.³⁹ For example, patients may be resistant to lifestyle changes including weight loss and exercise, which comprise the cornerstone of conservative treatment. This may partly explain the apparent underutilization of conservative treatments and a proportion of non-operative referrals. Further, a recent article examining the drivers of poor medical care suggest the idea that “more is better, new is better, and more expensive is better” drive patients to request unnecessary care. Patients' beliefs are often perpetuated within social systems, i.e. my neighbor, friend or relative had a certain procedure or test, and had a positive outcome.³⁹ Further, reliance on the internet as a tool to arm themselves with information (sometimes true, sometimes untrue, sometimes not applicable to their circumstance) can pose a challenge for clinicians. The interplay of these factors often leads patients to make demands of their

primary care physician for things like a referral to a surgeon or a requisition for an MRI that are not supported by evidence. In 2015, a survey of Canadians conducted by Ipsos Reid regarding unnecessary care indicated that 67% of participants believed that “patient demands are more responsible for unnecessary care than decisions by physicians”. Further, more than 90% of respondents felt that patients need more support and tools to help them engage in shared decision making regarding necessary health care.⁴⁰ Specific to OA, a recent systematic review of qualitative studies examining barriers to optimal management suggests that patient requests appear to influence physicians’ treatment recommendations. Physicians in these studies reported ordering tests or making referrals as a means of maintaining trust with their patients or if they were unclear about the usefulness of tests.^{41,42}

In terms of reducing the pressure on primary care physicians, stricter rules must be implemented around requests for special tests (like MRI) or referrals to a specialist that coincide with public education campaigns to support the agenda. For example, in Ontario the South West Local Health Integration Network recently partnered with Choosing Wisely Canada to address long wait times for MRI and inappropriate imaging.⁴³ Recently, they have implemented a standardized MRI requisition form to be used at all hospital sites across our region for both spine and knee imaging. The ‘MRI knee appropriateness checklist’ provides information on when x-ray is recommended, when MRI is recommended, when MRI is not recommended, and a checklist to consider MRI if all of the following are present: absent or mild osteoarthritis, persistent unexplained pain for greater than three months, failed conservative therapy (physiotherapy and anti-inflammatories), and patient is a surgical/arthroscopy candidate.

At the same time, providing a highly publicized and widely endorsed series of educational videos may increase the proportion of patients who are relying on evidence-based information and who are encouraged to serve as champions of responsible health care reducing their demand for non-evidence-based tests and empowering them to seek out appropriate medical options to exhaust non-operative care like PT. In the face of a shifting paradigm in healthcare, where “more is not always better”⁴⁴, surgical consultation should only be sought when the appropriate conservative management has been

exhausted, and patients have been educated regarding reasonable expectations of surgery and recovery. Referring patients to an orthopaedic specialist who are not yet eligible or who are unwilling to undergo surgery introduces substantial inefficiencies to an already overburdened system.

These clinical problems provided the impetus for my Doctoral thesis. The overarching goal of this program of research is to develop a new online platform to improve the management of patients with knee OA. Our vision is to offer a comprehensive online platform that will provide referring physicians with: a) guidance on diagnostic imaging, conservative treatment and the optimal timing and criteria for referral, b) a suite of educational and post-operative resources for patients, and c) streamlined access to allied health providers that can offer care for patients with OA.

In light of this larger objective, the goals of this Doctoral thesis were to:

- 1) Create and validate a patient-reported algorithm that will identify surgical candidates and screen referrals that are not ready or optimized for TKR.
- 2) Create a series of patient education videos to support primary care management of patients with knee OA
- 3) Pilot these educational materials with end-users (patients and physicians) to assess their potential utility in clinical practice.

To develop the educational content in our videos we considered the results of national and international evidence-based guidelines for knee OA⁴⁻⁹ and high-quality studies underlining common practices that should be abandoned (MRI/arthroscopy for OA)⁴⁵⁻⁴⁸. We also relied on the clinical expertise of all seven of our fellowship trained arthroplasty specialists and one sports orthopaedic surgeon to determine key topics, educational content routinely provided, format, and visuals for the videos. We also consulted with primary care physicians, sport medicine specialists and PTs in the initial stages of content development to query their opinion on relevant information to include and how to best convey key messages. Further engagement of allied health care providers was conducted throughout various phases of the video development where progress was summarized and presented in multidisciplinary clinical research rounds and arthroplasty specific research

rounds for further consensus to be reached. This process contributed to edits to the education videos at various stages of their development.

Through collaboration with a video production team and the aforementioned health care professionals I spearheaded the development of five novel whiteboard education videos for patients with knee OA. The video topics include: 1) What is knee OA, 2) Appropriate imaging for knee OA, 3) Conservative treatment options, 4) Indications for TKR and other surgical procedures, and 5) What to expect from TKR. The aim of these educational resources are to increase patient understanding of: a) the disease itself and its progression, b) the appropriate imaging required to diagnose the radiographic severity of OA (to discourage patients from requesting advanced imaging such as MRI and CT), c) conservative treatment options to trial before considering TKR, d) indications for TKR and other surgical procedures (to help patients understand when a referral to TKR is warranted.), and e) providing appropriate surgical candidates information on the surgery itself, while also demystifying the procedure, its rehabilitation, and expectation for recovery perhaps influencing willingness to undergo the procedure.

1.1 Thesis Outline

This introduction is followed by four chapters (Chapter 2-5). Chapter 2 is a published prospective cohort study investigating a multivariable model to predict the outcome of surgical consult for patients referred to TKR. This is the first study that explicitly aims to predict surgical candidacy for TKR based solely on patient-reported information. Our intention was to use identified predictors to create an algorithm to improve the quality and timing of referrals to TKR that would not require assessment or interpretation by a health-care provider.

Chapter 3 details the results of piloting our novel whiteboard educational videos with patients referred to an orthopaedic specialist for TKR. It is a qualitative descriptive study aimed at garnering patients' experiences and perspectives regarding interacting with the education videos.

Chapter 4 is a qualitative descriptive study during which we piloted our novel whiteboard educational videos with primary care physicians and family medicine residents to gain feedback regarding the videos and how they may be best incorporated into their practice.

Chapter 5 is a discussion regarding the challenges and future plans surrounding implementing our predictive model and educational content within the proposed online platform.

1.2 References

1. Bombardier C, Hawker GA, Mosher D. *The Impact of Arthritis in Canada: Today and over the next 30 Years.*; 2011. http://www.arthritisnetwork.ca/downloads/20111022_Impact_of_arthritis.pdf.
2. Sharma L, Kapoor D, Issa S. Epidemiology of osteoarthritis. *Curr Opin Rheumatol.* 2006;18:147-156. <http://europepmc.org/abstract/med/15747607>.
3. Bennel K, Hunter D, Hinman RS. Management of osteoarthritis of the knee. *BMJ.* 2012;345:37-42.
4. 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. *Osteoarthr Cartil.* 2008;16(2):137-162.
5. Fernandes L, Hagen KB, Bijlsma JWW, et al. EULAR recommendations for the non-pharmacological core management of hip and knee osteoarthritis. *Ann Rheum Dis.* 2013;72(7):1125-1135.
6. NICE. Management of Osteoarthritis.; 2015:1-13. <http://pathways.nice.org.uk/pathways/osteoarthritis>
7. American Academy of Orthopaedic Surgeons. Treatment of Osteoarthritis of the Knee: Evidence-Based Guideline, 2nd Edition. *J Am Acad Orthop Surg.* 2013:973.
8. Hochberg MC, Altman RD, April KT, et al. American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis Care Res.* 2012;64(4):465-474.
9. McAlindon TE, Bannuru RR, Sullivan MC, et al. OARSI guidelines for the non-surgical management of knee osteoarthritis. *Osteoarthritis Cartilage.* 2014;22(3):363-388.

10. Nelson AE, Allen KD, Golightly YM, Goode AP, Jordan JM. A systematic review of recommendations and guidelines for the management of osteoarthritis: The Chronic Osteoarthritis Management Initiative of the U.S. Bone and Joint Initiative. *Semin Arthritis Rheum.* 2014;43(6):701-712.
11. Jansen MJ, Viechtbauer W, Lenssen AF, Hendriks EJM, de Bie RA. Strength training alone, exercise therapy alone, and exercise therapy with passive manual mobilisation each reduce pain and disability in people with knee osteoarthritis: a systematic review. *J Physiother.* 2011;57(1):11-20.
12. Skou S, Roos E. Good Life with osteoArthritis in Denmark (GLA:D™): evidence-based education and supervised neuromuscular exercise delivered by certified physiotherapists nationwide. *BMC Musculoskelet Disord.* 2017;72(18):1-13.
13. Bourne RB, Chesworth BM, Davis AM, Mahomed NN, Charron KDJ. Patient satisfaction after total knee arthroplasty: Who is satisfied and who is not? *Clin Orthop Relat Res.* 2010;468(1):57-63.
14. Waimann CA, Fernandez-Mazarambroz RJ, Cantor SB, et al. Cost-Effectiveness of Total Knee Replacement: A Prospective Cohort Study. *Arthritis Care Res.* 2014;66(4):592-599.
15. Health Canada. *First Minister's Meeting on the Future of Health Care 2004: A 10-Year Plan to Strengthen Health Care.* Ottawa; 2004.
<https://www.canada.ca/en/health-canada/services/health-care-system/health-care-system-delivery/federal-provincial-territorial-collaboration/first-ministers-meeting-year-plan-2004/10-year-plan-strengthen-health-care.html>
16. Pomey MP, Clavel N, Amar C, et al. Wait time management strategies for total joint replacement surgery: Sustainability and unintended consequences. *BMC Health Serv Res.* 2017;17(1):1-18.

17. Wait Time Alliance. Time to Close the Gap: Report Card on Wait Times in Canada. 2014;(June):1-19. <http://www.waittimealliance.ca/wp-content/uploads/2014/06/FINAL-EN-WTA-Report-Card.pdf>
18. Canadian Institute for Health Information. Wait Times for Priority Procedures in Canada, 2017. *Can Inst Heal Inf*. 2017;(March):1-19. https://secure.cihi.ca/free_products/wait-times-report-2017_en.pdf
19. Ackerman IN, Bennell KL, Osborne RH. Decline in Health-Related Quality of Life reported by more than half of those waiting for joint replacement surgery: a prospective cohort study. *BMC Musculoskelet Disord*. 2011;12(1):108.
20. Desmeules F, Dionne CE, Belzile ÉL, Bourbonnais R, Frémont P. The impacts of pre-surgery wait for total knee replacement on pain, function and health-related quality of life six months after surgery. *J Eval Clin Pract*. 2012;18(1):111-120.
21. Fortin PR, Mahomed N, Tanzer M, et al. Timing of total joint replacement affects clinical outcomes among patients with osteoarthritis of the hip or knee. *Arthritis Rheum*. 2002;46(12):3327-3330.
22. Judge A, Arden NK, Cooper C, et al. Predictors of outcomes of total knee replacement surgery. *Rheumatology*. 2012;51(10):1804-1813.
23. Lingard E a, Katz JN, Wright E a, Sledge CB. Predicting the outcome of total knee arthroplasty. *J Bone Joint Surg Am*. 2004;86-A(10):2179-2186.
24. Gupta S, Hawker GA, Laporte A, Croxford R, Coyte PC. The economic burden of disabling hip and knee osteoarthritis (OA) from the perspective of individuals living with this condition. *Rheumatology*. 2005;44(12):1531-1537.

25. DiBonaventura MD, Gupta S, McDonald M, Sadosky A, Pettitt D, Silverman S. Impact of self-rated osteoarthritis severity in an employed population: Cross-sectional analysis of data from the national health and wellness survey. *Health Qual Life Outcomes*. 2012;10(1):30.
26. Loza E, Lopez-Gomez JM, Abasolo L, Maese J, Carmona L, Batlle-Gualda E. Economic burden of knee and hip osteoarthritis in Spain. *Arthritis Care Res*. 2009;61(2):158-165.
27. McHugh GA, Campbell M, Luker KA. GP referral of patients with osteoarthritis for consideration of total joint replacement: a longitudinal study. *Br J Gen Pract*. 2011;61(589):e459-501.
28. Klett M-J, Frankovich R, Dervin GF, Stacey D. Impact of a surgical screening clinic for patients with knee osteoarthritis: a descriptive study. *Clin J Sport Med*. 2012;22(3):274-277.
29. Badley EM, Canizares M, MacKay C, Mahomed NN, Davis AM. Surgery or Consultation: A Population-Based Cohort Study of Use of Orthopaedic Surgeon Services. *PLoS One*. 2013;8(6).
30. Basedow M, Esterman A. Assessing appropriateness of osteoarthritis care using quality indicators: a systematic review. *J Eval Clin Pract*. 2015;21(5):782-789.
31. De Sa D, Petruccelli D, Patton SJ, Winemaker M, De Beer J. From “surgical gatekeepers” to “patient navigators”: Examining perceptions and practices of hip and knee osteoarthritis management among primary healthcare physicians. *Curr Orthop Pract*. 2016;27(1):46-55.
32. Sherman S, Gulbrandsen T, Lewis H, et al. Overutilization of magnetic resonance imaging in the diagnosis and treatment of moderate to severe osteoarthritis. *Iowa Orthop J*. 2018;38:33-37.

33. Feuerstein JD, Pelsis JR, Lloyd S, Cheifetz AS, Stone KR. Systematic analysis of the quality of the scientific evidence and conflicts of interest in osteoarthritis of the hip and knee practice guidelines. *Semin Arthritis Rheum*. 2016;45(4):379-385.
34. Pinney SJ, Regan WD. Educating medical students about musculoskeletal problems: Are community needs reflected in the curricula of Canadian medical schools? *J Bone Jt Surg - Ser A*. 2001;83(9):1317-1320.
35. Wright J, Hawker G, Hudak P, et al. Variability in Physician Opinions About the Indications for Knee Arthroplasty. *J Arthroplasty*. 2011;26(4):569-575.e1.
36. Fraenkel L, Suter L, Weis L, Hawker GA. Variability in recommendations for total knee arthroplasty among rheumatologists and orthopedic surgeons. *J Rheumatol*. 2014;41(1):47-52.
37. Skou ST, Roos ER, Laursen M, et al. Criteria used when deciding on eligibility for total knee arthroplasty — Between thinking and doing. *Knee*. 2016;23:300-305.
38. Ferreira de Meneses S, Rannou F, Hunter DJ. Osteoarthritis guidelines: Barriers to implementation and solutions. *Ann Phys Rehabil Med*. 2016;59(3):170-173.
39. Saini V, Garcia-Armesto S, Klemperer D, et al. Drivers of poor medical care. *Lancet*. 2017;390(10090):178-190.
40. Choosing Wisely. Ipsos Reid Survey. 2015. <https://choosingwiselycanada.org/wp-content/uploads/2017/05/More-is-Not-Always-Better-Digital-Toolkit.pdf>
41. Egerton T, Diamond L, Buchbinder R, Bennell K, Slade SC. A systematic review and evidence synthesis of qualitative studies to identify primary care clinicians' barriers and enablers to the management of osteoarthritis. *Osteoarthritis and Cartilage*. 2017;25:625-638.

42. Parsons S, Harding G, Breen A, et al. The influence of patients' and primary care practitioners' beliefs and expectations about chronic musculoskeletal pain on the process of care : A systematic review of qualitative studies. *Clin J Pain*. 2007;23(1):91-98.
43. Choosing Wisely Canada. Imaging Wisely: Communicating and Collaborating to Improve Imaging Services. 2017.
<https://choosingwiselycanada.org/perspective/imaging-wisely/>. Published 2017. Accessed September 1, 2018.
44. Choosing Wisely Canda. More is not always better.
<https://choosingwiselycanada.org/campaign/more-is-not-always-better/>. Accessed November 22, 2018.
45. Kirkley A, Birmingham TB, Litchfield RB, et al. A randomized trial of arthroscopic surgery for osteoarthritis of the knee. *N Engl J Med*. 2008;359(11):1097-1107.
46. Howard D, Brophy R, Howell S. Evidence of no benefit from knee surgery for osteoarthritis led to coverage changes and is linked to decline in procedures. *Health Aff (Millwood)*. 2012;31(10):2242-2249.
47. Link TM, Steinbach LS, Ghosh S, et al. Osteoarthritis: MR imaging findings in different stages of disease and correlation with clinical findings. *Radiology*. 2003;226(2):373-381.
48. Quatman CE, Hettrich CM, Schmitt LC, Spindler KP. The clinical utility and diagnostic performance of magnetic resonance imaging for identification of early and advanced knee osteoarthritis: a systematic review. *Am J Sports Med*. 2011;39(7):1557-1568.

Chapter 2

2 The development and validation of a multivariable model to predict if patients referred to total knee replacement are suitable surgical candidates at the time of initial consultation

2.1 Abstract

Background: In previous studies, 50-70 percent of patients referred to orthopaedic surgeons for total knee replacement (TKR) are not surgical candidates at the time of initial assessment. The purpose of this study was to identify and cross-validate patient self-reported predictors of suitability for TKR, and to determine the clinical utility of a predictive model to guide the timing and appropriateness of referral to a surgeon. **Methods:** We assessed pre-consultation patient data as well as the surgeon's findings and post-consultation recommendations. We used multivariate logistic regression to detect self-reported items that could identify surgical candidates. **Results:** Patients' willingness to undergo surgery, higher rating of pain, worse physical function, previous intra-articular injections, and patient age were the factors predictive of patients being offered and electing to undergo TKR. **Conclusion:** The application of the model developed in our study would effectively reduce the proportion of nonsurgical referrals to 25%, while identifying the vast majority of surgical candidates (>90%). Using patient-reported information, we can correctly predict the outcome of specialist consultation for TKR in 70% of cases. To reduce long waits for first consultation with a surgeon, it may be possible to use these items to educate and guide referring clinicians and patients to understand when specialist consultation is the next step in managing the patient with severe osteoarthritis of the knee.

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2.2 Introduction

Worldwide estimates indicate that approximately 10-20% of people older than 60 years have symptomatic osteoarthritis (OA).¹ Currently, 4.4 million or 1 in 8 Canadians are living with OA and this number is expected to increase to 10.4 million by the year 2040.² Because of its substantial direct and indirect costs, OA is a growing public healthcare concern.^{3,4} The annual economic burden of OA is expected to reach \$405 billion by the year 2020 in Canada alone; emphasizing the need to spend healthcare dollars wisely.²

Total joint replacement (TJR) is an effective intervention for patients with moderate to severe OA in their lower-limbs.⁵ According to the Arthritis Alliance of Canada, TJRs could avert more than 72 000 cases of severe OA over the next 30 years, while also improving the symptoms and physical functioning of individuals living with the disease.² However, provincial and nation-wide reports indicate that wait times for Canadians to see an orthopaedic surgeon are longer than acceptable.⁶

Total knee replacement (TKR) accounts for the majority of joint replacement surgeries in Canada⁷, therefore targeting a reduction in wait times for TKRs will have the greatest impact in wait time statistics. Despite the growing concern regarding wait times for TKR, current efforts focus on reducing wait times for surgery; there is a limited amount of research that specifically targets improvements in the wait from referral to initial consultation with an orthopaedic specialist.⁸

Interestingly, current evidence suggests that nearly 50-70% of patients referred to an orthopaedic surgeon for TKR are not booked for surgery.^{9,10} In a public health care system, ensuring patients are seen by the appropriate specialist, at the right time is key to ensure efficient allocation of healthcare resources and timely access to care.

A proposed solution to help mitigate the demand for orthopaedic specialist care is to establish central intake and assessment centers (CIACs), where other allied health professionals (physical therapists, nurse practitioners) screen, triage and provide non-operative care for patients referred to TKR. Although a CIAC may help alleviate excessive wait times for surgical consultations, they may not represent an efficient model

of care, given that anecdotally it is reported that most patients referred to TKR eventually undergo surgery and that CIACs mandate an additional costly point of care.¹¹ Ensuring the majority of patients referred to orthopaedic specialists for TKR are interested in and eligible candidates for surgery could be achieved through simpler, less costly means than CIACs, such as non-operative management at the discretion of the family physician and appropriate education for family physicians regarding surgical candidacy.

Thus, the purpose of this study was to: identify the reasons patients are classified as nonsurgical candidates after consultation with an orthopaedic surgeon, identify and validate patient-reported predictors of being offered and electing to undergo TKR during the initial consultation, and determine the clinical utility of a predictive model to guide the referral to a surgeon for TKR.

2.3 Patients and Methods

2.3.1 Study design and Setting

This study took place in a clinic that specializes in joint replacement at University Hospital, London Health Sciences Center, in London, Ontario, Canada. The center performs 1,700 TKR surgeries per year, which accounts for approximately three percent of all joint replacement surgeries performed annually in Canada.¹² This study used a single-center prospective cohort design conducted with patients who were attending their first consultation for their knee, with one of seven fellowship-trained arthroplasty surgeons. Prior to meeting with the surgeon, patients completed a series of questionnaires. Following the consultation, the attending surgeon completed a form detailing their findings and recommendations for treatment. The study was approved by the Health Sciences Research Ethics Board at Western University (Appendix E).

2.3.2 Participants/study subjects

Patients aged 18-100 years of age who were referred by their primary health care providers for their first consultation for surgical treatment of knee OA, were eligible to participate in this study. Patients were ineligible if they: did not speak English; if they were deemed by the orthopaedic surgeon to be a complex case; if they were not a new

referral; if they had previously undergone a TKR; or if they were unable to complete the questionnaire because of psychiatric, cognitive, visual or physical impairment.

All newly referred patients were identified by the study coordinator before their surgical consultation and were registered into a secure web-based data management system (EmPower Health Research Inc., www.empowerhealthresearch.ca). Participants were provided a unique username and password that allowed them to login and complete the questionnaires before their appointment. Several studies support the validity of online data collection.¹³⁻¹⁵ Patients who chose not to complete questions online were provided a paper copy of the questionnaires to complete in the waiting room before meeting with the surgeon.

2.3.3 Outcome measures

We developed a patient demographic and OA questionnaire. The selection and content of the initial patient questionnaires was informed by a thorough literature review followed by a meeting of the participating arthroplasty surgeons who discussed (until consensus) the expected strength of association between collected information and likelihood that patients reporting those characteristics would be scheduled for TKR by the end of the consultation. Because we were interested in identifying items that did not require interference or interpretation by a clinician (in the interest of removing the need for a CIAC), only patient-reported items were included.

Specifically, we included demographic information including age, sex, body mass index (BMI), employment status, presence/absence of bilateral symptoms, previous use of allied health (i.e., physiotherapy, chiropractor, massage therapy), use of intraarticular joint injections, use of walking aids, and willingness to undergo surgery. Patients indicated their willingness by selecting one of five response options; a participant was considered “willing” if they selected the response “definitely willing” or “probably willing”, or “unwilling” if they selected the response “unsure”, “probably unwilling”, or “definitely unwilling.”

Patients also completed the Short Form 12-item survey (SF-12)¹⁶; and a global rating of knee pain on a numeric scale from 0 to 10 where 0 represents no pain. We also used the

Patient Acceptable Symptom State questions (PASS 1 and 2) for OA (in relation to activities of daily living [ADLs], pain, and function). The PASS 1 asks, “Taking into account all the activities you have during your daily life, your level of pain, and also your functional impairment, do you consider that your current state is satisfactory”? The PASS 2 asks, “Considering all the different ways in which your disease affects you, if you were to remain in this state for the next few months, would you consider your current state to be satisfactory?”¹⁷ The response options were yes/no.

After the orthopaedic surgeon performed the usual initial consultation with the participant, the surgeon completed a form detailing their findings and recommendations. The surgeons were blind to participant outcome measures, as only the primary data collector retained access to this information. The form asked the surgeon to indicate whether the participant was an appropriate candidate for TKR, if yes, the surgeon indicated whether the consult resulted in a booking for TKR; if no, the surgeon was asked to indicate the reason(s) via a standard checklist, which was determined apriori by all participating surgeons.

We constructed a simplified algorithm based on model findings and our recommendations for clinicians.

2.4 Statistical analysis

2.4.1 Independent/dependent variables

Based on the literature and surgeon expertise, we identified nine items that were most likely to identify surgical candidates including; age, BMI, unilateral/bilateral symptoms, willingness to undergo surgery, previous use of allied health, use of injections, use of walking aids, SF-12 Physical Composite Scale (PCS), and global rating of knee pain. We then set out to determine whether we could use patient responses to questionnaire items to identify patients who are scheduled for TKR during their initial consultation (dependent variable).

Our sample size was calculated based on the formula used by Peduzzi and colleagues¹⁸: ($n=10*k/p$) where p was the limiting event rate or the proportion of referrals deemed to

be nonsurgical candidates (47%)⁹ and k was the number of predictors. This yielded a sample size requirement of approximately 200 individuals.

Since our intention was to run both a model development analysis (training sample) and a validation analysis (testing sample) we required approximately 400 individuals randomly divided into two equally sized groups. We used an all enter method of multivariate logistic regression analysis where we pared down our model by eliminating any predictors with an alpha >0.20 and used the Hosmer-Lemeshow test to confirm the model fit. Model diagnostics were performed following Menard's method.¹⁹

Next, we performed additional analyses with predictors that assessed similar constructs such as those measuring pain and function. Specifically, we repeated our analysis by replacing global rating of pain and SF-12 PCS with the PASS 1 and PASS 2 questions, respectively, in both the training and validation models.

Last, we identified a final clinical model encompassing terms that were significant in both the training and test models that considered the results of our additional analyses. We calculated the sensitivity and specificity of this model to correctly identify patients booked for TKR following first consult using a standard cut-off value of 0.5. We then adjusted the cut-off value in increments of 0.5 to determine whether we could improve the sensitivity of our model.

All data analyses were performed using SPSS version 22.0 (SPSS Inc., Chicago, IL).

2.5 Results

2.5.1 Demographics/description of study population

Of the patients who consented to participate, available demographics were similar between those who completed all questionnaires and those who did not. Patients who refused consent tended to be older than those who consented (Table 2.1).

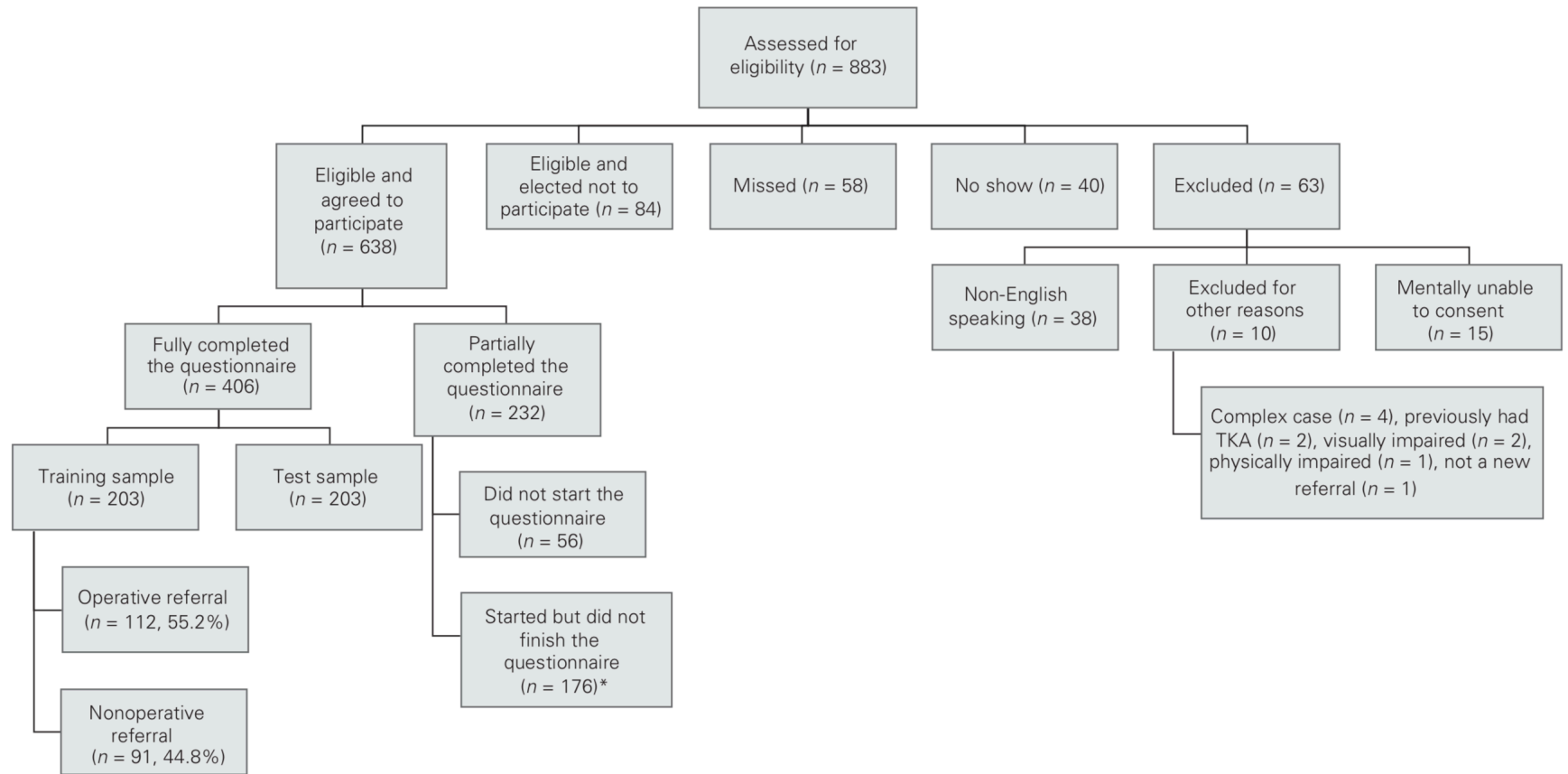
Table 2.1 Patient demographic characteristics

| Characteristic | Complete questionnaire (n=406) | Partially completed questionnaire (n=232) | Refused to participate (n=84) |
|---|---|--|--|
| Age (mean, SD) | 63 (10) years | 63 (12) years | 69(10) years |
| Gender (number female, % female) | 253 (62%) | 137 (59%) | 54 (64%) |
| BMI (mean, SD) | 31.2 (6.9) | N/A | N/A |
| Employment status (type, %) | Retired: 220 (54%) Full time: 106 (26%) Part time: 24 (6%) Self-employed: 22 (5%) Unemployed/ social assistance: 18 (4%) Stay at home caregiver: 11 (3%) Student: 2 (1%) Volunteer: 3 (1%) | N/A | N/A |

BMI= body mass index; NA= not available; SD= standard deviation.

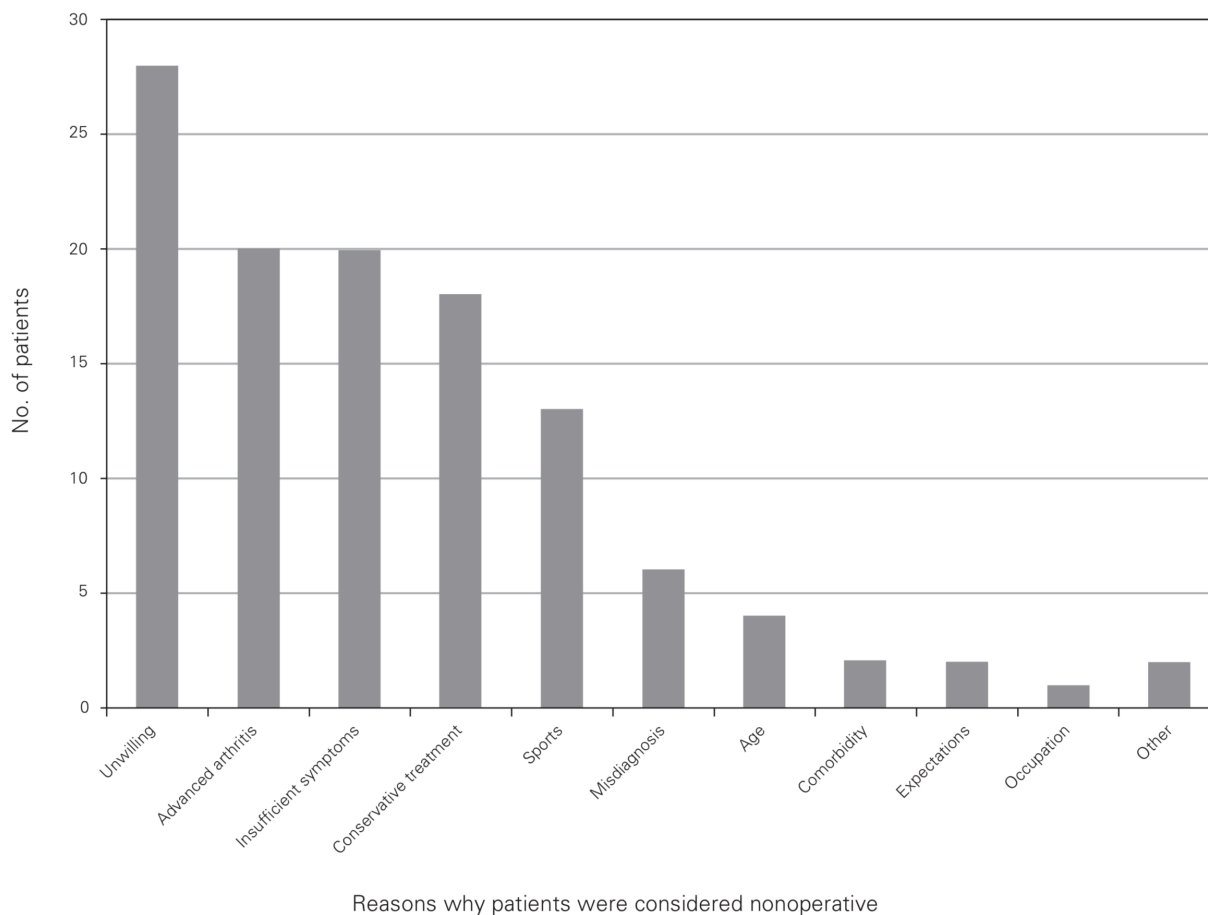
From April 17, 2013 to February 19, 2014, a total of 883 patients were consecutively screened for eligibility. Of these, 63 did not meet eligibility requirements, 40 patients did not attend their appointment, 58 were missed, and 84 refused consent. Of the 638 eligible patients who gave their consent 406 patients fully completed the study protocol (Fig 1). Using the American Association for Public Opinion Research (AAPOR) standard³⁰, our response rate was 72%. Our training and testing samples each comprised 203 patients.

Figure 1 Flow of participants through the study. TKA= total knee arthroplasty



Assumptions of the logistic model were confirmed. Within our training sample, 91 of 203 participants (44.8%) were not scheduled for surgery during the initial consultation with the orthopaedic surgeon. Figure 2 describes the reasons why patients were considered non-operative, as indicated by their surgeon.

Figure 2 Reasons why patients were considered nonoperative, as indicated by their surgeon.



Participants were considered non-operative during their first consultation for reasons including: unwillingness to undergo surgery (n=28), lack of advanced arthritis (n=20), insufficient symptoms (n=20), insufficient conservative management (n=18), more appropriate to be managed by a sports orthopaedic surgeon (n=13), misdiagnosis (n=6), patient age too young (n=4), comorbidities (n=2), patient expectations too high (n=2), patient occupation (manual labourer, n=1), other (personal reasons, n=2).

The final training and validation logistic regression models are shown in Table 2.2. Five variables were identified in the training model as being significant contributors to identifying surgical candidates: age, global rating of pain, SF12-PCS, willingness to undergo surgery, and previous injections. All of these variables were significant in the validation model in addition to BMI, bilateral symptoms, and previous use of allied health care. Thus, the original model was validated, as all of the predictors identified as significant in the training model were also significant in the validation model, with odds ratios of similar magnitudes.

Table 2.2 Training and validation, final models

| Variable | OR (95% CI) | P-Value |
|-----------------------------|--------------------|----------------|
| Training dataset* | | |
| Age | 1.06 (1.02, 1.10) | 0.001 |
| Global Rating of Pain | 1.24 (1.06, 1.44) | 0.006 |
| SF-12 PCS | 0.95 (0.91, 0.98) | 0.004 |
| Willingness | 4.45 (1.64, 12.08) | 0.003 |
| Tried Injections | 1.73 (0.89, 3.36) | 0.10 |
| Validation dataset † | | |
| Age | 1.02 (0.99, 1.06) | 0.19 |
| BMI | 1.05 (0.99, 1.10) | 0.09 |
| Bi/Uni Symptoms | 0.57 (0.29, 1.11) | 0.10 |
| Global Rating of Pain | 1.23 (1.06, 1.42) | 0.01 |
| SF-12 PCS | 0.97 (0.94, 1.01) | 0.15 |
| Willingness | 9.77 (3.02, 31.64) | <0.0001 |
| Tried Injections | 1.60 (0.83, 3.12) | 0.16 |
| Allied Health | 0.45 (0.14, 1.46) | 0.18 |

BMI= body mass index; CI= confidence interval; OR=odds ratio; SF-12 PCS=

Short-form 12-item survey Physical composite scale

* $-2\text{Log}l = 220.123$; HL $\chi^2_{8df} = 9.75$, $p = 0.28$. Final training model following 5 deletions

† $-2\text{Log}l = 216.283$; HL $\chi^2_{8df} = 7.45$, $p = 0.49$. Final validation model following 2 deletions

We found that willingness to undergo surgery was the strongest predictor of being scheduled for TKR during the initial consultation. In the training sample patients who were willing to undergo surgery were approximately 4.5 times more likely to be scheduled for TKR (95% CI, 1.64-12.08, $p=0.03$). This was further confirmed by the validation sample in which patients who were willing to undergo surgery were approximately 10 times as likely to be scheduled for TKR (95% CI 3.01-31.71, $p=<0.001$).

Several other variables were identified as significant predictors in both the training and validation samples. Specifically, the greater the pain reported by the patient the more likely they were to be scheduled for TKR (i.e., for every 1 unit increase on the 0-10 global rating of pain numeric rating scale, patients were 20% more likely to be scheduled for TKR). The higher a patient scored on the SF-12 (i.e. better function) the less likely they were to be scheduled for TKR. Patients who had tried injections were 1.5 times more likely to be scheduled for TKR compared to those who had not tried injections. Finally, age was a significant predictor in both models.

Additional analyses: In the training model, when we removed the global rating of pain variable and replaced it with the PASS 1, patients who answered “yes” (i.e., that they felt that their current level of pain and functional impairment was acceptable) were approximately 75% less likely to be scheduled for TKR than those who answered “no”. When we replaced the SF-12 PCS with the PASS 2 question, patients who answered “yes” (i.e., they felt that their current disease state was acceptable) were approximately 50% less likely to be scheduled for TKR than those who answered “no”. Results of these additional analyses revealed that the model fit improved in both the training and validation models when PASS 1 (Table 2.3) and PASS 2 (Table 2.4) were substituted into the model while the other terms remained relatively stable.

Table 2.3 Additional analysis (PASS 1): training and validation, final models

| Variable | OR (95% CI) | P-Value |
|---------------------|---------------------|---------|
| Training dataset* | | |
| Age | 1.05 (1.02, 1.09) | 0.004 |
| PASS 1 | 0.28 (0.12, 0.66) | 0.004 |
| SF-12 PCS | 0.95 (0.91, 0.98) | 0.003 |
| Willingness | 4.60 (1.70, 12.50) | 0.003 |
| Tried Injections | 1.64 (0.84, 3.20) | 0.15 |
| Validation dataset† | | |
| Age | 1.02 (0.99, 1.06) | 0.20 |
| BMI | 1.06 (1.00, 1.11) | 0.04 |
| Bi/Uni Symptoms | 0.49 (0.25, 0.95) | 0.03 |
| PASS 1 | 0.22 (0.10, 0.48) | <0.0001 |
| Willingness | 11.51 (3.57, 37.07) | <0.0001 |
| Tried Injections | 1.67 (0.86, 3.22) | 0.13 |
| Allied Health | 0.38 (0.12, 1.22) | 0.10 |

BMI= body mass index; CI= confidence interval; OR=odds ratio; SF-12 PCS=

Short-form 12-item survey Physical composite scale

*-2Logl=218.833; H-L $\chi^2_{8df}=7.30$, $p = 0.51$. Final training model following five deletions

†-2Logl=215.370; H-L $\chi^2_{8df}=1.04$, $p = 0.99$. Final validation model following three deletions

Table 2.4 Additional analysis (PASS 2): training and validation, final models

| Variable | OR (95% CI) | P-Value |
|-----------------------|--------------------|---------|
| Training dataset* | | |
| Age | 1.06 (1.03, 1.10) | 0.001 |
| Global Rating of Pain | 1.29 (1.12, 1.50) | 0.001 |
| PASS 2 | 0.54 (0.25, 1.15) | 0.11 |
| Willingness | 3.77 (1.40, 10.17) | 0.01 |
| Tried Injections | 1.79 (0.93, 3.43) | 0.08 |
| Validation dataset † | | |
| Age | 1.02 (0.99, 1.06) | 0.18 |
| BMI | 1.06 (1.00, 1.11) | 0.05 |
| Bi/Uni Symptoms | 0.50 (0.25, 1.00) | 0.05 |
| Global Rating of Pain | 1.12 (0.95, 1.31) | 0.17 |
| PASS 2 | 0.23 (0.10, 0.53) | 0.001 |
| Willingness | 8.67 (2.64, 28.46) | <0.0001 |
| Tried Injections | 1.62 (0.82, 3.21) | 0.16 |
| Allied Health | 0.43 (0.12, 1.50) | 0.19 |

BMI= body mass index; CI= confidence interval; OR=odds ratio

*-2Logl=226.117; H-L $\chi^2_{8df}=7.74$, $p = 0.46$. Final training model following five deletions

†-2Logl= 205.917; H-L $\chi^2_{8df}=7.75$, $p = 0.46$. Final training model following two deletions

Final clinical model: In formulating the final clinical model, the PASS 2 is preferable based on the clinical utility of a single question versus a 12-item questionnaire. Although the additional analyses evaluated similar constructs with different measures, we cannot compare them directly because they are scaled differently. To avoid collinearity between PASS 1 and PASS 2 statements, it is more suitable to include the global rating of pain in a final predictive model that includes the PASS 2. Thus, our final clinical model includes the following predictor variables: age, willingness to undergo surgery, global rating of pain, PASS 2 and previous injections (Table 2.5).

Table 2.5 Final clinical models, including the intercept*

| Intercept and Variables | β | OR (95% CI) | P-Value |
|-----------------------------|---------|--------------------|---------|
| <i>Training dataset †</i> | | | |
| Intercept | -6.163 | | |
| Age | 0.06 | 1.06 (1.03, 1.10) | 0.001 |
| Global Rating of Pain | 0.26 | 1.29 (1.12, 1.50) | 0.001 |
| PASS 2 | -0.62 | 0.54 (0.25, 1.15) | 0.11 |
| Willingness | 1.33 | 3.77 (1.40, 10.17) | 0.01 |
| Tried Injections | 0.58 | 1.79 (0.93, 3.43) | 0.08 |
| <i>Validation dataset ‡</i> | | | |
| Intercept | -3.362 | | |
| Age | 0.02 | 1.02 (0.98, 1.05) | 0.32 |
| Global Rating of Pain | 0.15 | 1.15 (0.99, 1.35) | 0.06 |
| PASS 2 | -1.45 | 0.23 (0.10, 0.53) | <0.0001 |
| Willingness | 2.21 | 8.67 (2.64, 28.46) | <0.0001 |
| Tried Injections | 0.50 | 1.65 (0.86, 3.19) | 0.13 |

CI= confidence interval; OR=odds ratio

*The predicted probability of surgical candidacy can be calculated using the following formula: $P(\text{Surgical}) = 1 / (1 + \exp(-(-6.613 + \text{Age} \times 0.06 + \text{Global rating of pain} \times 0.26 + \text{PASS 2} \times -0.62 + \text{Willingness} \times 1.33 + \text{Tried injections} \times 0.58)))$. Continuous variables (Age, Global rating of pain) are entered directly. Pass 2, Willingness, and Tried injections are coded as Y=1, N=0

†-2Logl=226.117; H-L $\chi^2_{8df}=7.74, p = 0.46$. Final training model following five deletions

‡-2Logl= 218.012; H-L $\chi^2_{8df}=6.924, p = 0.55$. Final training model following five deletions

Cut-off values of 0.5 and 0.35 were used to compute the sensitivity and specificity and overall percentage correct of the final clinical models (training and validation; Table 2.6). In the training sample using a cut-off value of 0.5 this model would have correctly screened out 57 of 91 (62%) patients who were not surgical candidates at the time of first consultation, while correctly identifying 87 of 112 (77%) patients scheduled for TKR. Using a cut-off value of 0.35, this model would have correctly screened out 40 of 91 (44%) non-operative patients, while correctly identifying 104 of 112 (92%) of patients scheduled for TKR.

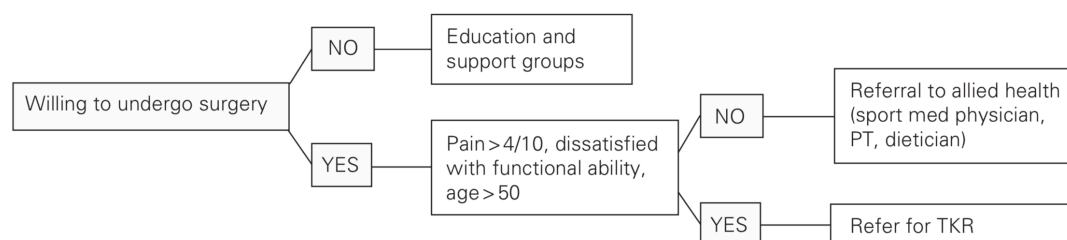
Table 2.6 Sensitivities and specificities of the final model

| Model | Sensitivity (95%CI) | Specificity (95%CI) | % Correct |
|----------------------------------|---------------------|---------------------|-----------|
| <i>0.5 cut-off value</i> | | | |
| Training | 0.78 (0.69-0.85) | 0.63 (0.52-0.72) | 70.9 |
| Validation | 0.85 (0.77-0.90) | 0.59 (0.48-0.70) | 73.9 |
| <i>0.35 cut-off value</i> | | | |
| Training | 0.93(0.86-0.97) | 0.44 (0.34-0.55) | 70.9 |
| Validation | 0.91 (0.83-0.95) | 0.48 (0.37-0.59) | 72.4 |

CI= confidence interval

Based on model findings and clinical experience a simplified algorithm for referring physicians is described (Figure 3).

Figure 3 Algorithm for patient referral to total knee replacement (TKR).



Based on model findings, willingness to undergo surgery should be determined before a referral to TKR is made. Physicians should direct unwilling patients to education and support groups. In patients who are willing to undergo surgery, pain, function and age should be further considered before referral. In patients whose symptoms are mild, referral to allied health may be the most appropriate avenue. Physicians should follow up with these patients regularly to monitor and reassess status for referral to TKR. PT = physiotherapy.

2.6 Discussion

We found that a large proportion of referrals for TKR (approximately 45%) are not suitable or “ready” candidates for joint replacement at the time of their surgical consultation (i.e., the patient was unwilling to proceed with surgery; lacked advanced OA; was only mildly symptomatic; or had not yet tried or exhausted conservative therapies such as physical therapy or injections to manage their OA). The application of the model developed in this study would reduce the proportion of nonsurgical referrals to 25%, while identifying the vast majority of surgical candidates (>90%). It may be useful for referring physicians to consider the predictors identified in our model when deciding if a referral to TKR is the most appropriate avenue for patients with knee OA. While not every patient referred to an orthopaedic surgeon will be a candidate for surgical intervention, improving education for patients and practitioners regarding the timing of referral and conservative options may introduce a more efficient care pathway.

2.6.1 Limitations

A limitation of the present study is that the results may be specific to the study center and its patient population. Our center is located within an academic institution and is a high-volume joint-replacement centre whose surgeons operate almost exclusively within their

designated specialty. Although there are similar centres in larger urban areas, the rate of referrals that are non-surgical at their initial consultation may be slightly overestimated in comparison to referrals to an orthopaedic surgeon whose practice includes non-surgical interventions and/or a broader spectrum of diagnoses.

2.7 Conclusion

Before making a referral, physicians must ask their patient about their willingness to undergo joint replacement surgery. If the patient is unwilling, but meets all other criteria for referral, the physician should investigate reasons for unwillingness (e.g. uncertain about what to expect during the recovery period, lack of support for ADLs during recovery period) and perhaps provide educational material and information about available support groups. Patients who are willing to undergo joint replacement, whose pain is greater than 4/10, who are dissatisfied with their current ability to function, and who are greater than 50 years of age should be referred for TKR.

For patients with mild symptoms, the physician may offer pharmacological pain relief (e.g., acetaminophen, non-steroidal anti-inflammatory drugs/COX inhibitors) with referrals made to clinicians with expertise in administering intraarticular injections (e.g., sports medicine physicians), physical therapy, nutrition and weight loss (Figure 3).

Physicians should follow up with the patient regularly to identify changes in pain and function to reassess eligibility and willingness for joint replacement. Finally, physicians should use radiography (bilateral weightbearing films) as a modifier to decision making, where patients with severe degenerative changes are more likely to benefit from TKR. Magnetic resonance imaging should not be used to diagnose the degree of degenerative changes or meniscal pathology because it is expensive and provides minimal diagnostic benefit over plain films even in patients with mild to moderate knee OA.

Our study showed that forty-five percent of patients referred to an arthroplasty surgeon are not suitable or “ready” surgical candidates at the time of initial consultation. A patient’s willingness to undergo surgery, previous injections, significant pain, physical disability, and older age can correctly predict whether a patient is scheduled for TKR in 70% of referrals to TKR. Given long wait times for initial consultation, and the potential

additional costs to the patient and health care system, joint replacement represents an area where education to optimize referrals may better optimize patient care.

2.8 References

1. Woolf AD, Pfleger B. Burden of major musculoskeletal conditions. *Bull World Health Organ.* 2003;81(9):646-656.
2. Bombardier C, Hawker GA, Mosher D. *The Impact of Arthritis in Canada: Today and over the next 30 Years.*; 2011. http://www.arthritisnetwork.ca/downloads/20111022_Impact_of_arthritis.pdf.
3. Gupta S, Hawker GA, Laporte A, Croxford R, Coyte PC. The economic burden of disabling hip and knee osteoarthritis (OA) from the perspective of individuals living with this condition. *Rheumatology.* 2005;44(12):1531-1537.
4. Bitton R. The economic burden of osteoarthritis. *Am J Manag Care.* 2009;15(8 Suppl):S230-S235.
5. Creamer P, Hochberg MC. Osteoarthritis. *Lancet.* 1997;350(9076):503-508.
6. Wait Time Alliance. *Shedding Light on Canadians' Total Wait for Care.* (June); 2012. http://www.waittimealliance.ca/wp-content/uploads/2014/05/2012_Report_Card.pdf
7. CJRR. *Hip and Knee Replacements in Canada: Canadian Joint Replacement Registry 2013 Annual Report.* Ottawa (Ont): Canadian Institute for Health Information (CIHI); 2013.
8. Wait Time Alliance. *Canadians Still Waiting Too Long for Healthcare.*(June); 2013. http://www.waittimealliance.ca/wp-content/uploads/2014/05/2013_Report_Card.pdf
9. Klett M-J, Frankovich R, Dervin GF, Stacey D. Impact of a surgical screening clinic for patients with knee osteoarthritis: a descriptive study. *Clin J Sport Med.* 2012;22(3):274-277.
10. McHugh GA, Campbell M, Luker KA. GP referral of patients with osteoarthritis for consideration of total joint replacement: a longitudinal study. *Br J Gen Pract.*

2011;61(589):e459-501.

11. Deloitte & Touche LLP and affiliated entities. *Evaluation of Central Intake and Assessment Centres for Hip and Knee Replacement Final Report*. 2011.
12. Canadian Institute for Health Information (CIHI). *Hip and Knee Replacements in Canada—Canadian Joint Replacement Registry (CJRR) 2008–2009 Annual Report*. Ottawa: CIHI; 2009.
13. Shervin N, Dorrwachter J, Bragdon CR, Shervin D, Zurakowski D, Malchau H. Comparison of paper and computer-based questionnaire modes for measuring health outcomes in patients undergoing total hip arthroplasty. *J bone Jt surgery American Vol*. 2011;93(3):285-293.
14. Marsh JD, Bryant DM, Macdonald SJ, Naudie DD. Patients Respond Similarly to Paper and Electronic Versions of the WOMAC and SF-12 Following Total Joint Arthroplasty. *J Arthroplasty*. 2014; 29: 670-673.
15. Salaffi F, Gasparini S, Grassi W. The use of computer touch-screen technology for the collection of patient-reported outcome data in rheumatoid arthritis: comparison with standardized paper questionnaires. *Clin Exp Rheumatol*. 2009;27(3):459-468.
16. Gandhi SK, Salmon JW, Zhao SZ, Lambert BL, Gore PR, Conrad K. Psychometric evaluation of the 12-item short-form health survey (SF-12) in osteoarthritis and rheumatoid arthritis clinical trials. *Clin Ther*. 2001;23(7):1080-1098.
17. Kvien K, Heiberg T. Minimal clinically important improvement/difference (MCII/MCID) and patient acceptable symptom state (PASS): what do these concepts mean? *Ann Rheum Dis*. 2007;66(3 Suppl):iii40-1.
18. Peduzzi P, Concato J, Feinstein AR, Holford TR. Importance of events per independent variable in proportional hazards regression analysis. II. Accuracy and precision of regression estimates. *J Clin Epidemiol*. 1995;48(12):1503-1510.
19. Menard S. *Applied Logistic Regression Analysis*. 2nd ed. Thousand Oaks, California: Sage Publications; 2002.

20. Research TAA for PO. *Standard Definitions: Final Disposition of Case Codes and Outcome Rates for Surveys*. 7th edition. AAPOR; 2011.

Chapter 3

3 A qualitative investigation of novel educational material for patients considering total knee arthroplasty

3.1 Abstract

Background: Current literature suggests that non-operative management of patients with knee OA and referrals to orthopaedic surgeons in consideration of TKR are inefficient. To help optimize non-operative management we created educational whiteboard videos for patients with knee OA. The purpose of this study was to pilot our educational videos with end-users (patients) to garner patients' experiences and perspectives regarding interacting with the videos to better understand their potential utility. **Methods:** This was a mixed methods evaluation, using a qualitative descriptive approach, of patients attending their first consultation with an arthroplasty surgeon for TKR. We conducted in-depth semi-structured interviews with patients. Three members of the research team coded data independently, implementing a content and thematic analysis **Results:** Thirteen participants were included. Participants indicated that the videos enhanced their confidence and clarity surrounding their decision to undergo TKR. The videos also addressed several knowledge gaps in their understanding of OA management. Barriers to uptake of the education were identified including limited access to PTs and the challenge of weight loss. Patients requested more information on alternative surgical procedures to TKR and rehabilitation post-TKR, highlighting areas for future content. **Conclusion:** The current educational intervention was valued by patients with knee OA. Implementation of these videos may have important implications for patients, providers, and our health care system.

3.2 Introduction

Previous studies have demonstrated that a large proportion of referrals to joint replacement surgeons are considered non-operative at the time of the initial consultation³. We previously developed a predictive model using patient-reported information, which can identify up to 90% of patients who are eligible and willing to undergo total knee replacement (TKR), reducing the proportion of non-operative referrals to 25%.¹ Following Churchill et al. (2016), this model was further validated in a prospective trial producing similar results.⁴ Non-operative referrals commonly include patients who are suitable candidates yet unwilling or reluctant to undergo surgery or patients who lack advanced osteoarthritis (OA), have mild symptoms, or who have not yet tried or exhausted conservative treatment therapies (i.e., weight loss, physical therapy or intraarticular injections) to manage their OA. These findings emphasize that clinical guidelines outlining conservative management of knee OA are either not adequately prescribed by primary care physicians or are underutilized by patients. It also confirms the importance of determining willingness to undergo surgery prior to specialist referral.¹ It is well established in the literature that willingness to undergo surgery is one of the most potent predictors of undergoing TKR among patients referred to orthopaedic specialists.^{1,3,5}

McHugh et al. (2011) found that nearly 70% of patients referred to a regional orthopaedic center in the UK for consideration of TKR were not surgical candidates within 12-months of their first surgical consultation. Of these, 14% did not follow through with their orthopaedic surgeon's recommendation to have surgery.³ Qualitative exploration of this sub-sample revealed various reasons patients opted against their specialists' recommendation for surgery including: feeling like they would rather cope with the symptoms than have the surgery; negative opinion of family or friends toward surgery; misconceptions about the risks associated with surgery; and seeking a second opinion.⁶

Education and support for patients and providers regarding conservative management options, and indications for TKR could reduce referrals to joint replacement specialists. This along with appropriate imaging could improve the overall quality of referrals. Patient education regarding the procedure, recovery, and expectations may also help to

determine willingness to undergo surgery prior to making a referral and eliminate unnecessary consults. Moreover, addressing the barriers to electing surgery through education and identifying organizations who can offer support to families throughout the surgery and recovery may help ensure appropriate candidates feel confident electing to undergo TKR if it is recommended.

New forms of multimedia, such as health information offered through a whiteboard video format, are revolutionizing the way health education is delivered to patients. Whiteboard videos delivering a health care message became extremely popular following Mike Evans video “23 and a half hours” which reached 2 million views in a matter of months after it was uploaded to YouTube in 2012. This type of multimedia features animations, which appear to be illustrated in ‘real time’, and an engaging narrative that is entertaining and informative.⁷ While millions of people are accessing high quality evidence-based education from this form of media, little is known regarding the influence of these videos regarding patient behaviour and health. Given the amount of attention these videos have garnered in such a short time frame, this form of multimedia should be considered as a promising medium in web-based patient education. The successful dissemination of these videos highlights the ability of compelling, well-designed multimedia to attract a large audience regarding important health topics.

To encourage responsible use of health care resources and guide decision making regarding non-operative and operative management we created educational whiteboard videos for patients with knee OA intended to be used in a primary care setting before referral to a joint replacement specialist. We created five videos including: 1) What is knee OA (describing the disease and its progression), 2) Appropriate imaging required to diagnose the radiographic severity of knee OA (to discourage patients from requesting advanced imaging such as MRI and CT), 3) Conservative treatments for knee OA, 4) Indications for TKR and other surgical procedures (to help patients understand when a referral to TKR is warranted), and 5) Surgery expectations (intended toward demystifying the procedure, its rehabilitation, and expectation for recovery perhaps influencing willingness to undergo the procedure).

The purpose of this study was to show our educational videos to end-users (patients) to garner patients' experiences and perspectives regarding the content and clarity of videos and to better understand their potential impact on patient's health behaviour. This feedback will also contribute to final edits of the videos, future directions for educational content, and ensure relevant stakeholders have vetted the videos before further widespread implementation.

3.3 Methods

3.3.1 Study design and setting

This study was a mixed methods evaluation, with a focus on qualitative interview data with patients attending their first consultation for their knee with a fellowship trained arthroplasty surgeon (SM). Before meeting with the surgeon, participants completed a baseline survey and watched five educational videos regarding knee OA. We conducted a series of five brief semi-structured interviews with patients to obtain their feedback after watching each video. After watching the videos and participating in the interviews, patients completed a post-intervention survey. After meeting with the surgeon, we recorded the outcome of their consultation (scheduled for TKR or not). An iterative qualitative thematic content analysis approach was used combining both inductive and research question driven coding, category formation, and theme identification for the qualitative interview data¹¹. This study was approved by the Health Sciences Research Ethics Board at Western University (Appendix E).

3.3.2 Sampling and recruitment

A Doctoral student (LC) approached a convenience sample of patients and obtained written consent for study participation. Patients were included if they could participate in an interview in English and agreed to be audio recorded. Purposive sampling was also employed to ensure that the sample represented both sexes undergoing TKR.

3.3.3 Outcome measures

Demographic information included age, sex, cultural background, education and employment status. Participants were asked to indicate whether they or their family

member had a previous TKR. We included the Medical Term Recognition Test (METER) which is a brief, self-administered measure of health literacy. The METER takes approximately two minutes to complete and asks patients to identify real medical words amongst nonwords. This measure has been validated for use in clinical settings and suggests using cut-offs of 0-20, 21-34, and 35-50, to indicate low, marginal, or functional levels of health literacy.⁸ Low, marginal, and functional health literacy levels indicate reading ability at or below grade 6 level (low), grade 7/8 level (marginal), and grade 9 or above (functional). Finally, patients completed the Traditional Decisional Conflict Scale (DCS); a 16-item measure which measures patient's uncertainty between two or more treatment options. Patients indicated their preference for TKR versus conservative treatment with an option to select 'unsure', and then completed 16 items in relation to their preferred choice. A total score is derived from the items ranging from zero (no decisional conflict), to 100 (extremely high decisional conflict). This measure has demonstrated adequate psychometric properties and has proven acceptable for use in a clinical setting where treatment options are preference-sensitive such as TKR.⁹

3.3.4 Data collection

We administered a baseline and post-interview survey with patients (Appendix B). In addition, we conducted semi-structured, in-depth interviews with each patient after they watched each educational video. The interviewer used an interview guide consisting of open-ended questions and prompts meant to elicit rich information regarding patient's experiences with each video. Questions addressed satisfaction and dissatisfaction with the education provided, impact of the education on patient's understanding of their condition and appropriate management, additional questions not answered, and confidence consulting with the surgeon (Appendix C). Two Doctoral students (RP and ML) conducted the interviews in a private, quiet room. To optimize trustworthiness, the Doctoral students (RP and ML) disclosed to participants that they were not involved in the development of the educational videos before proceeding with the interview. To increase the accuracy of data collection and trustworthiness, all interviews were audio recorded and transcribed verbatim by a professional transcriptionist. Transcripts were also reviewed against the audio recordings by the primary researcher (LC) to confirm accuracy. Interviews were analyzed immediately after transcription to allow for an

iterative process in revising the interview guide. As per a post-positivist design, we stopped recruitment when saturation was reached¹⁰, which we anticipated would occur after 10-15 interviews. We stopped data collection after 13 interviews, when no new categories emerged in two consecutive interviews, and when we were satisfied with the diversity of respondents considering key demographic variables. We replaced patient names with pseudonyms (i.e. Subject 1, 2, 3) prior to data storage to maintain participant confidentiality.

3.3.5 Data analysis

We presented categorical information (sex, race, education, employment status, health literacy, operative status) with percentages, and continuous measures (age and DCS scores) with means, and standard deviation and standard error respectively.

Three graduate students (LC, RP, and ML) independently analyzed the data using hard copy transcripts and Quirkos Software (version 1.4.2), utilizing an approach consistent with Braun and Clarke (2004) guide to thematic analyses.¹¹The primary investigator (LC) read and re-read hardcopy transcripts to gain familiarity with the dataset. After this process was complete, hardcopy transcripts were reviewed, and relevant sections of text were identified and labelled to generate an initial coding framework. To ensure inter-coder reliability, the interviewers (RP and ML) independently completed the same process for each interview that they conducted. Codes for each interview were then discussed, highlighting any discrepancies of interpretation between investigators until consensus was reached. Next, using Quirkos software, the primary investigator (LC) inputted the data and grouped codes and their accompanying data extracts into categories. Next, we determined which categories were addressing participant feedback, amenable to presenting as frequencies in a content analysis and which categories explored participant experiences interacting with the videos, better suited to exploring in a thematic analysis. For the content analysis, we counted the frequency of both positive and negative aspects (likes and dislikes) mentioned in participant interviews and presented these data as a frequency with supporting quotes in separate tables. For the thematic analyses, the data were grouped by key related categories to establish core overarching themes. Finally, themes were reviewed and refined to ensure coded data extracts within each theme

reflected a ‘coherent pattern’ and the entire dataset was re-read to ensure themes reflected the larger dataset as a whole. In addition to the multi-level coding approach and peer debriefing, the process incorporated other key aspects to optimize trustworthiness and minimize the potential for biased reporting including the use of frequency tallies, and an audit trail of the research and analysis process.¹⁰

3.4 Results

From June 6, 2018 to July 25th, 2018, 13 participants were interviewed. Interviews ranged in length from 30-45 minutes per participant allowing for adequate depth of familiarity. See table 3.1 for participant characteristics.

| Characteristic | Participants (n=13) |
|---|---------------------|
| Age (years) | |
| Mean (\pm SD) | 64 (9) |
| Median (min, max) | 67 (48,74) |
| Female n, (%) | 9, (69) |
| Race n, (%) | |
| White | 11, (84) |
| Asian | 1, (8) |
| Aboriginal | 1, (8) |
| Employment status n, (%) | |
| Part-time/Full-time | 7, (53) |
| Retired | 6, (46) |
| Social Assistance | 1, (1) |
| Education level n, (%) | |
| High school diploma | 4, (31) |
| Some college | 2, (15) |
| Vocational or technical school | 1, (8) |
| College/University Degree | 5, (38) |
| Graduate school | 1, (8) |
| Health literacy score n, (%)* | |
| Functional | 8, (67) |
| Marginal | 4, (33) |
| Previous TKR n, (%) | 1, (8) |
| Operative status: scheduled for surgery n, (%) | 7 (54) |

*missing data for 1 respondent

Table 3.1 Patient demographic characteristics**Decisional Conflict Scale (DCS)**

Participants with scores greater than zero on the DCS measure at pre-intervention (n=11/13), demonstrated a reduction in decisional conflict after watching the videos. On average patients' decisional conflict scores reduced by 26 points (See table 3.2).

| Variable | All participants, n=13 Mean (SE) |
|--------------------------------|-------------------------------------|
| DCS Total Score Pre | 48.62 (9.40) |
| DCS Total Score Post | 22.38 (4.12) |
| DCS Mean Difference (Post-Pre) | -26.23 (6.89) |

Higher DCS scores= greater decisional conflict (0= no decisional conflict, 100= extreme decisional conflict)

Table 3.2 Pre-post intervention decisional conflict scores**Content analysis**

Among the positive aspects, patients most frequently cited the use of analogies, the use of whiteboard animation, and the clarity and simplicity of the content as supportive to their satisfaction and learning (see table 3.3 for frequencies).

| Category | Sub-category | Frequency (count) |
|------------------|--|-------------------|
| Positive aspects | Use of analogies | 12 |
| | Use of whiteboard animation | 19 |
| | Clarity of information/ease of understanding | 29 |
| | Information needs met | 21 |

Table 3.3 Positive aspects of the videos

Specifically, patients frequently mentioned that they found the analogy comparing knee OA to a car strengthened their understanding by relating their condition to a familiar comparison and helped to increase accessibility of medical terminology. The majority of

patients expressed satisfaction with the whiteboard animation, citing that it allowed for greater attention and may foster improved retention of the information compared to other styles of videos or written information. Finally, many patients commented on the use of plain language and simple terms as preferable and supportive to their understanding (See table 3.4 for a selection of supporting quotes).

| Sub-category | Key Supporting quotes |
|-----------------------------|--|
| Use of analogies | <ul style="list-style-type: none"> • “What I really liked was the comparison to the car. Yeah because I do all the driving, so I understand that really well.” Subject 7 • “Yeah, I’m a picture person and I learn faster by looking at an image, so the car was excellent especially the second time around about how the accidents and missing the bumps in the road.” Subject 7 • “Comparing it to a car was a good comparison. It’s better actually, it’s not trying to get big words out that a lot of guys don’t understand.” Subject 6 • “I mean obviously when you see that and you start relating it to shock absorbers and tires and everything, it all makes sense and I guess when the surgeon or doctor is looking at an x-ray to see whether cartilage is worn or whether the meniscus or the fluid is all gone, you can relate back and forth to it.” Subject 8 |
| Use of whiteboard animation | <ul style="list-style-type: none"> • “The way they’re drawn draws your eyes, makes you keep up with what they’re doing – it’s not just all of a sudden presented.” Subject 2 • “I think it’s very good; the drawing grabs your attention. If you just put a picture up my minds going half the time but when you put a drawing you kind of zoom on it.” Subject 2 • “Just in general, before the hip surgery I was given a book yay |

| | |
|--|--|
| | <p>thick to read through and the videos are a much more pleasant way in dealing with the information and for anybody who is a visual learner, this is super.” Subject 3</p> <ul style="list-style-type: none"> • “Again, I love the graphics and stuff, it’s again, very simple to understand. Walks through the steps in terms of the appropriate choices, the management of it, yes.” Subject 4 • “I do think it is really great the way you say it and then you write it, I think that helps with the realization of it.” Subject 14 • I did learn a lot and it’s very helpful and if I read a whole big book I might have to go through pages to find this so yeah, I’m glad I came in.” Subject 11 |
| Clarity of information/ ease of understanding | <ul style="list-style-type: none"> • “And another thing, I’m not highly educated to understand all of these big words, it made it very simple.” Subject 6 • “And again, that simple part of it and not having it you know when you go on the internet and watch a Youtube video or a doctor talking about a knee and they talk in very more medical terms if you will so I guess this is a simplified version for the average person to be able to understand it in more layman’s terms.” Subject 8 • “Most of it [was new information] because the other one I seen on the computer was all big words I didn’t understand, this one is more simplistic.” Subject 13 |

Table 3.4 Supporting quotes for positive aspects of videos

Among areas for improvement, participants indicated that some terms may need to be defined to enhance clarity, as well as decreasing the speed of the narrative to ensure patient understanding. Some patients suggested changing the framing of the message to reflect a more patient-centered approach, believing that patients may not be as receptive to messaging that emphasizes system-level factors such as costs to the health care system. Few participants also mentioned adding a patient testimonial would enhance their trust in the videos, and questioned the credibility of the information presented, suggesting a need

for greater transparency regarding the sources and level of evidence (see table 3.5 for frequencies).

| Category | Sub-category | Frequency (count) |
|--|--|-------------------|
| Suggestions to enhance clarity/patient understanding | - Defining terms (3) | 11 |
| | - Increase patient centeredness (1) | |
| | - Add patient testimonial (2) | |
| | - Add information to enhance credibility (1) | |
| | - Decrease speed of narrative (4) | |
| Additional information requested | HTO/other surgical procedures | 10 |
| | Rehabilitation and recovery process at home | 14 |
| | +Other | 6 |

Table 3.5 Areas for improvement

Importantly, patients frequently requested additional information on two main topics: HTO/other surgical procedures, and rehabilitation and the recovery process at home (see table 3.6 for supporting quotes). Further, patients requested greater detail on other topics† including: specific strengthening exercises to trial, the odds of surgical risk factors, and the expected survivorship of the implant (see table 3.5).

| Sub-category | Key supporting quotes |
|--------------------------------|--|
| HTO/ other surgical procedures | <ul style="list-style-type: none"> • “Interviewer (I): So like you said in terms of the other procedure, osteotomy, you would have liked a little bit more information about that? Subject 4: Yes – like what it is? I don’t know if that’s even another option or if there are other options so.” • “Yes, explain what a scope would do and then explain the benefits and non-benefits because it’s saying they are finding it’s really not beneficial in most times, but why?” Subject 7 • “I think if you added some more detail to it, it’s a strange topic [realignment surgery] to a lot of people so they are going to flash through that quite quickly and they are going to go I don’t understand it... Yes, so people are |

| | |
|--|---|
| | <p>going to think maybe they could have that and they don't need it because they don't understand it." Subject 2</p> <ul style="list-style-type: none"> • "There seemed to be something in the middle there what was slightly hinted at but didn't go into detail [HTO]. Because in my own case I wonder if I need a total one because I do have quite a bit of mobility in the knee." Subject 3 |
| <p>Rehabilitation and recovery process at home</p> | <ul style="list-style-type: none"> • "I had a friend who just had this done and he was waiting for physio to come to the house, he didn't do any physio for a week so reinforcing that that is going to be a big part in your post-operative care... it doesn't really tell me what's going to happen." Subject 1 • "I think the physiotherapy because it's post-op it's free so that maybe would, I mean I know you can't put everything in these things but I mean it's part of the surgery, so people should be aware it's not going to cost them." Subject 2 • "I think maybe more of a timeline in terms of, I don't know, in terms of what's the timeline to get back to your normal?" Subject 4 • Subject 5: How long would it take to get better? I: Better in terms of pain or function? Subject 5: Yeah, to move, to walk again." • Subject 13: "Yeah, it didn't say how long it would take for you to walk again." I: "So more information on the recovery". Subject 13: "Yes." • "One of the things that I have as a dislike is that it doesn't tell you what to do or what's going to happen in the period following the period immediately after the surgery." Subject 14 |

Table 3.6 Supporting quotes for additional information requested

Thematic analyses

In the thematic analyses, four main themes were identified: 1) The challenge of decision making for elective surgery, 2) Education as supportive to patient decision making, 3) Education addressing knowledge gaps in patient understanding, and 4) Barriers to implementing recommendations. Within these themes, prominent categories were further explored (Table 3.7)

| Theme | Categories | Sub-categories |
|--|--|---|
| Challenge of decision making | Nature of decision Surgeon opinion as key Preference for didactic consultation | |
| Education as supportive to patient decision making | Education enhancing confidence for surgical consultation Education as influencing decision to undergo TKR | |
| Education addressing knowledge gaps in patient understanding | Video 1 Video 2 Video 3 Video 5 | |
| Barriers to implementing recommendations | Issues surrounding PT Challenge of implementation System-related factors | Cost, Fears Pain, Occupation Wait times |

Table 3.7 Overview of themes, categories, and sub-categories (where applicable)

1. Challenge of decision making for elective surgery

Nature of the decision

The decision surrounding any elective surgery is complex and multidimensional considering the patient's unique health status, preferences and values. While some indications for surgery, like radiographic evidence of disease, concomitant comorbidities, and implant survivorship require thoughtful consideration by the patient's surgeon, the decision to proceed with TKR is largely patient mediated. Surgery is typically indicated when pain and function reach an unacceptable threshold, and other non-operative avenues have been exhausted. In response to the education videos, some patients expressed their confusion with the nature of this decision and questioned whether they could determine whether their function and pain had deteriorated to a point where surgery should be considered:

“Yeah, it's just confusing, can you decide that you want to have a conservative treatment, you know, not have surgery or you know should you go ahead and have the surgery if you are having all these symptoms?” Subject 10

“Just the fact that one has to think about being a candidate for knee replacement, with the hip it was pretty obvious, but the knee seems to be a little more complicated.” Subject 3

Surgeon opinion as key factor

Some patients expressed their preference to proceed with conservative treatment based on the education provided and also discovered that their symptoms may not be severe enough to indicate surgical intervention. Despite this, many patients struggled to understand their influence or role in the decision-making process and felt that it is ultimately the surgeon's decision to decide if they are “ready” to undergo a TKR:

“Yes, the videos showed me lots...It's more what he [the surgeon] has to say” Subject 5

“Now I know you have options. I don't need to take it out yet...Doing more exercising, more exercises and more physio and stuff like that. But it's up to him, right? Because it's showing that if you have pain when you are walking or sleeping...I don't have that.” Subject 13

Preference for didactic consultation

In addition, some patients felt that the education provided encouraged a shift in responsibility from the specialist to the patient which was not always seen as desirable, highlighting patient's preference for a more didactic consultation where they are advised on the best course of action rather than left with a difficult decision or greater responsibility in their health care consultation:

“Yeah and it kind of made me feel that you are putting the responsibility up to what I want, to me, I'm here to ask you what I need.” Subject 1

These results highlight that patients may prefer certain aspects of a more didactic consultation when considering TKR and consider their surgeon's opinion as a key factor in the decision-making process.

2. Education as supportive to patient decision making

Education enhancing confidence for surgical consultation

Overall, several patients felt the education videos increased their confidence for their upcoming surgical consultation and were supportive in helping them decide whether they should proceed with TKR. Patients indicated that the videos would support their ability to better participate in or understand the discussion that they would soon be having with their surgeon:

“It's okay, these are making me more confident, I have lots to discuss with him.” Subject 7

“I think it increases my confidence, no question, I think it increases my confidence. I think that, and I think it just reinforces that it probably will need to be done if you've tried the conservative route and you are at the end from a conservative standpoint then that that might be the next, and overall the results are good.” Subject 1

Similarly, some patients suggested that the education provided was empowering and felt their newfound knowledge would enable a better patient-provider dialogue and a more collaborative consultation:

“I feel a little bit that I know what I’m talking about and not just listening to what he’s telling me.” Subject 11

Other patients cited that the education provided in the videos gave them new ideas for additional questions to ask their surgeon or clarified questions that they had previously planned to inquire about.

While most patients felt the videos enhanced their confidence, one patient expressed that the information on what to expect from surgery increased his fear regarding the potential risks associated with surgery, but reconciled this with the idea that this knowledge would enable him to ask more specific questions during his upcoming consultation:

“Yeah, because it highlighted the stuff I was already worried about...But at least too it gives you some information so when you go see the surgeon you can say these are my concerns.” Subject 12

Overall, patient’s accounts supported that the education videos may enhance the quality of the specialist consultation, empowering the patient to participate in the decision-making process with a greater understanding of the factors that mitigate this decision.

While some patients did not feel that the education videos enhanced their confidence, these patients tended to have a high baseline level of knowledge and a strong willingness to undergo surgery. These patients cited previous contact with other allied health care professionals such as sports orthopaedic specialists or PTs, previous experiences with surgery, and an understanding that they had exhausted all other options as factors that supported their confidence. Despite this, many of these patients still felt the information was useful as a way to “refresh” what they may have already learned about their condition and reinforced their expectation that they were a good candidate for surgery.

Education as influencing decision to undergo TKR

Throughout their interviews, most participants reflected on their appropriateness for surgery in relation to the education provided and indicated a preferred course of treatment. Patients cited that the education videos increased their knowledge and preference for conservative treatment options or reinforced that a TKR was the next logical step in their treatment pathway.

Some patients suggested that the education videos made them question their surgical candidacy and provided them with new options to manage their knee condition. For example, one patient reflected on the recommended conservative treatment pathway in Video 3, expressing gaps in her knowledge regarding available options and a clear preference to avoid surgery:

“Well, the very end when it goes one, two, three, four, I kind of feel I’m at number four but I didn’t do one and two [self-management, weight control, activity modification, exercise and physiotherapy] and I didn’t know about those so I’ve been taking number three which is medication and number four [referral to TKR] and now I feel like I need to think about trying to restart all over again because I don’t really want to have surgery.” Subject 7

Moreover, this participant stated that the education provided her with a greater locus of control over the management of her condition:

“The fact that there could be some exercise, that is what I’m really hopeful for because I don’t really want to have the surgery, it might be something down the road but I don’t want to take time out of my life to do it right now...I feel more positive that maybe I can be a part of getting it better.” Subject 7

In contrast, many patients felt that the videos reinforced previous education and management that they had already received from various allied health sources. These patients cited that the videos were helpful to confirm that their current symptoms, previous tests, and conservative treatment aligned with the education provided and reassured them that they may be a good candidate for TKR:

“It just verifies what I’ve been doing and sort of lets me know I’m at the end of my road.” Subject 1

Accounts of these patients highlighted the utility of checklists and a stepwise progression in OA management. These patients reflected on similarities between the education content and their management often citing the extensive non-operative management that they had trialed over the course of several years. Moreover, while much of the education was not “new” to these patients they felt that the education was consistent with their own experiences living with OA and would be useful for many patients earlier in the course of their disease:

“Again, it breaks it down, it’s simple and people need to know if you don’t hit all the check marks and I’ve hit every one of them again, then they have to know that they have to go, you know, the painkillers, the physio, the injections, and then I mean an HTO makes sense.” Subject 8

“Well again it walks through the steps for people so if you’ve been diagnosed with mild osteoarthritis, it’s a good educator to sort of give them the facts of what is going to happen down the road, the map, you know, as the diagnosis gets worse.” Subject 4

In some cases, patient’s willingness to undergo surgery was modified by the education provided, where patients with pre-existing fears and negative opinions about surgery found the education content reassuring and transformative:

“I came in here with kind of a biased... okay I don’t want you to cut into my knee, do I really need it, you know? We hear stories and like when we say a negative thing to a kid that’s what they remember, not the good things, well we remember the one incident where they cut off the wrong breast or they cut off the wrong knee and I’m thinking this is the knee, so we do have biases all of us do so it’s made me feel better even if I had to spend two hours, I feel better knowing that I’m well taken care of.” Subject 11

3. Education addressing knowledge gaps in patient understanding

The majority of participants in this study had some baseline knowledge surrounding their knee condition. Patients cited receiving education from allied health professionals such as their family doctor, sports orthopaedic surgeon, or PT. Further, patients had experiential knowledge from their occupation in a health-care related field, their own previous experience with surgery, or a friend, relative or spouse who had undergone TKR. Finally, media sources such as the internet (e.g., resources from the Arthritis Society), and newspaper articles contributed to patient’s baseline knowledge. Despite this, many patients indicated that there were opportunities for learning throughout all five videos. Patients in this study most frequently reported developing a greater understanding of the anatomy of the knee, risk factors for developing OA, the utility of x-ray for diagnosing knee OA, conservative treatment options, and what to expect from surgery.

Video 1 What is Knee OA:

Patients reported that Video one gave them a better understanding of the structure and function of the knee joint in the context of OA. Several patients indicated that they were

aware of some knee anatomy terminology from contact with health care providers, but that the information and visualization helped deepen their understanding of both the normal anatomy and changes that occur as a result of their condition. In addition, participants described increased clarity regarding their own risk factors for OA progression:

“Well I knew a little bit, my one doctor had said everybody grows old and we all get arthritis but I didn’t understand it all what he was saying because my mom doesn’t have it all, I see people with knees that have no problems, so this explains I’ve had activity my whole entire life, this explains why I am where I am.”
Subject 7

Video 2 Imaging:

The majority of participants indicated that this video provided them with new information or helped clarify the role of imaging in their disease management. Several patients reported a prior belief that MRI was the ‘gold standard’ for imaging and that the information presented helped clarify the role of imaging in knee OA:

“Well yeah, learning about the MRI isn’t necessarily best because I used to think it showed more, but that was good, that was a good point. So, it has points that we have misconceptions about.” Subject 11

Video 3 Conservative treatment:

While the majority of patients had trialed many of the recommended conservative treatment options, some patients indicated that the video gave them new ideas for management including medications, PT, weight loss, and activity modification.

“Yes, physio was all new to me, big time... Like I would have gone to a physiotherapist long ago if I knew that’s what I was supposed to be doing.” Subject 7

Video 5: What to expect from surgery:

Patients highlighted pre-operative considerations such as losing weight or quitting smoking, the risks of surgery, and post-operative satisfaction rates as novel information. Further, patients cited post-operative information such as medications, degree of post-operative mobility, and the possibility of same day discharge as new information. For

example, one patient who had previously undergone an HTO was surprised to learn about the possibility for early weight bearing and mobility after TKR:

“I think because my condition was different, straightening of the leg, I wasn’t aware that they go home quite as quickly as that and that they are up the first day.” Subject 2

4. Barriers to implementing recommendations

Access to physical therapy

Although the majority of patients were satisfied with the information provided, some barriers were identified which may limit patient’s ability to implement the recommendations. The barriers cited by patients included factors surrounding access to PT and misconceptions about PT itself. Specifically, a few patients highlighted the financial burden of PT and knee braces, suggesting that many patients who would benefit may be limited in their access given the out-of-pocket cost. Another patient suggested a fear of pain with PT, highlighting the need for better education regarding expectations for treatment.

Challenge of implementation

In addition, patients emphasized the challenge of losing weight, difficulty modifying work-related duties in occupations involving mostly manual labour, and pain as a barrier to remaining physically active:

“But the other thing you got to look at, I’m still working too so I’m trying to compensate with everything I got to work right, and sometimes when I work 12-hour days, I get home, I’m not getting out side getting for a walk because I can’t.” Subject 6

System-related factors

Finally, one patient suggested long wait times to access specialist care as a reason that patients may seek a referral when they are not currently optimized or interested in surgery:

“That’s the other reason why people want doctors to refer them when they are not completely ready for surgery to get them in the queue because by the time you wait until somebody is in severe pain it’s they’re in the queue for six months or a year or whatever it takes, again, our system needs adjusting.” Subject 2

3.5 Discussion

Overall, we found that our novel educational videos are a valuable tool to strengthen patient understanding of knee OA and decision-making surrounding the management of their condition. Through a qualitative investigation we were able to understand patient’s unique experiences and increased clarity in decision-making in relation to each video presented. Specifically, some patients discovered that they may not be ideal surgical candidates or were unwilling to undergo surgery and were informed regarding a number of non-surgical options that may be of value. Conversely, some patients found the videos to support that they were indeed a candidate for surgery, had exhausted all non-surgical options and that a TKR was the next logical step in their progression.

Further, we were able to address participants’ knowledge gaps and misconceptions regarding a variety of topics including advanced imaging, and what to expect from surgery which has important downstream implications for our health care system. Specifically, several participants indicated a newfound understanding that x-rays were the most appropriate way to visualize knee OA and that they previously believed MRI would be considered the gold standard. A recent systematic review outlining barriers to appropriate management of OA in primary care suggests that patient expectations appear to influence physicians’ treatment recommendations. Further, this study indicates that providers may oblige patient requests in an effort to maintain their trust.¹² In a health care system where patients are becoming active members in their health care consultation, our videos may support family physicians, as patients may be less likely to request

unnecessary imaging, improving the uptake of best practice and resource utilization in this population.

Participant's willingness to undergo surgery appeared to be affected on both ends of the spectrum. Some participants developed an understanding that they may not meet the criteria for TKR and that there were other less invasive options they should explore first, thus decreasing their preference for TKR at this time. Conversely, participants who were previously hesitant to undergo surgery, stated that the education addressed their concerns, thus increasing their willingness to proceed with TKR. These findings suggest that the provision of education earlier in patients' care pathway (before the referral to a specialist is made) may modify their decision to access a specialist. For example, patients who are not yet ready for TKR may delay consultation, freeing up a spot in the queue for someone who would benefit from consultation and subsequent surgery as soon as possible. Similarly, patients who would benefit from surgery who may be unwilling given a lack of education may opt to request access to a specialist earlier or agree to their family physicians' recommendations to access a specialist in light of this education. This has the potential to reduce the extent of disability in this population, while minimizing the societal costs associated with patients remaining in a poor health state. Stacey et al. (2016) research provides similar support for patient education during the total joint replacement (TJR) decision period. Patients who received a standard decision aid (PtDA), created specifically for hip and knee arthroplasty had more realistic expectations, felt more informed, and had a greater understanding of which risks and benefits mattered most to them compared with controls. However, surgery rates did not differ significantly between the PtDA group and controls, suggesting willingness to undergo surgery was not mediated by the provision of education.¹³

Of particular interest, while many participants had accessed PT to manage their knee OA, some patients were largely unaware that this was a good option or cited barriers to access. While the education provided may increase awareness of PT as a core treatment for knee OA, it does not address the issue of access, where patients may be limited in their adherence to these recommendations by financial constraints. This points to a larger system-level problem regarding access to PT. Regional joint assessment programs (RJAPs) where allied health professionals such as PTs screen referrals to TKR may

address the issue of awareness, as PTs can advocate for the benefits of their profession on an individual basis. However, this model may not address the root problem surrounding access, as patients may be advised they are not a candidate for TKR, recommended to trial PT, but not given a means to do so. Perhaps a more cost-effective use of resources would be education at the discretion of family physicians with the use of supportive educational materials and greater funding allocated towards OHIP covered PT programs geared towards patients with OA.

Results of our study also suggest that our series of educational videos may enhance patient's understanding and confidence surrounding their surgical consult, enabling them to better participate in shared-decision making. The majority of surgeon's time during initial consultation is utilized to explain information required to obtain informed consent, including options, benefits, risks and the surgical procedure. While this information is necessary, studies have shown that patients recall minimal information during medical consultations particularly if they are in pain, anxious, or older, which is common in TKR¹⁴⁻¹⁶. While the provision of educational materials prior to surgical consult cannot replace a formal discussion regarding informed consent, it may allow for patients to understand the decision-making process surrounding TKR to a greater degree. This may result in better engagement with their surgeon, better retention of the information discussed, and allow for patients to review information after their consultation to reinforce the education provided.

Van Kasteren et al. (2016) study examined communications between patients and their health care team in the delivery of TKR to identify opportunities where digital technology may enhance value along the pathway from referral to post-operative care. Results of their study suggest that consultations between patients and clinicians are "time poor, but information rich". They also identified that patients have a difficult time recalling information given by their surgeon during their initial consultation given the complexity of information. Their results recommend that digital technology can be used as a means to convey complex material in an attractive medium including text, video, audio, or imagery.¹⁶ Results of their study support the utility of our educational videos in enhancing the quality of care for patients undergoing TKR.

Finally, participants provided valuable feedback regarding the videos that will contribute to minor edits and enhance and direct future creation of content. Specifically, future content should consider the use of analogies that correspond with universally familiar concepts and the use of plain language. Further, this study provides support for whiteboard animation videos as an attractive medium for patient education and is one of few studies who have investigated this medium for patient education in a research setting. From a knowledge translation perspective this study provides initial support for more rigorous studies comparing the most effective way to disseminate patient education regarding elective surgery, whether through general print resources, established print decision aids, traditional video, whiteboard video, or likely some combination of these.

Moreover, patients indicated that they are interested in accessing additional content related to other surgical options such as HTO and the process of rehabilitation and recovery at home, indicating gaps in our current series of educational videos. Information regarding HTO may clarify the select few patients who would benefit from the procedure and could encourage an appropriate candidate to seek access to a surgeon who performs this operation instead of accessing an arthroplasty specialist. Further clarification regarding the role of arthroscopy and demarketing it's use for knee OA may help patients understand why this is no longer considered a viable option and should not be considered in their management. Finally, patients are interested in accessing more information regarding the rehabilitation and recovery process at home. The addition of another video detailing the recovery process at home may further mediate patients' willingness to undergo the procedure and improve outcomes of surgery.

3.5.1 Limitations

Our study has some limitations that should be considered. Our sample size was moderate but does align with other qualitative studies.¹⁰ From a quantitative perspective, this study lacks sufficient power to detect pre-post intervention changes in the DCS measure. Thus, our estimate of reductions in decisional conflict lacks precision and certainty. However, given that every patient who demonstrated decisional conflict pre-intervention demonstrated a reduction post-intervention, we believe that this finding is valid. Finally, the impact of our videos on clinical practice are unknown. Future studies should aim to measure the proposed effects (decreased resource utilization, costs, wait times, patient

satisfaction, decision to proceed with consult etc.) in a prospective trial where patients are randomized to our educational intervention before referral to a regional joint assessment program or arthroplasty specialist is initiated.

3.6 Conclusion

Patients were satisfied with the current series of educational whiteboard videos. Patients indicated that the videos were supportive to their confidence and decision making surrounding TKR. Our educational material may result in less decisional conflict among patients considering TKR. The educational videos addressed important knowledge gaps for patients, which may have important downstream implications for our health care system. Barriers were identified that may limit patient adherence to the recommendations made in the videos, including access to PT and the challenge of weight loss. These barriers are important to consider for future implementation to facilitate uptake of the recommendations. Patients also requested more information on HTO and the recovery process at home, highlighting areas for future creation of content.

3.7 References

1. Churchill L, Malian SJ, Chesworth BM, et al. The development and validation of a multivariable model to predict whether patients referred for total knee replacement are suitable surgical candidates at the time of initial consultation. *Can J Surg.* 2016;59(6).
2. Klett M-J, Frankovich R, Dervin GF, Stacey D. Impact of a surgical screening clinic for patients with knee osteoarthritis: a descriptive study. *Clin J Sport Med.* 2012;22(3):274-277.
3. McHugh GA, Campbell M, Luker KA. GP referral of patients with osteoarthritis for consideration of total joint replacement: a longitudinal study. *Br J Gen Pract.* 2011;61(589):e459-501.
4. Malian S. Predictors of appropriate referral to total knee arthroplasty: A validation study. (2015). Electronic Thesis and Dissertation Repository.2951.
<https://ir.lib.uwo.ca/etd/2951>
5. Hawker GA, Guan J, Croxford R, et al. A prospective population-based study of the predictors of undergoing total joint arthroplasty. *Arthritis Rheum.* 2006;54(10):3212-3220.
6. McHugh GA, Luker KA. Influences on individuals with osteoarthritis in deciding to undergo a hip or knee joint replacement: a qualitative study. *Disabil Rehabil.* 2009;31(15):1257-1266.
7. Hampton T. Media lab uses videos, comics, and more to deliver health messages. 2015;307(16).
8. Rawson KA, Gunstad J, Hughes J, et al. The METER: A brief, self-administered measure of health literacy. *J Gen Intern Med.* 2010;25(1):67-71.
9. O'connor AM. Validation of a Decisional Conflict Scale. *Med Decis Mak.* 1995;15(1):25-30.

10. Morrow SL. Quality and trustworthiness in qualitative research in counseling psychology. *J Couns Psychol.* 2005;52(2):250-260.
11. Braun V, Clarke V. Using Thematic Analysis in Psychology. *Qual Res Psychol.* 2006;3(2):77-101.
12. Egerton T, Diamond L, Buchbinder R, Bennell K, Slade SC. Barriers and enablers in primary care clinicians' management of osteoarthritis: protocol for a systematic review and qualitative evidence synthesis. *BMJ Open.* 2016;6(5):e011618.
13. Stacey D, Taljaard M, Dervin G, et al. Impact of patient decision aids on appropriate and timely access to hip or knee arthroplasty for osteoarthritis: A randomized controlled trial. *Osteoarthr Cartil.* 2016;24(1):99-107.
14. Levinson W, Chaumeton N. Communication between surgeons and patients in routine office visits. *Surgery.* 1999;125(2):127-134.
<http://www.ncbi.nlm.nih.gov/pubmed/10026744>. Accessed October 26, 2018.
15. Jansen J, van Weert J, van der Meulen N, van Dulmen S, Heeren T, Bensing J. Recall in older cancer patients: measuring memory for medical information. *Gerontologist.* 2008;48(2):149-157.
<http://www.ncbi.nlm.nih.gov/pubmed/18483427>. Accessed October 26, 2018.
16. Van Kasteren Y, Freyne J, Hussain MS. Total Knee Replacement and the Effect of Technology on Cocreation for Improved Outcomes and Delivery: Qualitative Multi-Stakeholder Study. *J Med Internet Res.* 2018;20(3):e95.

Chapter 4

4 A qualitative investigation of physicians' experience managing patients with knee OA and the utility of novel patient education materials for this population

4.1 Abstract

Background: Current literature suggests that primary care management of patients with knee OA and referrals to TKR are suboptimal. To help support physicians in their management of patients with knee OA we created whiteboard educational videos for patients. The purpose of this study was to pilot our educational videos with physicians to query the utility of the videos through the lens of providers. We also sought to refine the videos based on participant feedback and explore how the videos may best be incorporated into their practice. **Methods:** We conducted in-depth semi-structured interviews with physicians. Using a content and thematic analysis, two members of the research team coded data independently. **Results:** Ten participants were included. Participants indicated that the videos would support their management of patients with knee OA by: 1) supporting credibility and building trust with their patient, 2) reinforcing patient understanding, 3) enhancing their own management. Barriers to optimal management were identified including the challenge of patient adherence and access to conservative treatment options. The majority of participants requested access to the videos for use within their practice indicating a high level of satisfaction with the educational materials. Most participants indicated the preferred method of implementation would be online access where patients could view the videos at home as supplementary teaching. **Conclusion:** Future implementation of these resources with attention to barriers that may limit uptake is necessary and may optimize management of knee OA in primary care.

4.2 Introduction

Musculoskeletal (MSK) complaints are a common reason that patients seek medical care from their family physician, representing up to 20% of all visits in primary care practice.¹ Osteoarthritis (OA) represents a large proportion of these cases as its prevalence continues to increase alongside our aging population.

In Canada, primary care physicians assume the greatest role in managing patients with OA before joint replacement is considered as an effective end-stage treatment. According to several national and international clinical practice guidelines (CPGs), physicians should offer patients a core set of non-pharmacological and pharmacological interventions including but not limited to: self-management, activity modification, weight loss, exercise, physiotherapy (PT), non-steroidal anti-inflammatories, pain medications (tramadol and acetaminophen), and intraarticular joint injections (corticosteroid or hyaluronic acid).²⁻⁵ Primary care physicians must also act as gatekeepers to advanced imaging and specialist care, including referral to total knee replacement (TKR).

Despite several published evidence-based clinical practice guidelines outlining optimal management of knee OA²⁻⁵, non-operative management is often considered suboptimal.⁶ Suboptimal management includes poor uptake of evidence-based conservative management strategies⁶, a lack of clarity in the role of diagnostic imaging^{7,8}, and referrals to TKR that are non-operative.⁹⁻¹² These inefficiencies result from an interplay of factors involving primary care physicians, patients, and the systems in which they function.

There is significant variation in the frequency of recommendations and treatments offered in primary care for patients with OA, with several studies highlighting the underutilization of core pharmacological and non-pharmacological treatments.^{9,13,14}

It is also well established that weight-bearing radiographs are the most accurate method to detect and measure the ongoing progression of OA¹⁵, and that MRI offers minimal clinical utility in decision making surrounding the management of knee OA.¹⁶ Despite this, a recent Canadian study demonstrated that many primary care physicians are unaware of the superiority of weightbearing radiographs compared to non-weight bearing radiographs in terms of assessment accuracy. Additionally, physicians indicated higher

than expected ratings of the value and utility of MRI in their management of patients with OA.⁷

Current literature suggests that approximately half of all candidates referred by their family physician to orthopaedic specialists for TKR are non-operative at the time of initial consultation.⁹⁻¹¹ Furthermore, an Ontario study demonstrated that significant variation exists among physicians' indications for referral to TKR, and that there is a discrepancy between reasons indicated by physicians for referring a patient to TKR and orthopaedic surgeon's indications for performing the surgery.¹⁷

The reasons for this dissonance are likely multifactorial but may include issues surrounding the quality and clinical utility of current CPGs^{18,19}, lack of MSK training in family medicine residency²⁰, a lack of transparency/agreement surrounding indications for TKR^{17,21,22}, and a lack of shared decision making where patients preferences and values are considered. Further, uptake of optimal management may be influenced by patients as they may be unwilling to participate in certain conservative treatment options or may be persistent in requests for unnecessary care such as advanced imaging or specialist referral. Moreover, system-level barriers also exist including time constraints during the consultation, which may limit physicians' ability to deliver appropriate education, or varying levels of access to multidisciplinary teams who facilitate the optimization of care for patients with OA. In addition, long wait times for TKR in Ontario may encourage physicians to refer patients early to gain access to an orthopaedic surgeon if they anticipate that their patient will opt for surgery within a few years.

Regional joint assessment programs (RJAPs) were recently mandated in Ontario within the South West Local Health Integration Network (LHIN) and have already been adopted at various centers across Canada. In this model, health care professionals (HCPs) such as physiotherapists (PTs) and nurse practitioners screen referrals from primary care physicians to joint replacement specialists to ensure timely assessment. These RJAPs function to ensure appropriate candidates receive further consultation with a specialist and that non-operative patients are provided with education and directed to conservative care. This model ultimately shifts responsibility from the referring physician to other HCPs to help optimize referrals to arthroplasty. While the literature demonstrates the

efficacy of HCPs such as PTs in these roles^{23,24}, the addition of an intermediary gatekeeper to specialist care may not be sustainable from an economic standpoint. Given their considerable MSK expertise, PTs may indeed be the appropriate non-physician HCP to help optimize primary care management of OA. However, RJAPs do not provide ongoing support for patients after initial contact, and often end up directing patients to supervised PT, similar to the model of referral or recommendation for PT in primary care. A quarterly report reviewing a RJAP in LHIN-4 indicated that only 37% of patients referred by their primary care physician to the RJAP were deemed surgical candidates upon initial consultation (unpublished data, July–September 2011).²⁵ Supporting primary care physicians' in their ability to streamline education and direct treatment for their patients with knee OA may offer a cost-effective alternative to RJAPs.

Another consideration is that the responsibility of patient health has shifted from a traditional paternalistic paradigm, which relies on clinicians to prescribe appropriate interventions, to one where patients seek education and play a more active role in directing their care. This shift encourages engaging the patient in the appropriate management of their condition. Recognizing the role of patients is crucial, especially in regard to elective surgery like TKR, where the patient's perception of their pain, function, and preference for treatments and/or surgery is paramount in the decision-making process.

In an effort to support family physicians and their patients in responsible use of health care resources and guide decision making regarding non-operative and operative management, we created a series of whiteboard educational videos for patients with knee OA intended to be used in a primary care setting before referral to a joint replacement specialist. We created five education whiteboard videos for patients diagnosed with knee OA including: 1) What is knee OA (describing the disease and its progression), 2) Appropriate imaging required to diagnose the radiographic severity of knee OA (to discourage patients from requesting advanced imaging such as MRI and CT), 3) Conservative treatments for knee OA, 4) Indications for TKR and other surgical procedures (to help patients understand when a referral to TKR is warranted), and 5) Surgery expectations (intended toward demystifying the procedure, its rehabilitation, and expectations for recovery).

We previously piloted our educational materials with patients referred to TKR and demonstrated preliminary evidence for their utility with this population. The objective of this study was to pilot our educational materials with family physicians to explore the potential utility of our videos through the lens of providers and gain insight into how they may be best incorporated into their practice. We also sought to gain feedback to help refine the videos, thus ensuring relevant stakeholders (patients and physicians) have vetted the videos before further widespread implementation.

4.3 Methods

4.3.1 Study design

This study was a qualitative interview-based study conducted with newly practicing family physicians and family medical residents, whose practice was primarily in London, Ontario, Canada. We conducted qualitative interviews to explore physicians' current practice, confidence, and training surrounding the management of knee OA. Next, physicians watched five whiteboard education videos for patients regarding knee OA. We conducted a series of brief, semi-structured interviews with participants after watching each video to explore the utility of these education videos and to gain feedback on refining the final deliverable. An iterative qualitative thematic content analysis approach was used combining both inductive and research question driven coding, category formation, and theme identification²⁷. This study was approved by the Health Sciences Research Ethics Board at Western University (Appendix E).

4.3.2 Sampling and recruitment

A Doctoral student (LC) contacted a convenience sample of physicians via email, introducing the study and gauging further interest in participation. Among those interested, written consent was obtained prior to study participation. Participants were included if they were recent graduates of a family medical residency program in Canada or were currently completing family medical residency in Canada (either post-graduate year 1, 2 or 3), they could participate in an interview in English, and agreed to be audio recorded.

4.3.3 Data collection

We conducted semi-structured, in-depth interviews with physicians before and after they watched a series of educational videos. We used an interview guide consisting of open-ended questions and prompts meant to elicit rich information regarding physicians' current management of knee OA, and their thoughts and impressions regarding each video (Appendix D). Questions addressed their current experience referring patients to TKR, confidence in diagnosing and managing patients with knee OA, current practice in managing patients with OA (education/treatment offered), and questions surrounding their decision making when referring to TKR.

After each video, we queried participants' overall impression of the video (likes and dislikes), similarities and differences regarding the recommendations made in the video and their current practice, their opinion regarding the value of the videos to patients and providers, and ideas for implementing the videos into their practice. Interviews were conducted by three graduate students (RP, ML, and KL), in a private, quiet room. To optimize trustworthiness, the graduate students (RP, ML, and KL) disclosed to participants that they held no stake in the creation of the educational videos before proceeding with the interview. To optimize accuracy of data collection and trustworthiness, interviews were audio recorded and transcribed verbatim by a professional transcriptionist. Transcripts were also reviewed against the audio recordings by the primary researcher (LC) to confirm accuracy. Interviews were analyzed immediately after transcription to allow for an iterative process in revising the interview guide. As per a post-positivist design, we stopped recruitment when data saturation was reached²⁶, which we anticipated would occur after 10-15 interviews. We stopped data collection after 10 interviews, when no new categories emerged in two consecutive interviews. We replaced patient names with pseudonyms (i.e. Subject 1,2,3) prior to data storage to maintain participant confidentiality.

4.3.4 Data analysis

Two graduate students (LC and ML) independently analyzed the data using hard copy transcripts and Quirkos Software (version 1.4.2), utilizing an approach consistent with Braun and Clarke (2004) guide to thematic analyses.²⁷ The primary investigator (LC) read

and re-read hardcopy transcripts to gain familiarity with the dataset. After this process was complete, hardcopy transcripts were reviewed, and relevant sections of text were identified and labelled to generate an initial coding framework. To ensure inter-coder reliability, one study team member (ML) independently completed the same process for the first four interviews, resolving any discrepancies of interpretation by consensus. The primary investigator (LC) then completed the same process for the remaining interviews. Next, using Quirkos software, the primary investigator (LC) inputted the data and grouped codes and their accompanying data extracts into categories. Next, we determined which categories were addressing participant feedback, amenable to presenting as frequencies in a content analyses, and which categories explored deeper narratives relating to participants' experience with the videos, better suited to exploring in a thematic analysis. For the content analysis, we counted the frequency of both positive and negative aspects (likes and dislikes) mentioned in participant interviews and presented this data as a frequency with supporting quotes in separate tables. For the thematic analyses, the data were grouped based on key related categories to establish core overarching themes. Finally, themes were reviewed and refined to ensure coded data extracts within each theme reflected a 'coherent pattern', and the entire dataset was re-read to ensure themes reflected the larger dataset as whole. In addition to the multi-level coding approach and peer debriefing, the process incorporated other key aspects to optimize trustworthiness and minimize the potential for biased reporting including the use of frequency tallies, and an audit trail of the research and analysis process.²⁶

4.4 Results

From August 28- September 24, 2018, ten participants were interviewed. Interviews ranged in length between 30 and 50 minutes to ensure adequate depth of familiarity. Participant characteristics are presented in table 4.1. Participant feedback is organized into four separate sections: 1) descriptive content analyses detailing participant feedback regarding the videos, 2) description of participants' current practice surrounding knee OA management, 3) thematic analyses exploring physicians' opinions and experiences related to the videos, and 4) description of participants' preferences for implementation.

| Characteristic | Participants (n=10) |
|---|------------------------|
| Female n, (%) | 5, (50) |
| Institution of medical school training n, (%) | |
| Western University | 9, (90) |
| University of Calgary | 1, (10) |
| Institution of residency training n, (%) | |
| Western University | 6, (60) |
| University of Toronto | 1, (10) |
| Northern Ontario School of Medicine | 2, (20) |
| Current professional status n, (%) | |
| Independent practice in family medicine (New graduate as of July 2018) | 6, (60) |
| Post-graduate year two (PGY2) | 3, (30) |
| Post-graduate year three (PGY3)- enhanced skills chronic care | 1, (10) |

Table 4.1 Participant demographic characteristics

1) Descriptive content analysis

In the content analysis, participant feedback was grouped based on whether the participant indicated a positive feature of the videos or highlighted an area that could be improved.

Positive aspects

Physicians indicated their satisfaction with the use of simple terms, analogies, whiteboard animation, and particular topics discussed. Among positive aspects related to video content, physicians most frequently cited that they thought information on patient self-management strategies, unnecessary imaging or procedures, and what to expect from surgery was particularly important to convey to patients. Physicians also highlighted the stepwise approach to treatment, indications for referral, and the concept that pain during exercise is typically acceptable, as positive messages (see table 4.2 for frequencies and table 4.3 for a selection of supporting quotes).

| Category | Sub-category | Frequency (count) |
|------------------|-------------------|-------------------|
| Positive aspects | | |
| | Messaging/content | 34 |
| | Simple terms | 9 |
| | Use of analogies | 7 |
| | Use of whiteboard | 7 |

Table 4.2 Positive aspects of the videos

| Sub-category | Key Supporting quotes |
|-------------------|--|
| Messaging/Content | <p>“I liked that it talked about a lot of lifestyle modifications that people can do on their own, weight loss, modifying their activities, things like that, I thought that those were really good tips that anybody can do to sort of mitigate their symptoms a little bit and help them preserve their knees longer.” Subject 24</p> <p>“Yeah, I thought it was a really good outline of things you can do and not everyone needs the surgery right away as soon as you have arthritis and there are other things that you can talk about and I thought yeah, it was really clear and very useful.” Subject 17</p> <p>“I thought that was a good overview for patients to have an idea what to expect which is something that I find can often, like across specialties patients don’t necessarily have a good idea of what to expect following surgery so I think that does a great job of laying out what to expect.” Subject 16</p> <p>“I think for patients it would be very helpful... it would kind of allay some of the fear of surgery day, specifically what to expect and you know the month before and then during surgery.” Subject 18</p> <p>“So first I liked this whole MRI or not MRI debate, it’s a very common request, patients come in ‘my knee hurts, I should have an MRI’ although x-rays are far less expensive and actually more useful when coming to a diagnosis of osteoarthritis, so I thought that was really good.” Subject 19</p> |
| Simple terms | <p>“I think it was really well, I know it’s hard to say because we know the terms but I think patients would be able to understand it so I think all the fancy medical terminology was explained in layman’s level.” Subject 17</p> |

| | |
|-------------------|--|
| | <p>“Yeah everything is good, super clear, easy to understand, the language is good. I use the same language, I don’t think I would change anything about that.” Subject 20</p> <p>“I thought that it was a good level of medical jargon versus normal talk, I think it was very understandable for most people so I thought that was good.” Subject 24</p> |
| Use of analogies | <p>Yeah, I thought it was very good, I thought the analogy with the car, I think that’s excellent for patients to understand and put it in terms that they would know.” Subject 15</p> <p>“I thought it was very well done, the car analogy was really good, I really liked the car analogy, I’m jealous I didn’t think of it to be honest because it is helpful to have something that a lot of people have access to on a day to day life and to compare to right.” Subject 19</p> <p>“I think it was a good video, I liked the car analogy talking about lifestyle modifications, weight loss, exercise, it’s a really good informative video for patients.” Subject 21</p> <p>“I think the car analogy helped... For people that don’t understand it I was actually like oh that is a good way, I’m actually going to say that to my patients.” Subject 22</p> |
| Use of whiteboard | <p>“Yeah, yeah, it drew your eyes and you were watching the words and the illustrations as it went on.” Subject 15</p> <p>“Yeah, I thought those kinds of marker white board videos are pretty effective.” Subject 16</p> <p>“I liked that they like in terms of, the things that were said they also write them across the screen a lot to make it very easy to follow...” Subject 24</p> |

Table 4.3 Key supporting quotes for positive aspects of videos

Areas for improvement

Among areas for improvement, physicians gave suggestions regarding additional content, framing of the message, or questioned the utility of certain information. Specifically, it was highlighted that patients may not be as receptive to system-level factors such as resource utilization and that messaging that was more patient-centered may be more impactful. Importantly, one physician suggested an additional statement be made regarding medications, informing patients to discuss these options with a physician, to

ensure patient safety. Finally, one physician recommended that more emphasis should be made regarding diet for initial weight loss and exercise and that additional statements could be made about the utility of these measures.

A very small number of participants also commented on decreasing the length of the videos or condensing the amount of information presented in each video. Participants made suggestions regarding certain terminology in the videos. Specifically, that they felt a few terms may be too advanced for patients, and to indicate other brand names for NSAIDS as many patients are unaware of which brand names fall under the generic name. Finally, participants requested additional information be included in the videos including: alternative treatments such as stem cell injections, glucosamine, topical agents, and stronger pain killers, information on post-op rehabilitation, and the impact of comorbidities on surgical candidacy (See table 4.4 and 4.5 for frequencies and a selection of supporting quotes).

| Category | Sub-category | Frequency (count) |
|----------------------------------|----------------------------|-------------------|
| Areas for improvement | Messaging/Content | 8 |
| | Length of videos | 3 |
| | Terminology | 4 |
| Additional information requested | Alternative treatments | 7 |
| | Post-op rehab | 4 |
| | Influence of comorbidities | 1 |

Table 4.4 Areas for improvement

| Sub-category | Key Supporting quotes |
|-------------------|--|
| Messaging/Content | <p data-bbox="540 233 1349 369">“I didn’t like the focus on like the money for the health care system, I thought it was very like, and that is something that I don’t feel that a lot of patients necessarily respond to.” Subject 16</p> <p data-bbox="540 411 1373 611">“From the health care resource perspective, I think it is important, I feel like a lot of patients probably don’t relate to that as much. Again, for providers though I think there is an interesting provider perspective seeing that because it’s the providers ultimately are the gate keepers to health care resources.” Subject 23</p> <p data-bbox="540 653 1373 852">“I know they talked about the medications like Tylenol and Advil and whatnot but just like saying, putting something in there like ‘talk to your doctor’ because obviously some people can’t take Tylenol or Advil with NSAIDS because I don’t want them to go home and say ‘ I’ll take Advil’ and having a bleeding ulcer or something.” Subject 22</p> |
| Length of videos | <p data-bbox="540 869 1373 1068">“I don’t know, I don’t know if it was a little long, like it kind of, at one point maybe we get it, but maybe you need to kind of drill it into the patient’s head, for me it’s like I’ve already bought into this whole thing so maybe like having more than one way to explain it to a patient that might actually be useful, yeah.” Subject 17</p> <p data-bbox="540 1110 1365 1205">“I mean it was a bit condensed maybe so a lot of information all at once, but that would be the only thing I’d have to say, otherwise I think it was pretty solid yeah.” Subject 20</p> |
| Terminology | <p data-bbox="540 1220 1373 1388">“Yes, and at one point they mentioned smooth articular cartilage and I don’t know if you need to use the articular, just for I’m just trying to think of the actual patient base that would be seeing this, just like saying smooth cartilage or joint cartilage.” Subject 20</p> <p data-bbox="540 1430 1382 1705">“In terms of NSAIDS, people are like oh I don’t take any NSAIDS when you just ask them and they are like oh do you take Ibuprofen? No, I take Motrin and they don’t realize that that’s pretty much the same thing or they’re like no I take Aleve or Naproxen, those are all NSAIDS so if you... it might be helpful to put a couple of other ones, you know what I mean, so they can see, oh those are NSAIDS and I’m taking them as well.” Subject 19</p> |

Table 4.5 Key supporting quotes for areas for improvement

1) Description of participant's current practice

Diagnosis

Physicians in this study all indicated a moderate to high level of confidence in making a diagnosis of OA. All participants discussed the importance of a subjective history, physical exam, and radiography in their diagnosis. Some participants discussed looking for specific features to aid in their differential diagnosis between inflammatory arthritis or OA, as well as other red flags to rule out before a conclusive diagnosis could be made.

Imaging

All participants indicated radiographs were the only form of imaging they would order if they suspected OA, with the majority emphasizing the lack of utility for any other form of imaging (i.e. MRI). The majority of participants indicated that they would order a weightbearing film including anteroposterior, lateral, and skyline views, however some participants were less clear on which views or films they would order. Participants utilized imaging to differing degrees in their diagnosis with some participants indicating that they would typically read the radiologists report (indicating mild, moderate, or severe OA), while others detailed specific features they would look for on radiographs including joint space narrowing, sclerosis, osteophytes, and subchondral cysts.

Recommendations for conservative management

Participants indicated making a variety of recommendations for patients diagnosed with knee OA and offering these treatments in a stepwise progression. The majority of physicians indicated that they recommend patients trial some combination of lifestyle modification, PT, exercise, weight reduction and pharmacotherapy (including NSAIDs, acetaminophen and intraarticular joint injections). Few participants indicated bracing, topical joint creams (including Voltaren and capsaicin), and aquatic therapy as a potential option. Only one participant indicated providing specific nutrition counseling and exercise programming for weight loss. Overall, the majority of participants stated they have not referred to OA CPGs to inform their practice but instead have relied on teachings from medical school, residency, and clinical experience. The majority of

participants also indicated that they typically make their recommendations verbally and do not routinely use any standardized education aids with patients.

Experience with intraarticular joint injections

All participants had performed at least one or more joint injections for patients with knee OA. The majority of participants indicated a high level of confidence and comfort with administering these injections, citing experiences during family medicine residency as supportive to building this part of their practice. Specifically, participants described having a preceptor who performed injections as part of their family medical practice, and experiences during orthopaedic, rheumatology, and sports medicine electives as helpful in building this skill. Three participants (two residents and one family physician who had not yet started independent practice) indicated some reservation about performing injections given a relative lack of experience. These participants all expressed interest in incorporating injections into their future practice, stating that additional supervised experience would facilitate their confidence and abilities in this skill.

Referral to TKR

In describing their experience with referring to TKR, participants mentioned long wait times, frequent re-directions regarding imaging and a lack of transparency regarding the designated specialties of orthopaedic surgeons to whom they refer.

Participants described their criteria for referral as a combination of factors or described a common ‘clinical picture’ that would prompt them to refer to TKR. The most commonly indicated criteria for referral were severe symptoms or severe impact on function and quality of life, despite having exhausted conservative treatment. Few participants commented on patient’s willingness to undergo surgery as a key consideration for referral. Overall participants’ view on the impact of imaging was less clear and consistent, with some participants citing severe arthritis on x-ray as necessary for referral:

“I’ve only ever referred the people that have tried all the conservative managements [and] have a clear indication on the x-ray.” Subject 20

Conversely, other participants highlighted that function and symptoms were more influential in their decision-making process:

“Yeah, exactly, I tend to put more weight behind their symptoms and the impact on the quality of life versus how bad the x-ray looks.” Subject 19

“Even though I get the x-ray it doesn’t always change my management. If somebody has pretty convincing story and symptoms, then I would probably still send a referral to an orthopaedic surgeon even if the x-ray isn’t as convincing.” Subject 16

When considering the age of the patient, the majority of participants indicated that this was an area where clinical gestalt was very important in the decision to refer. In younger patients, physicians described considering the patient’s activity level, occupation, and the potential lifespan of the replacement. Most participants felt that referring a relatively young patient (early 40s and 50s) was justified if they were severely debilitated by their OA. In contrast, some participants described taking a more active role in management of this population, believing that a referral would likely not result in surgery:

“If someone is a bit younger, I don’t specifically expect to see OA on imaging like say forties unless they are severely overweight and I do have some of those in my practice too. For those guys it becomes a little bit more of a difficult situation because surgeons aren’t going to want to replace a knee for someone that young given that they are going to probably have to go in and replace the knee again which increases the risk of infection. In those guys you have to really talk about kind of conservative management, being really aggressive with physiotherapy, weight loss” Subject 21

In older patients, participants tended to weight function heavily, also considering the risks of surgery, and comorbidities that may preclude them from surgery:

“I think it is a little bit of a murky situation because it depends on the patient and like their other co-morbidities right so if they are really elderly and have a million co-morbidities, I probably wouldn’t suggest for them to get a knee replacement although you know definitely older people with no comorbidities can have it, but I’d probably push more towards lifestyle things.” Subject 22

Overall, participants indicated that considering age was an area that presented a challenge in their decision to refer and where they may defer to the surgeon in cases that were not clear:

“I think the main place where I say ‘do I refer or don’t I’ is age. Like you know, either very young or older.” Subject 18

Confidence in referring to TKR

In reflecting on their confidence in referring patients for consideration of TKR, half of participants indicated high confidence in knowing the appropriate timing and indications for referral, whereas the remaining half of participants described their confidence to be on the lower end of the spectrum:

“I don’t know that I’m probably super comfortable to be like ‘oh yeah you definitely need a replacement’. I think you kind of know they’re on that path and then that’s where you kind of... and it’s also patient preference too, if they’re like ‘I can’t function like this’ or ‘no I don’t want a referral yet’, so I think a lot of that goes into but I think that’s why we refer and that’s why maybe they wait a year because the orthopaedic surgeon says you’re not ready yet, so yeah, I would say that is something I’m not super comfortable with knowing.” Participant 17

A patient’s age or other comorbidities were felt to make this decision more difficult, with one participant describing a need for greater clarity regarding the indications for surgery and greater transparency regarding what factors mitigate this decision from orthopaedic surgeons:

“It would be helpful to like hear from the surgeons themselves like what they’re threshold for when they think a replacement is good, like I know for example for young people in general we try and avoid replacements for a while because they wear and you would need them again etcetera... so I know in that aspect like maybe avoid it there for as long as you can but like beyond that I’m not really sure.” Subject 24

2) Thematic Analysis

In the thematic analyses, two main themes were identified: 1) education as supportive to physician management, and 2) perceived barriers to implementing recommendations. Within these themes, key categories were explored further.

Theme 1) Education as supportive to physician management

Overall, the majority of participants felt the recommendations made in the first four videos generally aligned with their current approach to education and management of patients with knee OA. The last video detailing ‘What to expect from surgery’ was seen as less relevant to their practice, as all participants indicated that they typically did not discuss the surgery with patients and that this information would be provided by orthopaedic surgeons. Participants described the value of the videos as falling into three main subcategories: supporting credibility and building trust with their patient, reinforcing patient understanding, and enhancing their own strategies for management.

Supporting credibility and building trust

Physicians consistently indicated that the education provided may enhance or reinforce their patient’s perception of their credibility. Interestingly, physicians often cited that they felt that patients may lack confidence in their recommendations and that the education videos would help build mutual understanding and trust between patients and providers:

“I feel like they kind of believe us... but if they heard this they would be like ‘okay, it’s true’, do you know what I mean? Because I feel like they are kind of like skeptical when we say ‘no you actually don’t need that’, they think we’re just not...Interviewer: Not listening? Subject 22: Not listening or not following the right protocol or whatever.”

Participants indicated that they often lacked time during their clinical encounters to present information in a similar level of detail as the videos. Given the videos’ more comprehensive explanation, physicians commented that they would support patient’s acceptance or trust in their recommendations. Further, they indicated that delivering educational content endorsed by arthroplasty specialists would enhance patient “buy-in” to various aspects of their management:

“I think it kind of reiterates that yes the family docs are doing the right thing because we are at the first line people typically seeing these patients so it’s telling patients that family doctors are doing what the orthos want and x-rays are appropriate to do and we don’t need to do all these other tests.” Subject 15

“So I think the strength of it would be to be able to get patient buy-in like ‘this is what I know is the right thing to do as the family doctor’ and then say ‘look, this is what the surgeon thinks you’re supposed to do, like there’s no point in us sending this referral at this point in time, like you haven’t exhausted your conservative treatment options or...you haven’t even done an x-ray yet’, so I think it’s good to emphasize these things to get everyone on the same page.”
Subject 16

Reinforcing patient understanding

Physicians commonly indicated that the education videos would be useful in reinforcing the education or management that they would be offering to patients. Specifically, physicians indicated that the videos may clarify the rationale behind treatments offered. Physicians indicated that they sometimes fail to communicate the “why” or bigger picture behind their management to patients and that the videos would be useful for filling these gaps:

“It was very good to like outline the things we are thinking about when we are referring so that the patients know...maybe the symptoms, family doctors aren’t the best at communicating that so yeah having some resource to say these are the reasons why you should have surgery and these are the reasons why I think you shouldn’t.” Subject 17

Physicians also highlighted patients’ ability to review education via the videos as supportive to their management, as patients may have poor recall of important information discussed during their brief clinical encounter:

“This is more towards therapy and so once we get down the road, you have arthritis, this is how we are going to treat it, this is why we are going to treat it, if you have any questions, refer to this video...and then they can re-watch it and kind of understand why we are doing the things we are doing.” Subject 21

Similarly, one physician indicated that patients are often overwhelmed with an initial diagnosis of OA, and that the videos may facilitate their preference to review educational content at a pace that feels right for them:

“Yeah, I think whenever we are seeing someone and we think they have OA I think the videos will be useful for them because it goes over, you know, like self-management, imaging treatment, I think that is all useful information. There are some doctors that try and give that information, but it is a lot to absorb in the first visit and some people are really upset when they find out they have OA as a

diagnosis and so being able to watch those even on your own time I think would be helpful.” Subject 18

Enhancing providers’ strategies for management

Importantly, several physicians indicated that although the videos are intended for patients, the education provided is also important for family physicians and may enhance their current practice. Some participants acknowledged that reviewing this series of videos re-emphasized key information that they received during their medical education or provided a ‘script’ that they could use when delivering education to their patients in-person. One participant (PGY2 resident) stated that he felt these videos would have been beneficial to review before his orthopaedic rotation during residency. Other participants cited that the videos offered better explanations and diagrams than what they were currently using to educate their patients. Finally several participants indicated that the videos provided additional thoughts or ideas for management regarding risk factors for OA, activity modification, physiotherapy, specific imaging, indications for referral to TKR, and information on HTO:

“I liked again that they are very specific on the criteria on who would be a good surgical candidate, I think that was really helpful in terms of strengthening my referrals and sort of educating the patient...I liked that they even clarified what kind of x-rays they expect from us and things like that so I can be sure going forward that I’m sending them what they want to help with the delay in getting the referral sent and accepted and all that kind of stuff. I thought that was really helpful.” Subject 24

“I don’t and I probably should, I don’t refer to PT as much as I maybe should for symptomatic treatment of knee arthritis, I refer all the time for people that have an acute injury or acute low back pain, I’m always like well it’s been four weeks, let’s get you some physio or strength training and range of motion and stuff like that, but I don’t for knee OA and I’m not really sure why to be honest.” Subject 19

Theme 2) Perceived barriers to implementing recommendations

In describing the utility of the videos, some participants also discussed barriers that may limit the uptake of the education presented. Specifically, participants highlighted patient- and system-level factors that pose a challenge.

Patient-level factors

Challenge of weight loss and exercise

Among patient-level factors, several physicians commented that implementing lifestyle modifications including weight loss and exercise was challenging for patients. Many physicians held a strong belief that patients do not actually comply with these recommendations, citing that patients typically prefer more passive treatments that require less behavioural change such as medications and injections. Physicians also acknowledged the difficulty of exercise in OA patients who are overweight and have significant knee pain:

“Yeah, I think the biggest challenge is people are like ‘oh well I’ve already had, my knee is already messed up, like I can’t exercise’ right?...and even when we try and explain to them there are things you can do that don’t damage your knee, they are kind of hesitant to do it or they’re like ‘if I swim I’m not going to be able to walk for three days’ because their knee is going to hurt too badly.” Subject 22

Some physicians described trying to emphasize the efficacy of exercise with their patients, despite the challenge of patient adherence to these recommendations:

“[Exercise] is like better than anything we can give other than a replacement and it’s free and it has no harm at all so I really try and nail that down but it’s hard though when people are one overweight and they have arthritis, the last thing they want to do is exercise but I really try and nail down that lifestyle modification bit.” Subject 19

While others felt that they did not have the time or expertise to have a meaningful impact on patients’ behaviours regarding exercise:

“They understand that they should be doing these things but it’s hard for them to adhere to it even knowing it’s the best thing for you and so that, there is only so much I can do in terms of convincing there, I can’t, like that requires a lot more motivational coaching and kind of supplementary teaching.” Subject 20

Disparity between perceived needs and best clinical practice

Most participants described that patients’ beliefs about what they need were often discrepant with best clinical practice. Physicians suggested that patients may request advanced imaging such as MRI for their knee or request a consult with a specialist when

these are not indicated. This poses a challenge for clinicians who have limited time during their clinical encounters to provide appropriate education:

“I think it was like very important to touch on because I do find that a lot of patients want that MRI and it is hard to always explain especially when you only have a 15 minute appointment it is easier to fill out the form then explain why you don’t want them to have that so having this video, I’d like say watch this and talk to me if you still want the MRI kind of thing would be really useful.” Subject 17

“So I think there are two main groups, one I think who have followed through with their conservative therapy and is no longer seeing benefit, I refer them, the other group are the patients who are kind of either are unwilling to complete conservative management or they are just so adamant about being referred then I will refer even if I don’t think it is indicated yet.” Subject 18

Further, several physicians explained that patients often have anecdotal stories regarding family and friends who have had advanced imaging, knee arthroscopy or a specialist referral which may make a patient more persistent in their requests.

Fears of surgery

Finally, few participants highlighted that patients’ fears surrounding surgery and the recovery process can pose a barrier, as they may meet criteria for referral, but they do not wish to proceed with surgery. Participants highlighted patients’ previous negative experience with surgery or lack of clear expectations as a driver of this belief.

System-level factors

Long wait times to access specialist

Several physicians commented on long wait times to access orthopaedic surgeons and patient’s awareness of this issue as a barrier to appropriate patient referrals:

“We hear this all the time, ‘I just want to be put on the list, I just want to get put on the list’ so people wanting to get referred before it is actually appropriate because they are aware of the fact that they might wait eight months to see somebody and then another eight months before they have surgery so people are always thinking, well what if I get worse over the next year and a half I want to have already have seen somebody.” Subject 18

In response to this issue some physicians indicated that they may be more likely to send an early referral even when they think surgery is not yet indicated. Conversely, some

physicians highlighted that although they were aware of this issue, they still felt it was their responsibility to manage these patients until they were an appropriate surgical candidate.

Financial constraints/access to PT

Lastly, physicians highlighted the cost of some of the recommended interventions as a barrier to patient access. Specifically, patients may not have coverage or the financial latitude to afford PT, gait aids, bracing, exercise classes, and hyaluronic acid joint injections, which can present a challenge in their management.

Facilitators

When asked how these barriers could be addressed, a small number of participants indicated strategies including improved access to multidisciplinary teams such as dieticians and PTs, the use of educational aids, having more time in their clinical encounter to deliver education, and a better awareness of basic exercise prescription for patients. Of particular interest, one physician indicated that he commonly refers to a dietician within his family health team for patients with OA for nutrition counselling and has also integrated customizable exercise templates in the electronic medical record (EMR) to facilitate exercise prescription in his practice.

3) Preferences for implementation

The majority of participants specifically requested access to the education videos for use within their current practice. Most physicians felt it would be useful to present this information early in the diagnosis of OA to set expectations regarding their patients' course of treatment. The majority of physicians indicated a preference for presenting the videos as supplementary teaching that patients could do on their own at home. The provision of a link via email or business card was suggested as a means to give patients access to the videos, with an accompanying summary sheet with written information for patients who do not have internet access. Other suggestions for access included a volunteer-run group education session where interested patients could attend on their own time, playing the videos in their waiting rooms, or training their front desk staff to play

the videos in a room before they meet with the patient. Finally, one physician felt that these videos would be better delivered by PTs.

4.5 Discussion

We sought to describe participants current practice in relation to recommendations made in our educational videos, and pilot our educational materials with physicians, identifying suggestions for improvement, the perceived utility of the videos and preferences for implementation.

Overall, participants in our study were confident in their ability to diagnose OA. However, we found some variation regarding participants understanding of the appropriate radiographs to diagnose OA and the degree to which participants interpreted radiographic films. This finding is consistent with a Canadian study by De Sa et al. (2016) which demonstrated that primary care physicians assigned higher than expected value ratings to plain non-weightbearing radiographs in the diagnosis of knee OA. In their study, this value was significantly higher among physicians who had less than 15 years of independent clinical practice.⁷ This may help explain our results as our sample was comprised of residents and newly practicing physicians. In contrast to De Sa et al. (2016), all of our participants indicated radiography as the only appropriate means to determine a diagnosis of knee OA.

Participants' use of conservative treatments for patients with knee OA generally aligned with accepted best practice, despite limited awareness or use of CPGs to guide their management. This may reflect that appropriate mentorship and clinical experience throughout medical school and residency are more important than explicit use of CPGs. It is important to consider that our participants cited having clinical experiences throughout their training within specialized arthroplasty and sport medicine clinics unique to this geographical area, which may explain this finding. In providing education and treatment options for knee OA, few participants indicated using any formal education aid with patients. Instead the majority of participants reported delivering this education verbally to patients. This is similar to Kingsbury et al (2012), where half of primary care physicians surveyed reported use of education materials with OA patients, with only a third of these physicians indicating the quality of these materials as 'good or very good'. Physicians in

this study pointed to lack of time, lack of material, or poor-quality materials as barriers to provision.²⁸ This sheds light on the relative importance of our educational materials as participants indicated congruence between our videos and their own beliefs surrounding best practice and patient education which may encourage physicians' future adoption of these resources into their practice. This was confirmed as nearly all participants explicitly requested access to the videos to supplement their patient education.

Half of the participants in our study lacked high confidence in their decision to refer to TKR, commonly indicating extremes in patient age as confounding factors in this decision. Further, some participants indicated limited awareness of explicit criteria that orthopaedic surgeons use in deciding on surgical appropriateness for TKR. This finding aligns with the Waugh et al. (2016) study, where nearly half of physicians in their study indicated a lack of clarity for surgical indications for total joint replacement (TJR) and only moderate confidence in deciding who to refer. They suggest that better communication between primary care physicians and specialist colleagues would facilitate their confidence.²⁹ The provision of education materials created with arthroplasty specialists is one such means to facilitate communication between primary care and specialist care. Finally, participants indicated patient fears surrounding surgery may limit their referral of an "appropriate" surgical candidate to TKR. This supports the provision of information on expectations for TKR, as it may allay patient fears and modify patients' decision to proceed with surgery.

Our study revealed that our series of education videos may support physician management in a variety of ways including supporting their own credibility and building trust with their patient, reinforcing patient understanding and uptake of recommendations, and enhancing providers' strategies for education and patient management. When reflecting on their current practice in relation to the videos, physicians highlighted gaps in their own practice that they may not have been aware of, including the importance of activity modification, appropriate imaging, the usefulness of PT, and indications for referral to TKR and other surgical procedures (i.e. HTO). This has important downstream implications as viewing these videos may improve physicians' future resource utilization and referrals to TKR. It also supports the idea that new models of care that ensure primary care physicians have adequate resources to manage this population are required.

Finally, barriers to implementation of the recommendations made in our videos were identified. Patient-level factors were reported including physicians' beliefs surrounding the challenge of weight loss and a perception that patients do not adhere to lifestyle modifications such as diet and exercise. Physicians in our study also commonly described a disparity between their knowledge of best clinical practice and patients' perception of their own needs. A recent systematic review synthesizing primary care physicians' barriers and enablers to OA management similarly identified negative beliefs about patient adherence and dissonant patient expectations as pervasive themes in the qualitative literature. Their review also highlights that dissonant patient expectations surrounding specialist referral appear to influence physicians' treatment recommendations as a means of maintaining trust with their patients.³⁰ Physicians in our study felt our educational resources would be helpful to manage patient expectations regarding appropriate care, especially when patients are persistent in requests that are deemed unnecessary. This suggests that the provision of our education videos to patients may decrease patient requests for unnecessary imaging or access to specialists, which may influence physicians' practice. The Egerton et al. (2017) review also identified other barriers including: 'clinicians are, or perceive they are, under-prepared', and the perception that 'OA is not that serious', which were not considered main themes in our study. The authors indicate that their findings suggest a need to address primary care physicians' knowledge gaps to better prepare them for OA management.³⁰

Moreover, system-level barriers were identified including long wait times to access specialist care and financial constraints limiting access to interventions such as PT. When considering the best dissemination strategy for our educational materials, we must also pre-emptively consider these barriers to ensure uptake of our recommendations. One such means to address issues surrounding access would be to provide primary care physicians with an online platform that houses the videos as well as information on local resources such as OHIP-covered PT clinics or free self-management programs for OA.

Finally, ideas for implementation were presented which suggest participants are keen to implement our education videos with patients and are generally interested in patients accessing these materials at home via an online link that they could provide to patients in clinic.

4.5.1 Limitations

Our study has limitations that are important to consider. Firstly, our description of participant's current practice may lack transferability given the small sample size. However using a qualitative methodology allowed for deeper understanding of physicians' practice, including barriers to uptake of our education, which are important to consider in knowledge implementation research. Further, participants' description of their current practice was meant to be utilized as contextual information to understand the alignment of their practice with our patient education videos and not meant to be taken as a reflection of wider practice. However, our results did generally mirror other large survey studies examining physicians' OA management.^{7,28,29} Finally, our results are most transferable to less experienced clinicians. Residents and newly practicing physicians may be more interested in novel educational materials than physicians with several years of experience. Given their relative lack of clinical experience our participants may not have discovered the most effective way to educate and guide management of their patients, predisposing them to viewing our patient education videos more favourably. This may actually be a relative advantage of our sample as it highlights a potential group of physicians who could be considered 'early adopters' of our education materials.

4.6 Conclusion

The majority of physicians' current practice generally aligned with evidence-based recommendations surrounding the management of patients with knee OA. Physicians are interested in utilizing our education videos to support buy-in regarding appropriate management, enhance patient understanding, and indicated that the videos may also improve their own future practice.

4.7 References

1. Oswald AE, Bell MJ, Snell L, Wiseman J. Medical Students The Current State of Musculoskeletal Clinical Skills Teaching for Preclerkship. *J Rheumatol J Rheumatol Oct.* 2008;35(12):2419-2426.
2. Hochberg MC, Altman RD, April KT, et al. American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis Care Res.* 2012;64(4):465-474.
3. McAlindon TE, Bannuru RR, Sullivan MC, et al. OARSI guidelines for the non-surgical management of knee osteoarthritis. *Osteoarthritis Cartilage.* 2014;22(3):363-388.
4. American Academy of Orthopaedic Surgeons. Treatment of Osteoarthritis of the Knee: Evidence-Based Guideline, 2nd Edition. *J Am Acad Orthop Surg.* 2013:973.
5. NICE. Management of Osteoarthritis. 2015:1-13.
<http://pathways.nice.org.uk/pathways/osteoarthritis>
6. Porcheret M, Jordan K, Jinks C, Croft P, Primary Care Rheumatology Society. Primary care treatment of knee pain a survey in older adults. *Rheumatology.* 2007;46(11):1694-1700.
7. De Sa D, Petruccelli D, Patton SJ, Winemaker M, De Beer J. From “surgical gatekeepers” to “patient navigators”: Examining perceptions and practices of hip and knee osteoarthritis management among primary healthcare physicians. *Curr Orthop Pract.* 2016;27(1):46-55.
8. Sherman S, Gulbrandsen T, Lewis H, et al. Overutilization of magnetic resonance imaging in the diagnosis and treatment of moderate to severe osteoarthritis. *Iowa Orthop J.* 2018;38:33-37.
9. Churchill L, Malian SJ, Chesworth BM, et al. The development and validation of a multivariable model to predict whether patients referred for total knee replacement

are suitable surgical candidates at the time of initial consultation. *Can J Surg.* 2016;59(6).

10. Badley EM, Canizares M, MacKay C, Mahomed NN, Davis AM. Surgery or Consultation: A Population-Based Cohort Study of Use of Orthopaedic Surgeon Services. *PLoS One.* 2013;8(6).
11. McHugh GA, Campbell M, Luker KA. GP referral of patients with osteoarthritis for consideration of total joint replacement: a longitudinal study. *Br J Gen Pract.* 2011;61(589):e459-501.
12. Huynh C, Puyraimond-Zemmour D, Maillefert JF, et al. Factors associated with the orthopaedic surgeon's decision to recommend total joint replacement in hip and knee osteoarthritis: an international cross-sectional study of 1905 patients. *Osteoarthr Cartil.* 2018;26(10):1311-1318.
13. Glazier RH, Dalby DM, Badley EM, et al. Management of common musculoskeletal problems: A survey of Ontario primary care physicians. *Cmaj.* 1998;158(8):1037-1040.
14. Basedow M, Esterman A. Assessing appropriateness of osteoarthritis care using quality indicators: a systematic review. *J Eval Clin Pract.* 2015;21(5):782-789.
15. Leach RE, Gregg T, Siber FJ. Weight-Bearing Radiography in Osteoarthritis of the Knee. *Radiology.* 1970;97(2):265-268.
16. Menashe L, Hirko K, Losina E, et al. The diagnostic performance of MRI in osteoarthritis: a systematic review and meta-analysis. *Osteoarthr Cartil.* 2012;20(1):13-21.
17. Wright J, Hawker G, Hudak P, et al. Variability in Physician Opinions About the Indications for Knee Arthroplasty. *J Arthroplasty.* 2011;26(4):569-575.
18. Nelson AE, Allen KD, Golightly YM, Goode AP, Jordan JM. A systematic review of recommendations and guidelines for the management of osteoarthritis: The Chronic Osteoarthritis Management Initiative of the U.S. Bone and Joint Initiative.

Semin Arthritis Rheum. 2014;43(6):701-712.

19. Feuerstein JD, Pelsis JR, Lloyd S, Cheifetz AS, Stone KR. Systematic analysis of the quality of the scientific evidence and conflicts of interest in osteoarthritis of the hip and knee practice guidelines. *Semin Arthritis Rheum.* 2016;45(4):379-385.
20. Pinney SJ, Regan WD. Educating medical students about musculoskeletal problems: Are community needs reflected in the curricula of Canadian medical schools? *J Bone Jt Surg - Ser A.* 2001;83(9):1317-1320.
21. Fraenkel L, Suter L, Weis L, Hawker GA. Variability in recommendations for total knee arthroplasty among rheumatologists and orthopedic surgeons. *J Rheumatol.* 2014;41(1):47-52.
22. Skou ST, Roos ER, Laursen M, et al. Criteria used when deciding on eligibility for total knee arthroplasty — Between thinking and doing. *Knee.* 2016;23:300-305.
23. Desmeules F, Dionne CE, Belzile ÉL, Bourbonnais R, Frémont P. The impacts of pre-surgery wait for total knee replacement on pain, function and health-related quality of life six months after surgery. *J Eval Clin Pract.* 2012;18(1):111-120.
24. Desmeules F, Toliopoulos P, Roy J-S, et al. Validation of an advanced practice physiotherapy model of care in an orthopaedic outpatient clinic. *BMC Musculoskelet Disord.* 2013;14(1):162.
25. Macintyre NJ, Johnson J, Macdonald N, et al. Characteristics of people with hip or knee osteoarthritis deemed not yet ready for total joint arthroplasty at triage. *Physiother Canada.* 2015;67(4):369-377.
26. Morrow SL. Quality and trustworthiness in qualitative research in counseling psychology. *J Couns Psychol.* 2005;52(2):250-260.
27. Braun V, Clarke V. Using Thematic Analysis in Psychology. *Qual Res Psychol.* 2006;3(2):77-101.

28. Kingsbury SR, Conaghan PG. Current osteoarthritis treatment, prescribing influences and barriers to implementation in primary care. *Prim Health Care Res Dev.* 2012;13(4):373-381.
29. Waugh EJ, Badley EM, Borkhoff CM, et al. Primary care physicians' perceptions about and confidence in deciding which patients to refer for total joint arthroplasty of the hip and knee. *Osteoarthr Cartil.* 2016;24(3):451-457.
30. Egerton T, Diamond L, Buchbinder R, Bennell K, Slade SC. A systematic review and evidence synthesis of qualitative studies to identify primary care clinicians' barriers and enablers to the management of osteoarthritis. *Osteoarthritis and Cartilage.* 2017;25:625-638.

Chapter 5

5 Summary and Discussion

The purpose of this chapter is to summarize the main findings of this thesis and discuss implications and limitations of the current research. We then discuss our overall objective of knowledge implementation and future research.

5.1 Summary

The overall purpose of this thesis was to develop a means to optimize the management of patients with knee OA until they undergo TKR including education and awareness of non-operative treatment options and improving the timing and quality of referrals to TKR. We developed a clinical prediction tool and accompanying patient educational videos to support primary care physicians and patients with knee OA. We piloted our education videos with end-users (physicians and patients) to refine content, investigate their perceived utility, inform future content, and guide implementation.

Chapter 2 (Study 1)

This prospective cohort study identified and cross-validated patient self-reported predictors of surgical candidacy for TKR. We discovered that a large proportion of patients referred to TKR were not currently surgical candidates (45%). Reasons patients were considered non-operative included: an unwillingness on the part of the patient to proceed with surgery, the patient lacked advanced arthritis or was only mildly symptomatic, or the patient had not yet tried or exhausted conservative treatment options. The final clinical model revealed that greater age, willingness to undergo surgery, higher pain, unacceptable limitations in function/QOL (indicated by PASS 2) and previous intraarticular joint injections, were predictive of being offered and electing to undergo TKR. These findings were validated using a new dataset. This model has also been further validated in a prospective trial of patients at our center.¹ The application of this model would reduce the proportion of nonsurgical referrals by nearly 45%, while correctly identifying greater than 90 percent of patients who will schedule a TKR at their first consultation. We can correctly predict the outcome of surgical consults in 70% of

cases. In light of these findings, we presented a simple algorithm that could be used by clinicians with their patients to help guide referral to TKR.

Chapter 3 (Study 2)

Our findings in study 1 indicated a high proportion of non-operative referrals. The reasons patients were considered non-operative included factors that may be addressed through education for patients and referring physicians. We developed education videos for patients to support primary care physicians. Video content focuses on the optimal management of knee OA by educating patients about the disease itself, appropriate imaging, conservative treatment options, indications for referral to TKR, and what to expect from TKR.

This qualitative investigation explored patient feedback to determine the utility of the videos (i.e. patient likes/dislikes, patient understanding, perceived benefits, and barriers to enacting the recommendations). Through a content analysis we determined positive features of the videos including: the use of analogies, the clarity and ease of understanding, and the use of whiteboard animation. Patients also identified areas for improvement including decreasing the speed of the narrative to enhance clarity, the addition of patient testimonials, and the provision of sources to allow for enhanced credibility of the information.

In our thematic analysis we identified 4 themes in relation to patients' experience observing the videos: 1) The challenge of decision making for TKR, 2) Education as supportive to patient decision making, 3) Education addressing knowledge gaps in patient understanding, and 4) Barriers to implementing recommendations. To expand on these themes, participants felt the education videos enabled greater confidence in their upcoming consultation with the surgeon and enhanced their clarity surrounding their decision to undergo TKR.

The videos also addressed various knowledge gaps in patient understanding. Barriers to implementing the recommendations include the challenge of weight loss and limited access to PT. Finally, patients indicated that they would like more information regarding

other surgical procedures i.e. HTO, and the process of recovery and rehabilitation at home post-TKR, indicating areas where additional education could offer further support.

Chapter 4 (Study 3)

This qualitative interview study investigated the utility of our patient education videos through the lens of providers. We also investigated barriers that may limit uptake of our recommendations and strategies for implementation.

Physicians' current practice generally aligned with recommendations made in CPGs, despite limited awareness or explicit use of these guidelines. All physicians were confident in their diagnosis of OA, but half of participants indicated lower confidence in deciding who to refer to TKR.

In the content analysis, physicians highlighted their satisfaction with the use of analogies, simple terms, whiteboard animation, and the information conveyed within the videos. Physicians also pointed to some areas where minor edits may be needed including information to increase clarity surrounding medications. Further, physicians in our study highlighted alternative treatments that were not discussed in our recommendations, suggesting that information to demarket treatments that are not evidence-based would be beneficial to include. Physicians also requested more information regarding the process of rehabilitation at home and HTO, similar to patient requests in study 2.

In the thematic analyses, two themes were identified: 1) Education as supportive to physician management and 2) Perceived barriers to implementing recommendations. Physicians commonly identified that the videos would be useful to: a) support their credibility and build trust with their patients b) reinforce patient understanding and c) enhance aspects of their own management of patients with knee OA. Barriers cited included patient factors such as the challenge of patient adherence to lifestyle modifications, and a disparity between patient's expectations for treatment and best practice. Other barriers were highlighted relating to the health care system including: long wait times and financial constraints limiting access to interventions such as PT.

The majority of participants were very satisfied with the series of education videos and requested access to utilize them in their own practice. Most participants indicated that

online access where patients could view the videos at home would be the preferred method of implementation.

5.2 Implications and future directions

The burden of chronic MSK conditions like OA is widespread and will continue to grow as our population ages. Despite existing evidence-based recommendations for knee OA, suboptimal management still persists. Results of study 1 further supports the growing body of literature regarding non-operative referrals to TKR and provides a simple algorithm to guide clinicians in their decision to refer. Studies 2 and 3 pilot our education videos with relevant stakeholders. These studies support the use of our educational content in improving primary care management of patients with knee OA. However, thoughtful consideration is required regarding how to implement, measure, and sustain our deliverables into wider practice.

The overarching goal of this program of research is to develop a novel online platform to improve the management of patients with knee OA. Our vision is to offer a comprehensive online platform that will provide referring physicians with: a) guidance on diagnostic imaging, conservative treatment and the optimal timing and criteria for referral b) a suite of educational and post-operative resources for patients b) streamlined access to allied health providers that can offer care for patients with OA. Future dissemination activities should consider the principles of knowledge translation (KT) to support implementation of this platform.

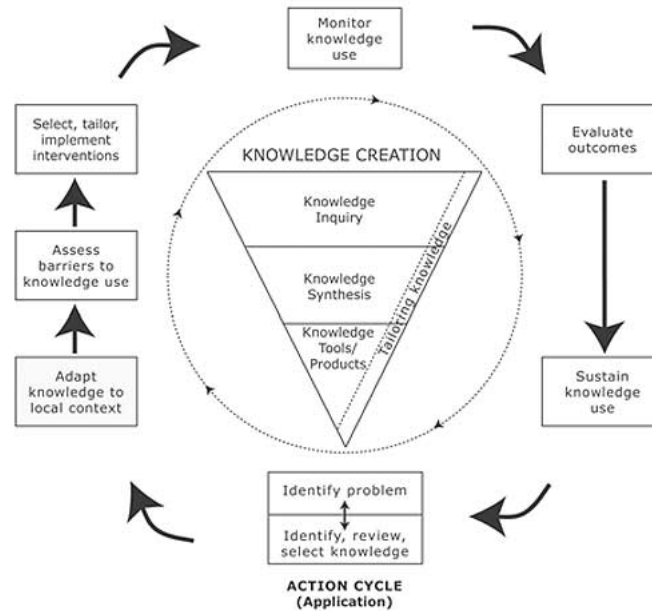
What is Knowledge Translation?

The study of KT provides a comprehensive framework for understanding how research and clinical practice guidelines (CPGs) move from evidence to practice.² The definition provided by the Canadian Institutes of Health Research (CIHR) describes KT as “a dynamic and iterative process that includes the synthesis, dissemination, exchange, and ethically sound application of knowledge to improve health, provide more effective health services and products that strengthen the healthcare system”.³ Straus, Tetroe & Graham (2013) highlight the idea that among all of the working definitions of KT, the common theme is that KT moves beyond the dissemination of evidence (i.e. development

of evidence-based guidelines, publication of systematic reviews in journals) to actual knowledge utilization.²

The knowledge to action framework developed by Graham and colleagues in 2006 provides a conceptual model for understanding the comprehensive, dynamic, and cyclical process of KT in health care (Figure 4). At the center of the knowledge to action cycle, three phases of knowledge creation are emphasized: 1) Knowledge inquiry; where knowledge is sought from existing sources or is generated, 2) Knowledge synthesis; where knowledge is amalgamated to understand the culmination of multiple knowledge sources and, 3) Knowledge tools/products; where knowledge is repurposed or built into a new method of delivery. The seven action phases within the cycle can occur sequentially or simultaneously and can be influenced by the knowledge creation phases at any point in the process.⁴

In order to situate this thesis in the context of the knowledge to action cycle, a brief summary is provided to understand what has been done and what needs to be done to move from knowledge creation to the integration of knowledge into a usable and effective online platform.



Retrieved from the *Journal of Continuing Education in the Health Professions*, Vol. 26, No. 1, Graham, I. D. et al., Lost in knowledge translation: Time for a map, pp. 13–24, copyright © 2006

Figure 4 Knowledge to action cycle

Application of the Knowledge to action cycle:

Identify the problem: Study 1 and current literature suggest that non-operative management of patients with knee OA is often suboptimal. Areas for improvement include use of appropriate diagnostic imaging, utilization of conservative treatment, and optimizing referrals to TKR.

Review and select the knowledge to implement: Healthcare is becoming less didactic and more inclusive of patients and their role in shared decision making with providers. This shift encourages new tools and platforms that provide education to patients that can encourage appropriate use of the best available evidence. We reviewed evidence-based national and international guidelines for knee OA management and collaborated with arthroplasty specialists, physicians, and allied health care professionals (HCPs) to determine relevant knowledge to include in our videos.

Knowledge Inquiry, synthesis, and the creation of knowledge tools/products:

Within the center of the knowledge to action cycle is the knowledge funnel which depicts the creation of knowledge. It is proposed that at each level of the funnel, knowledge becomes increasingly more useful to end-users, including tailoring the knowledge to researchers, health care providers, policy makers and the public throughout each stage. The knowledge funnel is subdivided into first, second, and third generation knowledge. First generation knowledge is primarily derived from research studies, second generation knowledge involves the synthesis of these findings, and third generation represents tools and products.²

In this thesis we contributed to first generation knowledge via study 1, synthesized this knowledge with additional literature, and tacit knowledge from relevant health care professionals and created an educational product. We then evaluated our educational product (videos) with end-users. The challenge for future directions lies within exploring the left side of the knowledge- to-action cycle which focuses on widespread implementation considering the local context as well as barriers and facilitators to uptake.

Adapting the knowledge to the local context:

Regional joint assessment programs (RJAPs) have recently been mandated in our South-West LHIN, which means the process of referral to arthroplasty specialists in our local region has changed. In this new model, primary care physicians will refer patients to an intermediary assessor (PT), enabling timely assessment and effective screening of non-operative referrals. If we are to offer an online platform for physicians as an alternative to this model of care, we must ensure that our platform offers a relative advantage to RJAPs (less costly and more convenient to end-users), without sacrificing effectiveness. One potential strategy to support the relative value of our online platform is to offer streamlined access to allied health professionals in the local community who will provide non-operative care for patients with knee OA. In the current model, physicians may refer patients to a RJAP, where an assessor decides that they are currently non-operative and recommends they trial conservative treatment. The responsibility then shifts back to the referring provider or the onus falls on the patient to seek appropriate care. Providing

referring physicians with a central platform linking them with allied health care in their local community may avoid the need for a referral in some cases. Another relative advantage of the proposed online platform is the potential for cost savings compared to the RJAP model. An important consideration for our online platform is to ensure that minimal ongoing maintenance is needed to support its use. In light of this, we propose providing access to local clinicians via links to organizational websites such as The College of Physiotherapists “Find a Physiotherapist” search engine tool (Figure 5) or Canadian Academy of Sport and Exercise Medicine’s “Find a Sport Medicine Physician” tool (Figure 6). These organizational bodies have a vested interest in updating and maintaining their own members information, thus ensuring we would not need personnel to maintain a database of local practitioners for various regions. Physicians can either direct patients to our online platform or can recommend a practitioner via these tools. Finally, when considering the local context we must include local stakeholders (clinicians, policymakers) in the development of our online platform to facilitate uptake. This may involve partnering with our local LHIN and continuing to engage relevant HCPs throughout the process.

COLLEGE OF
PHYSIOTHERAPISTS
of ONTARIO

Apply for Registration Search Sign In


Find a Physiotherapist



Search for a Physiotherapist by name, former name, registration number, clinic or city.

Name, Registration Number, or Clinic City SEARCH

Advanced Search

Figure 5 Example of existing search engine for finding physiotherapists

CASEM  ACMSE

f  Fr  BECOME A MEMBER LOG IN MENU

Find a Sport Medicine Physician

First Name

Last Name

Specialty

Clinic

City

Province/State

Country

SUBMIT

Figure 6 Example of existing search engine for finding sport medicine physicians

Assessing the barriers/facilitators of knowledge use: Current literature and studies 2 and 3 have identified barriers to optimal knee OA management in primary care. The most notable patient barriers involve adherence and access to conservative treatment recommendations. Specifically patients with knee OA may have challenges with weight loss and exercise, or limited access to these interventions given associated costs. Our online platform will attempt to address these barriers by facilitating access to dietitians and physical therapists who possess the required expertise to help patients adhere to these interventions. The online platform will also provide information regarding community exercise and self-management programs. To further support patients and physicians in overcoming these barriers we will also provide a list of OHIP-funded allied health providers as an option for patients who lack coverage or who cannot afford to pay ‘out of pocket’ for these services.

Other patient barriers identified include fears of surgery and dissonant patient expectations for treatment. Our education videos clearly outline the appropriate stepwise

care for patients with knee OA which may help to address dissonant patient expectations for treatment. Through our education videos we also hope to allay patient's fears regarding TKR, ensuring patients who would benefit from surgery are willing to undergo the procedure. From studies 2 and 3 it is clear that more information regarding what to expect from rehabilitation and the recovery process at home would be beneficial to patients. Given this, future directions should consider offering an additional video detailing this process or provide a summary of written information within our online platform.

Another idea to further support patients during the recovery process is to provide a suite of resources within our online platform to support patients in the post-operative period for TKR. These resources could include a list of businesses that have earned our stamp of approval in providing amenities and services to help patients navigate the process of recovery. For example, we could provide a list of hotels who are willing to accept post-operative patients that are also in close proximity to the surgery site, a list of home-care support workers, or services that can support the patient in the immediate post-operative period (transportation, meals, cleaning, caregiving support etc.) Presenting this information to patients during the decision period for TKR may alleviate barriers to patients electing surgery and better support their rehabilitation.

In addition, physician-related barriers have been identified including clinicians' beliefs that they are under-prepared to manage knee OA, and lack of applicability of CPGs. Specifically, some physicians are not aware of certain treatments within OA CPGs or feel that they are not easily implemented into practice.⁵ Our online platform will attempt to address these barriers by providing a stepwise algorithm for physicians to simplify management of their patients with knee OA. For example, physicians would first indicate if they are diagnosing a patient with knee OA or managing a patient whom they have already diagnosed. If they select 'new diagnosis' we would provide relevant diagnostic criteria and red flags for inflammatory arthritis or other arthropathies for physicians to consider in their differential diagnosis. Next, we would outline appropriate imaging for physicians to order as a baseline for measuring radiographic disease severity. From there, physicians would indicate patient characteristics such as age, comorbidities and previous

treatments trialed. The online algorithm could then provide tailored feedback regarding appropriate avenues to explore with their patients and streamlined access to clinicians and allied health in their community who can facilitate this care. The system may also suggest relevant patient educational materials (videos 1-3) via an online link that providers can share with their patients.

If the physician selects ‘previous diagnosis of OA’, the system would similarly query patient characteristics including age, duration of diagnosis, comorbidities, and which treatments have been trialed. Based on their selections the system would provide a) other conservative treatment options to trial with links to allied health or b) considerations and indications for referral to TKR. Next, the physician would select any criteria that their patient meets to help decide if a referral to TKR is appropriate. Again, the system would suggest relevant education materials for patients (videos 4 and 5).

It is our hope that housing all of this information in one central location for providers and their patients will create convenience in their practice while enhancing their knowledge, confidence and resources to manage this population.

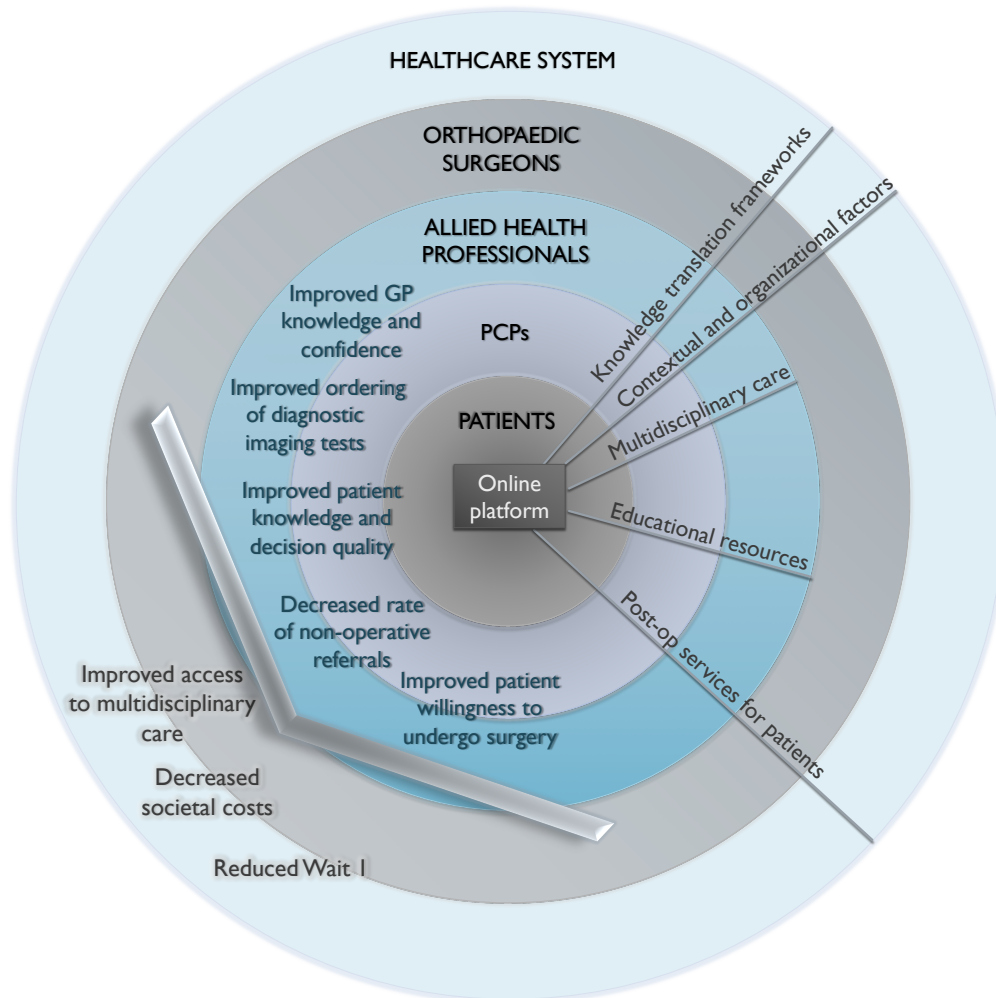
Another important barrier to consider is physicians’ lack of time during clinical encounters, which may limit the adoption of our proposed online platform into routine practice. We must ensure that our online platform is simple and time-efficient to use and engage primary care physicians in piloting the new platform to gauge its usability.

Select, tailor, implement interventions:

Tailoring our online platform to best serve end-users is an important consideration before implementation. While we have created a series of educational videos that are attractive to patients and providers, we should also consider including additional high-quality educational resources to our online platform (i.e. publicly available decision aids or option grids for TKR). This will allow patients to tailor their learning based on their preferences for more detailed written information.

To illustrate our plans for implementation we developed a conceptual model of our proposed online platform that demonstrates key stakeholders, intended outcomes, and key

components. The sustainability and effectiveness of this model will require ongoing refinement and engagement with end-users including patients, physicians, orthopaedic surgeons, and allied health professionals (Figure 7).



Adapted from Lebedeva et al. 2018 unpublished MSc thesis, Western University

Figure 7 Conceptual model of online platform

In planning for future implementation, the sociologic theory of diffusion innovation is helpful to consider as it seeks to understand how to encourage faster uptake of an innovation. One key component of the theory encourages reflection on the innovation itself, which has several important characteristics that influence rate of adoption. One key

component is whether the innovation offers a relative advantage; does the consumer perceive the new intervention as advantageous i.e. less costly or more convenient.⁶

In considering the relative advantage of our system, there are benefits to consider from both a patient, provider, and health care system perspective. For patients, this system will provide them with educational resources that may influence their decision making surrounding their OA management. For example, if a patient decides to pursue conservative management instead of a specialist consult in response to our education, this may result in cost-savings to the patient. These costs include those associated with transportation, accommodation, and patient and caregiver time off from paid work to attend an in-person consultation with an assessor or specialist. Further, our online platform may offer patients additional resources to streamline and simplify their rehabilitation while they recover from surgery creating convenience for patients and their caregivers, while potentially increasing their willingness to undergo surgery.

From a provider perspective, this system may provide more convenient and streamlined management of their patient, saving them time while enhancing their confidence, knowledge, and resources to manage a large proportion of their practice. From a health care system perspective, our system will advocate and support access to allied health care providers which may help to minimize the burden on primary care physicians and disperse care amongst their allied health colleagues. This may expedite the Wait one period for TKR by reducing the proportion of nonoperative referrals and redirecting them to alternative care. It may also decrease the costs associated with unnecessary imaging and specialist consultation. Finally, it is important to consider that the burden of OA will continue to grow as our population ages. This burden will become significant and will demand innovation in our health care system to retain costs. The future costs to the healthcare system associated with patient screening by allied health care professionals may become unsustainable from an economic standpoint. An alternative web-based model acknowledges this growing burden and aims to be proactive rather than reactive as it may represent a more cost-efficient model, especially over the next 15-20 years. Future research is needed to determine whether our proposed online model of care offers a cost-effective alternative to current practice.

Monitor knowledge use, evaluate outcomes, sustain knowledge use:

The final consideration for implementing our proposed online platform is to determine the best way to measure its impact. One way of comparing our proposed deliverable with the current standard of care would be a cluster randomized controlled trial, where family health teams of physicians in the community are randomized to either access our online platform or utilize their current standard of care. We would then track all referrals from participating physicians to our RJAP and determine the proportion of referrals considered non-operative by the assessor, the proportion of patients who actually undergo surgery after meeting with the specialist, and resource utilization between groups (including costs, previous treatments trialed, imaging etc.).

5.3 Conclusion


The results of this collection of work emphasizes an unmet need for patient and physician support in the management of patients with knee OA. The implementation of a patient-reported algorithm to screen referrals to TKR and accompanying patient education videos may improve the quality and timing of referrals to TKR. Our proposed online platform has the potential to change current practice and offer a cost-effective and sustainable means to optimize the care for patients with knee OA.


5.4 References

1. Malian S. Predictors of appropriate referral to total knee arthroplasty: a validation study. 2015. Electronic Thesis and Dissertation Repository.2951.
<https://ir.lib.uwo.ca/etd/2951>
2. Straus S, Tetroe J, Graham ID. *Knowledge Translation in Health Care: Moving from Evidence to Practice*. 2nd ed. (Straus S, Tetroe J, Graham ID, eds.). John Wiley and Sons; 2013.
3. Canadian Institutes of Health Research. Knowledge Translation: Definition. Date modified, 2016-07-28. <http://www.cihr-irsc.gc.ca/e/29418.html#2>
4. Graham ID, Logan J, Harrison MB, et al. Lost in knowledge translation: time for a map? *J Contin Educ Health Prof*. 2006;26(1):13-24. doi:10.1002/chp.47
5. Egerton T, Diamond L, Buchbinder R, Bennell K, Slade SC. A systematic review and evidence synthesis of qualitative studies to identify primary care clinicians' barriers and enablers to the management of osteoarthritis. *Osteoarthritis and Cartilage*. 2017;25:625-638.
6. Everitt R. *Diffusion of Innovations*. 4th ed. (The Free Press, ed.). New York; 1995.

Appendices

Appendix A- Permission to reproduce publication for Study 1

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Appendix B- Pre/post-intervention surveys for Study 2

Survey for Patients: Baseline Survey

Demographic Information

Date: ____ / ____ / ____ (yyyy/mm/dd)

Date of birth: ____ / ____ / ____ (yyyy/mm/dd)

Sex (check one): Male Female Other Prefer not to say

Do you know any of your cultural background? Yes No/Don't wish to answer

- Aboriginal or Native North American
- Arab/Middle Eastern
- Asian
- Black or African origin
- Hispanic, Latino, or other Spanish origin
- Native Hawaiian or other Pacific Islander
- White

What was the highest level of schooling you ATTENDED?

- Elementary school
- High school
- Vocational or technical school or CEGEP
- Some college or university but did not complete a degree
- College or University degree
- Graduate or professional degree (Masters, Doctorate, Medicine, Law etc.)
- Don't wish to answer

Employment Status:

Retired

If retired- what was your previous occupation: _____

Employed (full time/part time)

Please indicate your occupation: _____

WSIB

Accident Insurance

Disability

Litigation

Temporary sick leave from work

Self-employed

Government

Homemaking

Student

Volunteer

Social assistance

Other: _____

Have you ever had a previous total knee replacement? Yes No

Has a family member, spouse/partner ever had a total knee replacement? Yes No

If yes, please indicate your relationship to the patient: _____

The Medical Term Recognition Test (METER)

The following list contains some real medical words. For example, some of the words have to do with body parts or body functions, kinds of diseases, or things that can make your health better or worse. The list also contains some items that may look or sound like medical words but that are not actually real words. As you read through the list, put an “X” next to the items that you know are real words. You should not guess. Only put an “X” next to an item if you’re sure it’s a real word.

| | | | |
|---------------------------------------|---|---------------------------------------|---------------------------------------|
| <input type="checkbox"/> Irrity | <input type="checkbox"/> Antibiotics | <input type="checkbox"/> Gallbladder | <input type="checkbox"/> Allagren |
| <input type="checkbox"/> Arthritis | <input type="checkbox"/> Antiregressant | <input type="checkbox"/> Miscarriage | <input type="checkbox"/> Prognincy |
| <input type="checkbox"/> Obesity | <input type="checkbox"/> Colitis | <input type="checkbox"/> Appendix | <input type="checkbox"/> Stress |
| <input type="checkbox"/> Flu | <input type="checkbox"/> Diabetes | <input type="checkbox"/> Fam | <input type="checkbox"/> Ellargic |
| <input type="checkbox"/> Behaviose | <input type="checkbox"/> Occipitent | <input type="checkbox"/> Infarth | <input type="checkbox"/> Sexually |
| <input type="checkbox"/> Syphilis | <input type="checkbox"/> Nausion | <input type="checkbox"/> Dose | <input type="checkbox"/> Pelvince |
| <input type="checkbox"/> Potassium | <input type="checkbox"/> Impetigo | <input type="checkbox"/> Hemorrhoids | <input type="checkbox"/> Vaccilly |
| <input type="checkbox"/> Hormones | <input type="checkbox"/> Menstrual | <input type="checkbox"/> Testicle | <input type="checkbox"/> Prescription |
| <input type="checkbox"/> Nerves | <input type="checkbox"/> Abghorral | <input type="checkbox"/> Eye | <input type="checkbox"/> Germs |
| <input type="checkbox"/> Pilk | <input type="checkbox"/> Seizure | <input type="checkbox"/> Midlocation | <input type="checkbox"/> Gonorrhea |
| <input type="checkbox"/> Rection | <input type="checkbox"/> Cerpes | <input type="checkbox"/> Insomniate | <input type="checkbox"/> Tumic |
| <input type="checkbox"/> Blout | <input type="checkbox"/> Kidney | <input type="checkbox"/> Bloodgatten | <input type="checkbox"/> Fatigue |
| <input type="checkbox"/> Boweling | <input type="checkbox"/> Emergency | <input type="checkbox"/> Hepatitis | <input type="checkbox"/> Osteoporosis |
| <input type="checkbox"/> Exercise | <input type="checkbox"/> Potient | <input type="checkbox"/> Astiringe | <input type="checkbox"/> Constipation |
| <input type="checkbox"/> Pustule | <input type="checkbox"/> Menopause | <input type="checkbox"/> Nutral | |
| <input type="checkbox"/> Inlest | <input type="checkbox"/> Diagnosis | <input type="checkbox"/> Asthma | |
| <input type="checkbox"/> Pollent | <input type="checkbox"/> Depretion | <input type="checkbox"/> Inflammatory | |
| <input type="checkbox"/> Malories | <input type="checkbox"/> Jaundice | <input type="checkbox"/> Anemia | |
| <input type="checkbox"/> Cancer | | | |
| <input type="checkbox"/> Alcoheliouse | | | |

Rawson et al. (2009)

Traditional Decisional Conflict Scale (DCS)

At this time which option do you prefer? Please check one.

- Conservative treatment (non-operative)
 Total knee replacement (operative)
 Unsure

Considering the option you prefer, please answer the following questions:



| | Strongly Agree [0] | Agree [1] | Neither Agree nor Disagree [2] | Disagree [3] | Strongly Disagree [4] |
|---|--------------------------|--------------------------|-----------------------------------|--------------------------|--------------------------|
| 1. I know which options are available to me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. I know the benefits of each option. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. I know the risks and side effects of each option. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. I am clear about which benefits matter most to me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. I am clear about which risks and side effects matter most. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. I am clear about which is more important to me (the benefits or the risks and side effects). | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. I have enough support from others to make a choice. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. I am choosing without pressure from others. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. I have enough advice to make a choice. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. I am clear about the best choice for me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. I feel sure about what to choose. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. This decision is easy for me to make. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. I feel I have made an informed choice. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 14. My decision shows what is important to me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. I expect to stick with my decision. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. I am satisfied with my decision. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Decisional Conflict Scale © AM O'Connor, 1993, revised 2005

Survey for Patients: Post-Video Survey

Traditional Decisional Conflict Scale

Which option do you prefer? Please check one.

- Conservative treatment (non-operative)
 Total knee replacement (operative)
 Unsure

Considering the option you prefer, please answer the following questions:

| | Strongly Agree [0] | Agree [1] | Neither Agree nor Disagree [2] | Disagree [3] | Strongly Disagree [4] |
|--|--------------------------|--------------------------|-----------------------------------|--------------------------|--------------------------|
| 17. I know which options are available to me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. I know the benefits of each option. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. I know the risks and side effects of each option. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. I am clear about which benefits matter most to me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21. I am clear about which risks and side effects matter most. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 22. I am clear about which is more important to me (the benefits or the risks and side effects). | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 23. I have enough support from others to make a choice. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 24. I am choosing without pressure from others. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 25. I have enough advice to make a choice. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 26. I am clear about the best choice for me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 27. I feel sure about what to choose. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 28. This decision is easy for me to make. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

| | | | | | |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 29. I feel I have made an informed choice. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 30. My decision shows what is important to me. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 31. I expect to stick with my decision. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 32. I am satisfied with my decision. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Decisional Conflict Scale © AM O'Connor, 1993, revised 2005

Appendix C- Interview guide for patients (Study 2)

Interview guide for patients

1. What did you like about this video? What didn't you like about this video?
 - Possible prompts: what would you change, what was unclear, what was helpful?
 - Possible prompts: voice over, pictures, whiteboard animation
2. What additional questions might you have regarding the topic in the video that were not answered?
 - Possible prompts: what else would you like to know about, what do you wish was discussed?
3. How did the education provided in this video affect the way you view your condition (if at all)?
 - Possible prompts: What new information was useful? What did you learn?
 - Possible prompts: What information did you already know and where did you receive this information? (i.e. other health care providers, experience with the surgery via a partner, own research, work in health care etc.)
4. How does the education provided in this video align with your current understanding of the appropriate pathway or steps to manage your knee?
5. How does the education provided in this video affect your confidence in meeting with the surgeon?
6. What do you think were the main “take home” points or key messages of this video?
7. Is there anything I have not asked about that you would like to talk about?

Appendix D- Interview guide for physicians (Study 3)

Interview Guide for Physicians

Pre-video:

1. Tell me about your experience with the current referral system at University Hospital for TKR. Possible prompts: What has worked well? What hasn't worked well? Who do you regularly refer to?
2. What is your confidence in diagnosing/managing knee OA?
 - a. How confident would you be making the decision to refer to arthroplasty?
 - b. Do you feel confident in determining whether a patient's knee OA is at a severity that would warrant conservative measures vs. TKR?
 - If yes-what resources or supports have been helpful in increasing your ability to manage this population?
 - If no- what resources or supports would be helpful to increase your ability to manage this population
3. What criteria do you use to determine if your patient is a suitable candidate to be referred for a TKR?
 - Possible prompts: pain/function/imaging results/age/willingness/failed non-operative treatment or exhausted conservative measures i.e. joint injection?
 - a. What imaging do you routinely order to diagnose and manage a patient with suspected knee OA?
 - b. What level of pain/reduced function is necessary for referral?
 - c. What are your age cutoffs for referring to TKR- youngest/oldest?
 - d. What do you consider failed non-operative treatment?
4. What is your impression of why people wait for initial consult (Wait 1) and again when they are booked for TKR (Wait 2)?
5. Have you ever referred someone for a high tibial osteotomy?
 - What is your overall impression of the surgery?
 - What went into that decision?
 - What is your impression of why someone would refer to HTO vs. TKR?

Post video:

1. What did you like about this video? What didn't you like about this video?
 - Possible prompts: what would you change, what was unclear, what was helpful, what additional information would you include
 - Possible prompts: voice over, pictures, whiteboard animation
2. Do the recommendations in these videos align with your current practice and patient education? Why or why not?
3. Has watching this series of videos clarified anything about the referral process or do you feel they will be useful to strengthen the quality of your referrals?

Possible prompts: If YES- what information was helpful and how may it impact your future referrals? IF NO- what could be improved upon.

4. Do you think these whiteboard videos would be a useful source of education with your patient population? Why or Why not?

Possible prompts: What are the barriers or facilitators to using these videos with patients in your own practice.

5. We are planning to implement an e-referral system that will require all patients referred to our center to view these education videos before attending their consultation. What method of implementation would be the least disruptive to your practice?

Possible prompts: direct email to patients, you administer videos as part of the referral process, set up the videos in your waiting room etc.? Do you see any disadvantage to people watching in your waiting room?

6. Is there anything I have not asked about that you would like to talk about?

Appendix E- Ethics approval forms



Research Ethics

Use of Human Participants - Ethics Approval Notice

Principal Investigator: Dr. Robert Gillin
 File Number: 103374
 Review Level: Delegated
 Approved Local Adult Participants: 1000
 Approved Local Minor Participants: 0
 Protocol Title: Predicting outcome of surgical consultation for TKA and HTO
 Department & Institution: Schulich School of Medicine and Dentistry/Surgery, Western University
 Sponsor:
 Ethics Approval Date: April 16, 2013 Expiry Date: September 30, 2013
 Documents Reviewed & Approved & Documents Received for Information:

| Document Name | Comments | Version Date |
|---|---|--------------|
| Instruments | Form for orthopaedic surgeon to fill out after surgical consultation for HTO with study participants. | |
| Instruments | Form for orthopaedic surgeon to fill out after surgical consultation for TKA with study participants | |
| Western University Protocol | | 2012/12/30 |
| Instruments | Revised forms for the online survey | 2013/01/30 |
| Revised Letter of Information & Consent | Revised LOI FKSMC clean | 2013/04/14 |
| Revised Letter of Information & Consent | Revised LOI LHSC clean | 2013/04/14 |
| Amendment | Response to REB Comments | 2013/04/09 |

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted approval to the above referenced revision(s) or amendment(s) on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the University of Western Ontario Updated Approval Request Form.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

The Chair of the HSREB is Dr. Joseph Gilbert. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Ethics Officer to Contact for Further Information

This is an official document. Please retain the original in your files.

Western University, Research, Support Services Bldg., Rm. 5150
 London, ON, Canada N6A 3K7 t. 519.661.3036 f. 519.850.2466 www.uwo.ca/research/services/ethics



Date: 1 August 2018

To: Dr. Dianne Bryant

Project ID: 109676

Study Title: Exploring the feasibility of implementing a novel e-referral platform for total knee replacement (TKR)

Application Type: HSREB Amendment Form

Review Type: Delegated

Meeting Date / Full Board Reporting Date: 21/Aug/2018

Date Approval Issued: 01/Aug/2018

REB Approval Expiry Date: 11/Dec/2018

Dear Dr. Dianne Bryant,

The Western University Health Sciences Research Ethics Board (HSREB) has reviewed and approved the WREM application form for the amendment, as of the date noted above.

Documents Approved:

| Document Name | Document Type | Document Date | Document Version |
|---|-----------------------|---------------|------------------|
| 109676_Study protocol_july27-cl | Protocol | | clean |
| 109676-Email to family medicine residents introducing the study | Recruitment Materials | 31/Jul/2018 | |
| LOI-referring physicians_residents_july27_cl | Consent Form | 27/Jul/2018 | clean |

REB members involved in the research project do not participate in the review, discussion or decision.

The Western University HSREB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2), the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP), Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations, Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

Curriculum Vitae

- Name:** Laura Churchill
- Post-secondary Education and Degrees:**
- Wilfrid Laurier University
Waterloo, Ontario, Canada
2008-2012 BA Honours Kinesiology and Physical Education
- Western University
London, Ontario, Canada
2012-2013 MSc Health and Rehabilitation Science
- Western University
London, Ontario, Canada
2015-2017 Master of Physical Therapy
- Western University
London, Ontario, Canada
2013-2019 PhD Health and Rehabilitation Science
- Honours and Awards:** Ontario Graduate Scholarship
2014-2015, 2015-2016, 2016-2017
- Related Work Experience**
- Teaching Assistant
Western University
2013-2014
- Physiotherapist
Fowler Kennedy Sports Medicine Clinic (3M)
2017-present
- Publications:**
- Churchill L, Pasic N, Pollock M, Lanting B, Rudman D. (2018) "Optimizing outpatient total hip arthroplasty: Listening to key stakeholders", Can J Surg, 61(5).
 - Moyer R, Lanting B, Churchill L, Marsh J, Howard J, Somerville L. (2018) "Postoperative gait mechanics in patients after total hip arthroplasty: a systematic review and meta-analysis", JBJS Reviews, 6(11).
 - Churchill L, Malian S, Chesworth B, Bryant D, MacDonald S, Marsh J, Giffin JR. (2016) "The development and validation of a multivariable model to predict whether patients referred for total knee replacement are suitable surgical candidates at the time of initial consultation", Can J Surg, 59(6),407-414.

4. Churchill L (2014) "The Waiting Game: A Primary Care Intervention to Improve Access to Specialist Care to Patients with Osteoarthritis", Health Science Inquiry, 5(1), 69-70.
5. Churchill L, Bryant D, Giffin R, MacDonald S (2014) "The Waiting Game: A Primary Care Intervention to Improve Access to Specialist Care to Patients with Osteoarthritis", Orthopedic & Muscular System (3)158.