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Feasibility, Effectiveness, Costs and Patient Satisfaction Associated with a Web-based Follow-up Assessment Following Total Joint Arthroplasty

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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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FEASIBILITY, EFFECTIVENESS, COSTS AND PATIENT SATISFACTION
ASSOCIATED WITH A WEB-BASED FOLLOW-UP ASSESSMENT FOLLOWING
TOTAL JOINT ARTHROPLASTY

(Spine title: Web-Based Follow-up Following Total Joint Arthroplasty)

(Thesis format: Integrated Article)

by

Jacquelyn Marsh

Graduate Program in Health & Rehabilitation Sciences

A thesis submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy

The School of Graduate and Postdoctoral Studies
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THE UNIVERSITY OF WESTERN ONTARIO
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**Feasibility, Effectiveness, Costs and Patient Satisfaction
Associated With a Web-based Follow-up Assessment Following
Total Joint Arthroplasty**

is accepted in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

Date

Chair of the Thesis Examination Board

Abstract

Objectives: To determine the feasibility, effectiveness, costs and satisfaction involved with a web-based assessment following total joint arthroplasty compared to the usual method of in-person assessment.

Methods: We determined agreement between electronic and paper versions of the WOMAC and SF-12 questionnaires (Chapter 2). We randomized patients who were at least 12 months post-operative to complete a web-based follow-up or to have their appointment at the clinic. We recorded travel distances, costs, and time involved with each appointment. We report the frequency of web-based patients who: 1) indicated they were having problems, 2) had an identified radiographic issue, 3) the surgeon felt actually had a significant issue, and 4) the surgeon felt an issue was missed by using the web-based follow-up (Chapter 3). All patients completed a satisfaction questionnaire, and patients in the web-based group were invited to take part in a focus group session (Chapter 4).

Results: The intraclass correlation coefficient (ICC) values for the WOMAC and the SF-12 were high, indicating excellent agreement (WOMAC ICC=0.96, 95% CI 0.94 to 0.98), SF-12(PCS) ICC=0.95, 95% CI 0.92 to 0.97; SF-12(MCS) ICC=0.92, 95%CI 0.86 to 0.95) (Chapter 2). A total of 229 patients (118 Web, 111 Usual) completed the web-based study. Patients in the web-based group travelled less (13.5 km vs 34km, ($p<0.01$)), had lower associated travel costs (\$5.50 vs \$19.00, ($p<0.01$)) and reduced associated time (90.50 min web vs 152.1 min usual). Caregivers assisted web-based patients for 30 minutes versus 105 minutes in the usual group.

Twenty-five patients reported that they were having problems, of which eight (32%) were considered to actually have a significant issue. There were no patients who the surgeon felt had issues that were missed by the web-based follow-up (Chapter 3). Patients were satisfied with the web-based follow-up (29% extremely satisfied, 36.6% very satisfied, 20.4% somewhat satisfied). Forty-four percent of patients preferred the web-based method, 36% preferred the usual follow-up in person at the clinic, and 16% had no preference (Chapter 4).

Conclusions: Web-based follow-up assessment is a feasible, clinically effective and cost saving means of tracking patient outcomes following total joint arthroplasty.

Keywords

Electronic, Web-based, Total Joint Arthroplasty, Follow-up, Feasibility, Cost, Effectiveness

Co-Authorship Statement

With the assistance of the entire committee (Dr. Dianne Bryant, Dr. Steven MacDonald and Dr. Douglas Naudie) we designed three separate studies to address each of our research questions. I was solely responsible for recruitment, data collection, and coordination of all study related procedures. I conducted the statistical analysis for each study, interpreted the results and wrote the original draft of all three manuscripts. All committee members reviewed each manuscript and provided their suggestions and feedback. We received funding from Physicians Services Incorporated to support this project.

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Chapter 1

1 Introduction

Telemedicine is a term used to describe the use of information and communications technology to provide health services to people who are at a distance from their health care provider. The use of telemedicine has become widespread across numerous health care fields. It has been suggested that telemedicine has substantial cost benefits to the health care system, including hospitals, health care providers, patients, and employers. Despite the rapid growth of telemedicine, there is limited sound research to support its effectiveness.

Osteoarthritis results from the breakdown of cartilage in the joints, leading to pain, stiffness, and decreased mobility. It is one of the most common chronic conditions affecting Canadians, and thus a leading cause of health care utilization¹⁻⁶. Joint replacement surgery is a highly cost-effective procedure for the treatment of advanced osteoarthritis. The incidence of major complications following surgery is low; however complications such as thromboembolic events, infection, stiffness, and instability can occur in the early post-operative period, whereas infection, wear, implant loosening and failure are complications that may present later on.

It is common practice to monitor patient outcomes and the performance of the implant through an annual follow-up visit. Regular follow-up appointments are a time consuming process for all involved, including patients, often their families or caregivers who accompany them to visits, as well as the surgeon, clinic and research staff. Because the rate of post-operative complications is low, the majority of follow-up visits are routine with no change in clinical management.

The increasing demand for arthroplasty has resulted in longer wait times. For example in Canada, the mean wait time in 2006-2007 from first consultation to surgery for total hip arthroplasty was 182 days, and the mean wait time for knee arthroplasty surgery was 237

days⁷. There are currently no official reports on the average wait time from referral to first consultation with an orthopaedic surgeon, as this wait time is highly dependent on location and each surgeon's patient load. With the aging population and increasing incidence of osteoarthritis, it is important to improve the efficiency of care for these patients, and to maximize the utilization of limited surgical time and resources. Thus, there is great interest from policy makers, clinicians and patient advocate groups to explore opportunities to reduce wait times.

There are approximately 1300 total joint replacements performed at London Health Sciences Centre each year. Health care systems are under pressure to cope with the increasing demands for joint replacement surgery and the resultant increased workload associated with assessing and monitoring patient outcomes.

Frustrations with the rapidly increasing number of patients needing care and the overcrowded clinics got us thinking about alternative ways to assess post-operative patients. Advances in technology now make it possible to assess patients without them physically being present with the surgeon. Reducing the number of patients presenting in clinic for routine follow-up assessments could significantly decrease wait times for new patients waiting for a pre-surgery consultation, as well as potentially free up more of the surgeon's time to operate. Additional benefits include reduced patient burden by decreasing travel, financial and time requirements associated with clinic follow-up appointments for patients and their caregivers.

Several studies have assessed the feasibility of conducting orthopaedic outpatient assessments using telemedicine, using methods such as Skype, video and telephone consultations⁸⁻¹³. For example, Haukipuro et al.¹² randomized both new and review orthopaedic patients to receive their examination either at their surgeon's office, or via videoconferencing at their general practitioners office, where the orthopaedic surgeon guided the general practitioner throughout the examination. They found that the video assessments were feasible, and patients were satisfied with this method of follow-up. Although a video assessment may save the patient having to travel to see their orthopaedic surgeon in person, there are still the same time requirements involved in the

assessment for both patient and surgeon, in addition to time required from the general practitioner as well as the use of expensive cameras, equipment, and monitors to conduct the assessment.

With the rapid increase in internet accessibility, it seems that a more efficient method would be to conduct the entire assessment electronically, including completion of questionnaires using a web-based program, and online review of the radiographs by the surgeon. For a web-based method of follow-up to be valid, we first needed to determine whether or not patients responded similarly to electronic versions of the questionnaires compared to responses provided on paper.

This led to the development of our three research questions: 1) Do patients respond similarly to electronic and paper versions of quality of life questionnaires? 2) Is a web-based follow-up following total joint replacement surgery feasible, cost saving and clinically effective compared to the usual method of in person follow-up? and 3) Are patients satisfied with a web-based follow-up method?

The following chapters present the results from three separate studies designed to answer each of our research questions. Each study is presented in manuscript form.

1.1 References

1. Kopec JA, Rahman MM, Berthelot JM, Le Petit C, Aghajanian J, Sayre EC, et al. Descriptive epidemiology of osteoarthritis in British Columbia, Canada. *J Rheumatol* 2007 Feb;34(2):386-93.
2. Perruccio AV, Power JD, Badley EM. Arthritis onset and worsening self-rated health: a longitudinal evaluation of the role of pain and activity limitations. *Arthritis Rheum* 2005 Aug 15;53(4):571-7.

3. Badley EM, Wang PP. Arthritis and the aging population: projections of arthritis prevalence in Canada 1991 to 2031. *J Rheumatol* 1998 Jan;25(1):138-44.
4. Badley EM, Rothman LM, Wang PP. Modeling physical dependence in arthritis: the relative contribution of specific disabilities and environmental factors. *Arthritis Care Res* 1998 Oct;11(5):335-45.
5. Badley EM. The effect of osteoarthritis on disability and health care use in Canada. *J Rheumatol Suppl* 1995 Feb;43:19-22.
6. Badley EM. The impact of disabling arthritis. *Arthritis Care Res* 1995 Dec;8(4):221-8.
7. Canadian Joint Replacement Registry. Hip and Knee Replacements in Canada: Canadian Joint Replacement Registry (CJRR) 2008–2009 Annual Report. 2009.
8. Wood G, Naudie D, MacDonald S, McCalden R, Bourne R. An electronic clinic for arthroplasty follow-up: a pilot study. *Can J Surg* 2011 Dec;54(6):381-6.
9. Wallace P, Haines A, Harrison R, Barber J, Thompson S, Jacklin P, et al. Joint teleconsultations (virtual outreach) versus standard outpatient appointments for patients referred by their general practitioner for a specialist opinion: a randomised trial. *Lancet* 2002 Jun 8;359(9322):1961-8.
10. Good DW, Lui DF, Leonard M, Morris S, McElwain JP. Skype: a tool for functional assessment in orthopaedic research. *J Telemed Telecare* 2012;18(2):94-8.

11. Couturier P, Tyrrell J, Tonetti J, Rhul C, Woodward C, Franco A. Feasibility of orthopaedic teleconsulting in a geriatric rehabilitation service. *J Telemed Telecare* 1998;4 Suppl 1:85-7.
12. Haukipuro K, Ohinmaa A, Winblad I, Linden T, Vuolio S. The feasibility of telemedicine for orthopaedic outpatient clinics--a randomized controlled trial. *J Telemed Telecare* 2000;6(4):193-8.
13. Harno K, Arajärvi E, Paavola T, Carlson C, Viikinkoski P. Clinical effectiveness and cost analysis of patient referral by videoconferencing in orthopaedics. *J Telemed Telecare* 2001;7(4):219-25.

Chapter 2

2 Patients respond similarly to paper and electronic versions of the WOMAC and SF-12 following total joint replacement

2.1 Introduction

Patient self-ratings of quality of life, general health, and functional status are often considered one of the preferred methods of evaluating patient outcomes following total joint replacement surgery. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and Short-Form Health Survey (SF-12) are two commonly used health outcome measures to evaluate patients undergoing total joint replacement surgery.

Typically patients complete these questionnaires on paper and the data are then entered by research staff into an electronic database at a later date. This method may, however, increase the risk of errors including data tampering, translation errors, or misplacing the paper form before it is entered into the electronic database. One solution is to have patients complete the questionnaires directly online. Online data collection is becoming increasingly popular in clinical health research. Other advantages of electronic data collection include timed data entry, and the ability for patient's to complete self-report assessments outside of the clinic, prior to their appointment, to save time in clinic.

It is possible that patients may respond differently to electronic versions of questionnaires compared to the traditional paper method, or that the location in which they complete the questionnaire may affect their responses (home versus clinic). The purpose of this study is to determine the agreement between responses on an electronic version and a paper version of the WOMAC and the SF-12(v2) questionnaires in patients who have had a total hip or total knee replacement.

2.2 Methods

Potentially eligible patients were recruited at their regularly scheduled follow up visit at the orthopaedic clinic, prior to their appointment with their surgeon. Consenting patients were asked to complete both an electronic and paper version of a disease-specific and a general health questionnaire. The order in which they completed the two versions of the questionnaires was randomly assigned, with a one week interval between completing the two versions. One week was chosen so that no true change was likely to occur in the patient's health status, but that a sufficient amount of time would have passed so that they could not simply remember their previous responses¹. Participants completed the first version in the clinic following their consultation with the surgeon, and were asked to complete the second version at home, the following week.

Participants who were randomized to the electronic version first completed the questionnaires using a computer in the clinic during their consultation with their surgeon. They were sent home with paper copies of the same questionnaires, were provided with a pre-stamped return envelope, and were asked to complete the questionnaires in one week and mail them to the study coordinator. Patients received a reminder phone call to complete their forms on the day the questionnaires were due.

Participants who were randomized to complete the paper versions first completed the questionnaires in the clinic during their appointment with their surgeon. They were sent home with instructions as to how to log onto and use the online database. Patients were sent a reminder email one week later asking them to log on and complete the electronic version of the questionnaires.

2.2.1 Eligibility Criteria

We included patients who had received either a primary total knee or total hip replacement, and who were at least one year post-operative, and due for their normally scheduled annual follow-up appointment. We excluded patients who had had revision surgery, patients with osteolysis, or those with previous complications, and identified radiographic issues. We also excluded patients with no fixed address, those who would

not be able to complete the questionnaires due to major psychiatric illness, cognitive impairments, or those unable to speak or understand English.

Patients were randomized using a computer algorithm with permuted block sizes of two and four, using a computer-generated randomization scheme. To facilitate the balance of potential prognostic characteristics between groups, randomization was stratified by surgeon.

2.2.2 Outcome Measures

Participants were required to complete both a paper and electronic version of the Western Ontario and McMaster Universities Osteoarthritis index (WOMAC), and the Short-Form Health Survey version 2(SF-12).

The WOMAC is a 24-item, disease-specific questionnaire, consisting of 24 questions, divided into three domains: pain, stiffness, and difficulty with physical function. The WOMAC is a valid, reliable instrument that is sensitive to change²⁻⁴. A change in score of 9 to 12 points has been shown to be a clinically important difference among patients with osteoarthritis⁴.

The SF-12 is a 12-item generic health instrument that evaluates eight domains including restrictions or limitations on physical and social activities, normal activities and responsibilities of daily living, pain, mental health and well-being, and perceptions of health. The SF-12 is valid, reliable, and responsive in a wide variety of populations and contexts including patients with orthopedic conditions⁵.

When patients completed their questionnaires for the second time, they also completed a Global Rating of Change questionnaire to assess whether the patient perceived that there had been a true change in their pain, ability to function, or symptoms related to their joint replacement. Those patients who indicated that a change had occurred were excluded from the analysis.

2.2.3 Sample Size

To provide estimates of agreement between the electronic and paper versions of the data, the appropriate calculation to determine sample size requirement is one that allows us to estimate a parameter (test-retest reliability = 0.90) with a pre-specified level of precision (0.10). Using sample size calculations for estimating a parameter⁶ we required a total of 56 participants (28 per group).

2.2.4 Statistical Analysis

Our first objective was to determine the validity of the electronic ratings. We assumed that ratings provided on the paper versions of the questionnaires provided a gold standard of patients' quality of life, functional status, and general health and that, if valid, the scores from the electronic versions would accurately predict the scores obtained on paper. Our second objective was to measure the agreement between electronic and paper versions of the questionnaires. We assumed that both modes were measuring the same construct and would therefore have high agreement or reliability.

To assess the validity of the electronic ratings, we performed a linear regression to determine the ability of patients' electronic scores on the questionnaires to predict the scores obtained on the paper versions. We then constructed scatterplots of the data with 95% prediction lines to explore the variability (between- and within-subject) and agreement between the two ratings at the group and individual levels.

We compared overall mean scores using a paired t-test to determine whether there were any significant systematic differences between the electronic and paper ratings. To estimate the magnitude of the association between electronic and paper data, we calculated an intraclass correlation coefficient (ICC) (two-way mixed model with measures of consistency) for each instrument and its 95% confidence interval. We considered ICC values greater than or equal to 0.75 as indicators of excellent agreement, and values less than 0.75 as poor to moderate agreement⁷.

Finally, we calculated the standard error of measurement (S.E.M.) and its 95% confidence intervals. The ICC provides information about the total variance (between and

within-subject variability and random error), whereas the S.E.M. expresses individual measurement error only, without the influence of variance among patients⁸.

2.3 Results

A total of 69 patients were screened for the study. Eight patients were not eligible (6 did not have access to a computer, and 2 were non-English speaking). Of the 61 remaining patients, 2 were withdrawn because they did not complete or return the second version of their questionnaires, leaving 59 patients who completed the study. Six patients indicated that their health status had changed on the Global Rating of Change Score, and were therefore removed from the dataset, leaving 53 patients in the final analysis.

The mean age of study participants was 69 years (range, 50 to 90 years). Fifty-two percent of patients had a primary total hip arthroplasty, while 48% had a primary total knee arthroplasty. Table 2.1 provides a detailed description of the demographic characteristics of the study participants.

Table 2.1: Demographic Characteristics of Participants

Characteristic	(N=53)
Gender	
Male	23 (43.4%)
Female	30 (56.6%)
Age (years)*	69.1 (10.3)
Joint Replaced	
Hip	27 (50.9%)
Knee	26 (48.1%)
Employment Status	
Retired	36 (67.9%)
Employed Full time	9 (17.0%)
Employed Part time	5(9.4%)
Disability	3 (5.7%)

*Mean (standard deviation)

2.3.1 Validity

Ratings provided on the electronic versions of the questionnaires were a significant predictor of ratings provided on paper across all questionnaires ($p < 0.001$). Similarly, Pearson's correlation coefficients indicated excellent association between ratings (WOMAC, $r = 0.93$, SF-12 PCS, $r = 0.91$, and SF-12 MCS, $r = 0.83$). (Table 2.2). Scatterplots of electronic versus paper ratings were also suggestive of high levels of agreement (Figure 2.1). Residual analysis of the data verified that it was consistent with the assumptions of linear regression (linearity, normality, and homoscedasticity).

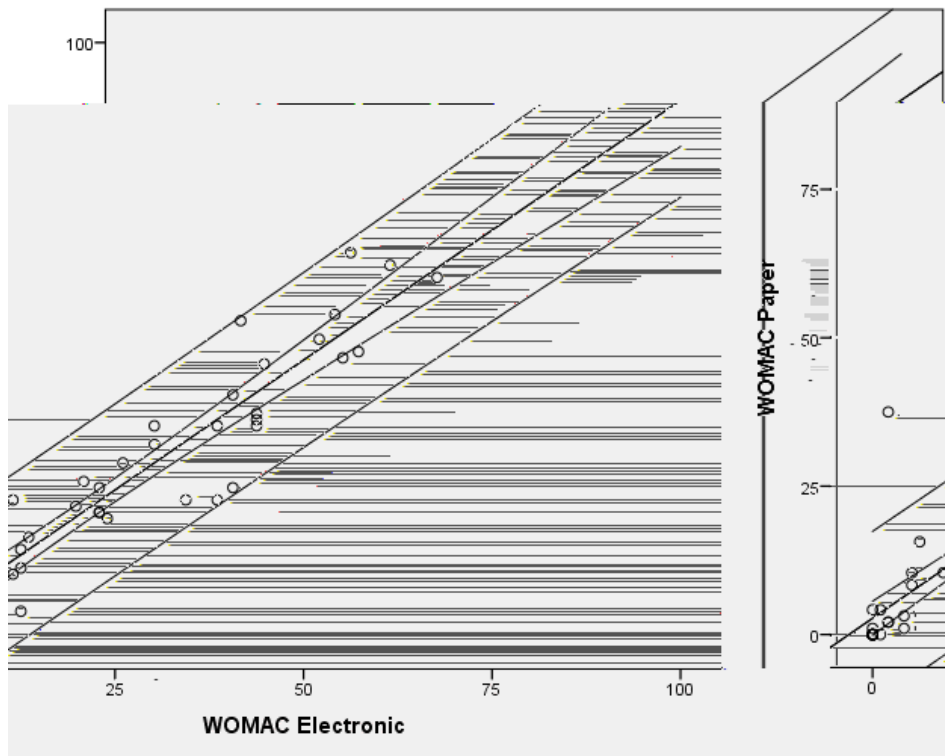
Table 2.2: Predictive validity of using electronic questionnaires in place of paper ratings

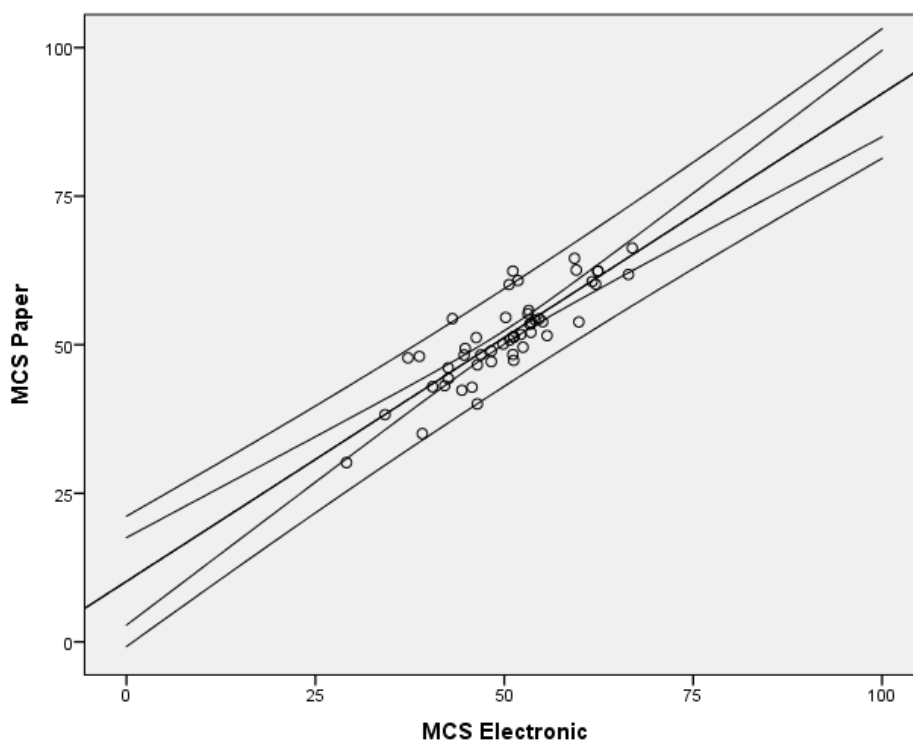
Questionnaire	Pearson's r	Coefficient (B)
WOMAC (Total)	0.93	0.88 (0.78 to 0.98), $p < 0.001$
SF-12 (PCS)	0.91	0.94 (0.81 to 1.00), $p < 0.001$
SF-12 (MCS)	0.83	0.80 (0.64 to 0.96), $p < 0.001$

Abbreviations: WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index, SF-12=Short-Form Health Survey, PCS=Physical Component Score, MCS=Mental Component Score

Figure 2.1 displays the scatterplots with 95% mean and individual prediction lines for the WOMAC (an example of large between-subject variability) and the MCS component of the SF-12 (an example of small between-subject variability). The SF-12 MCS scores of patients in our study population fell within the middle part of the scale, indicating that they (not surprisingly) do not represent the entire range of scores possible for the SF-12 among the general population. The WOMAC (disease specific questionnaire) shows a larger between-subjects effect, representing a greater proportion of the possible scores among an arthroplasty population, and therefore display greater between-subject variability (Figure 2.1).

Figure 2.1: Scatterplots with 95% Mean and Individual Prediction lines for the WOMAC and the SF-12 Mental Component Score





The mean difference between scores on the paper and electronic versions of the WOMAC was small and non-significant (0.04, $p=0.81$); The SF-12 Physical and Mental component score mean differences were also quite small, but the difference was statistically significant due to the small between-subject variability (1.80, $p=0.01$, and 1.18, $p=0.05$, respectively) (Table 2.3).

Table 2.3: Mean Difference between electronic and paper versions of questionnaires

Questionnaire	Mean (SD)	Mean Difference (95% CI)	p-value
WOMAC			
Paper	21.76 (19.7)	0.04 (-2.04 to 2.16)	0.81
Electronic	21.72 (20.60)		
SF 12 PCS			
Paper	42.70 (12.12)	1.80 (0.40 to 3.21)	0.01
Electronic	44.50 (11.80)		
SF 12 MCS			
Paper	51.44 (7.65)	1.18 (-0.02 to 2.37)	0.05
Electronic	50.27 (7.94)		

Abbreviations: WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index, SF-12=Short-Form Health Survey, PCS=Physical Component Score, MCS=Mental Component Score, SD=Standard Deviation, CI=Confidence Interval

2.3.2 Reliability

The ICC values for both the WOMAC and the SF-12 were high, indicating excellent agreement between the paper and electronic versions (WOMAC ICC=0.96, 95% CI 0.94 to 0.98), SF-12(PCS) ICC=0.95, 95% CI 0.92 to 0.97; SF-12(MCS) ICC=0.92, 95% CI 0.86 to 0.95). The standard error of measurement was small for all questionnaires, suggesting a small degree of within subject error (Table 2.4).

Table 2.4: Agreement between paper and electronic versions

Questionnaire	ICC	95% CI	SEM	95% CI
WOMAC	0.96	0.94 to 0.98	5.33	4.47 to 6.59
SF-12 (PCS)	0.95	0.92 to 0.97	3.53	2.95 to 4.39
SF-12 (MCS)	0.92	0.86 to 0.95	3.01	2.52 to 3.74

Abbreviations: WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index, SF-12=Short-Form Health Survey, PCS=Physical Component Score, MCS=Mental Component Score, ICC=Intraclass Correlation Coefficient, CI= Confidence Interval, SEM=Standard error of measurement

2.4 Discussion

Electronic data collection offers many advantages over the traditional method of collecting patient self-report outcomes on paper. We looked at the agreement between responses on an electronic and a paper version of the WOMAC and the SF-12(v2) questionnaires in patients who had a total hip or total knee replacement. Our results show that patients respond similarly to electronic versions of the WOMAC and the SF-12 v2, therefore validating the use of electronic data collection to evaluate outcomes following surgery in a lower extremity arthroplasty population.

Our results are consistent with several other studies⁹⁻¹⁴ that have assessed agreement between electronic and paper versions of many questionnaires across various patient populations. To our knowledge this is the first randomized study to assess agreement between electronic and paper versions of the WOMAC and SF-12 (v2) in both a total hip and total knee arthroplasty population. Other strengths include the methodological design, the use of different types of self-assessment instruments (both disease-specific

and generic), and a wide spectrum of patients included in our population (both hip and knee replacement patients).

A limitation of this study may be the generalizability of the results to other patient populations which also use the WOMAC and SF-12 questionnaires. Our results are applicable only to total hip and total knee patients at least one year following surgery. Moreover, two patients in the current study were withdrawn because they did not complete or return the second version of their questionnaire suggesting there may be difficulty obtaining complete data when questionnaires are completed outside of the clinic.

Otherwise, we found that only six of the 69 patients screened (8%) declined to participate due to lack of computer or internet access at home, therefore computer use in this population was not considered to be a limitation. Other methods of electronic data capture are also becoming popular for use in clinic situations, such as touch screen computers and hand held devices, which may increase our ability to capture data online. Future studies are needed to assess the agreement between these various methods of electronic data collection.

2.5 Conclusion

Scores obtained on the electronic versions of the WOMAC and the SF-12 had excellent agreement with the paper versions. Online data collection may be substituted for the traditional paper method with no significant effect on the validity of the questionnaires. Switching to online data collection could potentially reduce time required by research staff, reduce the chance of error in data entry, and provide greater security and protection against loss of data.

2.6 References

1. Marx RG, Menezes A, Horovitz L, Jones EC, Warren RF. A comparison of two time intervals for test-retest reliability of health status instruments. *J Clin Epidemiol* 2003 Aug;56(8):730-5.
2. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol* 1988 Dec;15(12):1833-40.
3. Davies GM, Watson DJ, Bellamy N. Comparison of the responsiveness and relative effect size of the western Ontario and McMaster Universities Osteoarthritis Index and the short-form Medical Outcomes Study Survey in a randomized, clinical trial of osteoarthritis patients. *Arthritis Care Res* 1999 Jun;12(3):172-9.
4. Ehrich EW, Davies GM, Watson DJ, Bolognese JA, Seidenberg BC, Bellamy N. Minimal perceptible clinical improvement with the Western Ontario and McMaster Universities osteoarthritis index questionnaire and global assessments in patients with osteoarthritis. *J Rheumatol* 2000 Nov;27(11):2635-41.
5. Ware J,Jr, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996 Mar;34(3):220-33.
6. Bonett DG. Sample size requirements for estimating intraclass correlations with desired precision. *Stat Med* 2002 May 15;21(9):1331-5.
7. Portney LG, Watkins MP. Foundations of clinical research: applications to practice. 3rd ed. Upper Saddle River, N.J.: Pearson/Prentice Hall; 2008; 2009.
8. Stratford PW, Goldsmith CH. Use of the standard error as a reliability index of interest: an applied example using elbow flexor strength data. *Phys Ther* 1997 Jul;77(7):745-50.

9. 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 Joint Surg Am* 2011 Feb 2;93(3):285-93.
10. Kongsved SM, Basnov M, Holm-Christensen K, Hjollund NH. Response rate and completeness of questionnaires: a randomized study of Internet versus paper-and-pencil versions. *J Med Internet Res* 2007 Sep 30;9(3):e25.
11. Basnov M, Kongsved SM, Bech P, Hjollund NH. Reliability of short form-36 in an Internet- and a pen-and-paper version. *Inform Health Soc Care* 2009 Jan;34(1):53-8.
12. 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 May-Jun;27(3):459-68.
13. Olajos-Clow J, Minard J, Szpiro K, Juniper EF, Turcotte S, Jiang X, et al. Validation of an electronic version of the Mini Asthma Quality of Life Questionnaire. *Respir Med* 2010 May;104(5):658-67.
14. Wood G, Naudie D, MacDonald S, McCalden R, Bourne R. An electronic clinic for arthroplasty follow-up: a pilot study. *Can J Surg* 2011 Dec;54(6):381-6.

Chapter 3

3 Feasibility, Clinical Effectiveness and Costs Associated with a Web-Based Joint Replacement Follow-Up Assessment

3.1 Introduction

Arthritis is one of the most common chronic conditions, and is a leading cause of pain, physical disability and use of health care services¹⁻⁶. Total joint replacement surgery is an effective procedure to alleviate pain and improve function for patients with advanced osteoarthritis. The incidence of major medical complications and death following total joint arthroplasty is low, with the majority of complications occurring in the first year post-operative⁷. Complications can occur both early (thromboembolic events, infection, stiffness, instability) and late (infection, wear, implant loosening and failure). It is generally common practice to monitor patient outcomes and the performance of the implant through an annual follow-up visit. Because of the low rate of post-operative complications, the majority of follow-up visits are uneventful with no change in clinical management.

The increasing demand for arthroplasty has resulted in longer wait times. For example in Canada, the mean wait time in 2006-2007 for total hip arthroplasty was 182 days, and the mean wait time for knee arthroplasty surgery was 237 days⁸. Thus, there is great interest from policy makers, clinicians and patient advocate groups to explore opportunities to reduce wait times.

Routine follow-up appointments are a time consuming process for all involved, including patients, often their families or caregivers who accompany them to visits, as well as the surgeon, clinic and research staff. The technology and resources now exist to enable assessment to take place without the patient physically coming to see the surgeon. This alternative method of conducting patient follow up assessments could significantly reduce wait times in orthopaedic clinics, allowing more time for surgeons to see new patients, as well as to free up more of the surgeon's time to operate. A web-based

approach to follow-up could also potentially reduce patient burden by decreasing travel distances, as well as financial and time requirements of patients and their caregivers.

A small pilot study conducted at our institution⁹ found that an electronic follow-up was less costly and time consuming for patients compared to the usual in-person clinic follow-up. The purpose of this study was to assess the feasibility, costs, and clinical effectiveness of a web-based follow-up compared to the usual method of in-person annual follow-ups at the clinic, following total hip or knee replacement surgery.

3.2 Patients and Methods

This was a single-centre, randomized controlled trial with five surgeons participating in recruitment. A consecutive sample of elective primary total hip and total knee replacement patients, who were at least 12 months post-operative were recruited from the London Health Sciences Centre, University Hospital. Patients were randomized into one of two groups. Group 1 completed a web-based follow-up assessment and Group 2 completed the current standard in-person follow-up.

3.2.1 Group 1 – Web-based Follow-up

Group 1 participants underwent a web-based follow-up in place of their usual in-person follow-up visit at the orthopaedic clinic. The web-based follow-up included having x-rays taken at a web-enabled radiology facility nearest to the patient's home. Local patients had their x-ray done at University Hospital. If the patient did not live in London, we arranged for their x-rays to be taken at an imaging centre nearest to the patient's home that was connected to the online Picture Archiving and Communication System (PACS) or ONEView, which allowed the surgeon to review the patient's x-ray online.

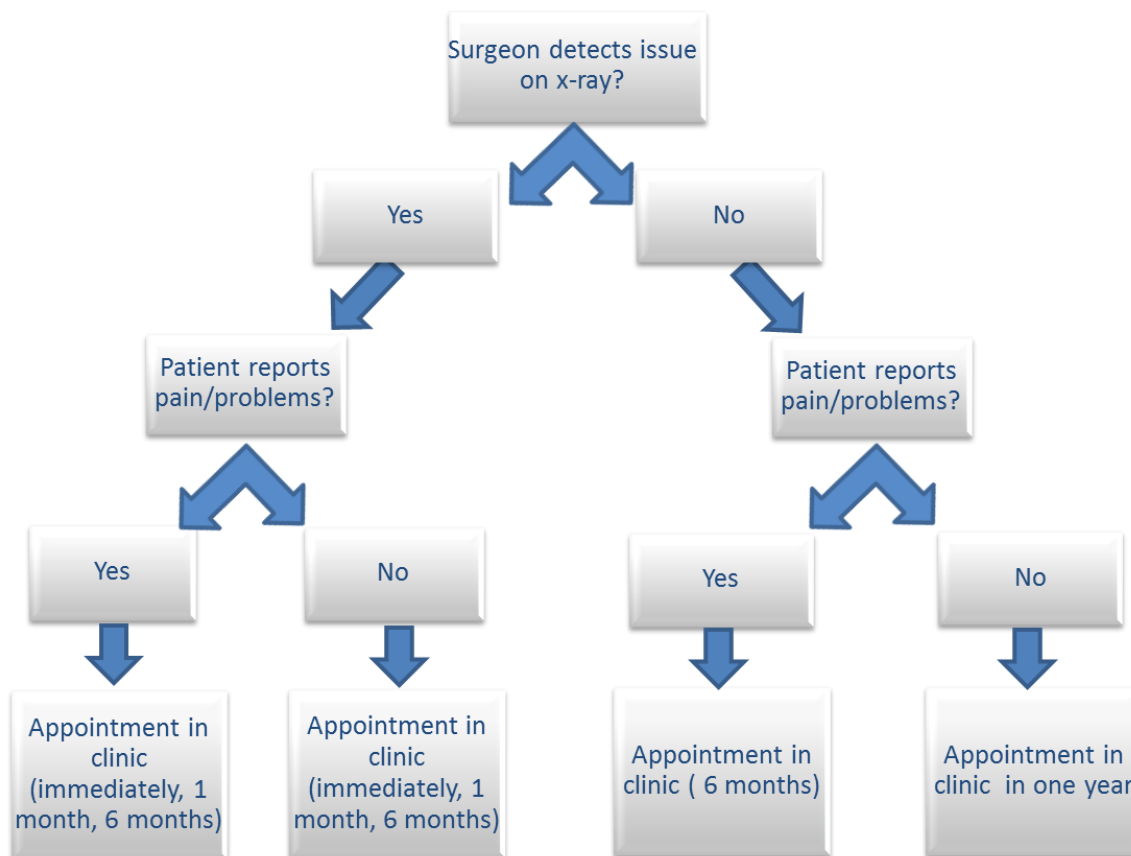
Patients were also asked to complete several patient-reported quality of life and function questionnaires, (normally completed on paper at the clinic), using an online database system. Database generated automatic email reminders were sent to the patient one week prior to their online appointment date. Patients were emailed the website, a unique username and password and instructions for completing the online questionnaires.

Each patient also completed a short history questionnaire online that contained two questions: 1) Do you have any pain or symptoms in your replaced joint? and, 2) Do you have any problems in their other hip or knee? These two questions were identified by the surgeon investigators as being of primary importance in providing optimum care for their patients.

After the patient completed the online questionnaires and the x-ray, a database-generated automatic alert was emailed to the surgeon requesting him to review the images and responses to the history questions. If the surgeon saw anything of concern on the x-rays, an appointment was booked for the patient to see the surgeon in clinic. If the patient responded 'yes' to either of the two history questions, then an appointment was requested even if the x-rays were unremarkable. The surgeon indicated when they would like to see the patient back in clinic (either immediately, within one month, within six months, or in one year) depending on the perceived urgency of the problem. If the patient was having no pain or symptoms (i.e. responded 'no' to both history questions) and there were no problems noted on the radiographs, the patient was scheduled for their next annual follow-up visit at the clinic in one year.

Once the surgeon had indicated when they would like to see the patient back in clinic, an automatic email was sent to the surgeon's administrative assistant asking her to book the appointment time within the specified timeframe. An email was also sent to the patient indicating when the surgeon would like to see them, and notifying them that his administrative assistant would be in contact with them to book this appointment (Figure 3.1).

Figure 3.1: Web-based Assessment Process



3.2.2 Group 2 – Usual care, In-Clinic Follow-up Assessment

Patients randomized to the usual care group had their follow-up appointment in-person at the orthopaedic clinic at London Health Sciences Centre, University Hospital. Prior to their appointment, patients had their x-rays taken at the hospital, as per usual protocol. Patients completed the same series of questionnaires as the web-based group but they were completed on paper, prior to their appointment.

3.2.3 Eligibility Criteria

We included all patients who had received a primary total knee or total hip replacement that were at least 12 months post-operative, and approaching their annual follow-up visit with their surgeon. We excluded patients who had revision surgery, patients with

osteolysis, or previous complications and identified radiographic issues. We also excluded patients with no fixed address, those who would not be able to complete the questionnaires due to major psychiatric illness, cognitive impairments, or those unable to speak or understand English. If patients indicated that they did not have a computer or internet access, we encouraged them to have a friend or family member assist them, or to use a local library or internet café to complete their online assessment.

3.2.4 Randomization

Patients were randomly allocated to either the web-based or usual care group using a computer-generated randomization scheme. To facilitate the balance of potential prognostic characteristics between groups, randomization was stratified by the time from surgery (one to five years versus five years or greater) and the distance each patient travels to the clinic (greater than 100 kilometers versus less than 100 kilometers).

3.2.5 Outcome Measures

All patients completed the Western Ontario and McMaster Universities Osteoarthritis index (WOMAC), Harris Hip Score (if THA), SF-12 v2, EQ-5D, and a cost questionnaire, which included travel distances, costs, total time spent in x-ray, time spent in clinic and time taken off paid employment to attend the appointment.

The WOMAC is a 24-item, disease-specific questionnaire. The index consists of 24 questions, divided into three domains: pain, stiffness, and difficulty with physical function. Individual questions are assigned a score between 0 points (no pain, stiffness, or difficulty with physical functions) and 4 points (extreme pain, stiffness, or difficulty with physical functions). Domains are equally weighted and reported as sums, with a higher number indicating a greater burden of OA. The WOMAC is extensively used and has been shown to be a valid, reliable instrument that is sensitive to change¹⁰⁻¹².

The Medical Outcomes Study 12-Item Short Form Health Survey (SF-12v2)¹³ is a 12-item generic general health instrument that evaluates eight domains including restrictions or limitations on physical and social activities, normal activities and responsibilities of daily living, pain, mental health and well-being, and perceptions of health. The SF-12

correlates highly with the SF-36¹⁴⁻¹⁶, and has been shown to be valid, reliable, and responsive in a wide variety of populations and contexts including patients with arthritis¹⁷.

The EQ-5D index is a 5 item standardized generic measure of health-related quality of life that includes domains of mobility, self-care, usual activities, pain and discomfort and anxiety and depression. Each item is scored using a 3 point response scale and each combination of response choices describes a health state (243 unique health states). Each health state can be converted to a utility value from 0 (worst) to 1.0 (best) using a scoring formula. The EQ-5D index and VAS have demonstrated good test retest reliability^{18, 19} and good cross-sectional construct validity in patients with arthritis¹⁸⁻²⁰.

We asked patients in the web-based group to record the total distance travelled to their x-ray appointment. If they did not have a computer or internet access in their home, we recorded the distance travelled to the location where they completed their online forms. Patients in the usual care group reported the distance travelled to University Hospital for their x-ray and clinic visit. We also asked patients to report all costs associated with the follow up appointment including transportation costs (gas, parking fees) and accommodation costs, if any. We recorded the total time required to complete the follow up assessment for both groups, including time spent completing the online forms, wait time in x-ray, and total time spent at the orthopaedic clinic from the time the patient checked in until check out.

We also recorded the results of the online follow-up when patients in the web-based group returned for their next clinic visit. For those that were seen back in clinic early, either as a result of their x-ray or patient history, the surgeon noted whether they felt there was an actual problem that the patient needed to be seen in the clinic to address.

Web-based patients who did not report any problems were seen back in the clinic one year after their online follow-up. At this review appointment, the surgeon noted whether or not they felt that using the web-based system caused them to miss an issue with the patient.

3.2.6 Sample Size

We recruited all eligible patients due for their annual follow-up visit following a total hip or total knee arthroplasty between March 2010 and March 2011.

3.2.7 Statistical Analysis

We used descriptive statistics to summarize the costs and time required for each type of follow-up appointment. We compared the costs between the two groups using an independent sample student t-test (for normally distributed data), or the Mann-Whitney U test (for non-normal data), where we considered results to be significant at $p < 0.05$.

We also compared scores on the health-related quality of life questionnaires (WOMAC, EQ-5D, SF-12) between the two groups using an independent sample student t-test.

To determine the effectiveness of the web-based follow-up assessment, we report the frequency of: 1) patients who indicated they were having problems or pain, 2) patients who had an identified radiographic issue, detected by the surgeon, 3) patients who the surgeon felt actually had a significant issue that needed to be seen in clinic to address, and 4) patients who the surgeon felt an issue was missed by using the web-based follow-up.

3.3 Results

There were 427 eligible patients contacted for the study during the recruitment period. Of these 256 agreed to participate. The most common reasons for non-participation included: no computer/internet access (23%), having problems or pain they wanted to discuss with their surgeon (9.2 %), and a preference to see the surgeon in person (12.5 %). A total of 229 (89.4%) patients (118 Web, 111 Usual) completed the study (Figure 3.2). The two groups were similar in age, time from surgery, distance travelled, and joint replaced. Demographic characteristics of the study participants and non-participants are listed in Table 3.1.

Figure 3.2: Flow of patients through trial

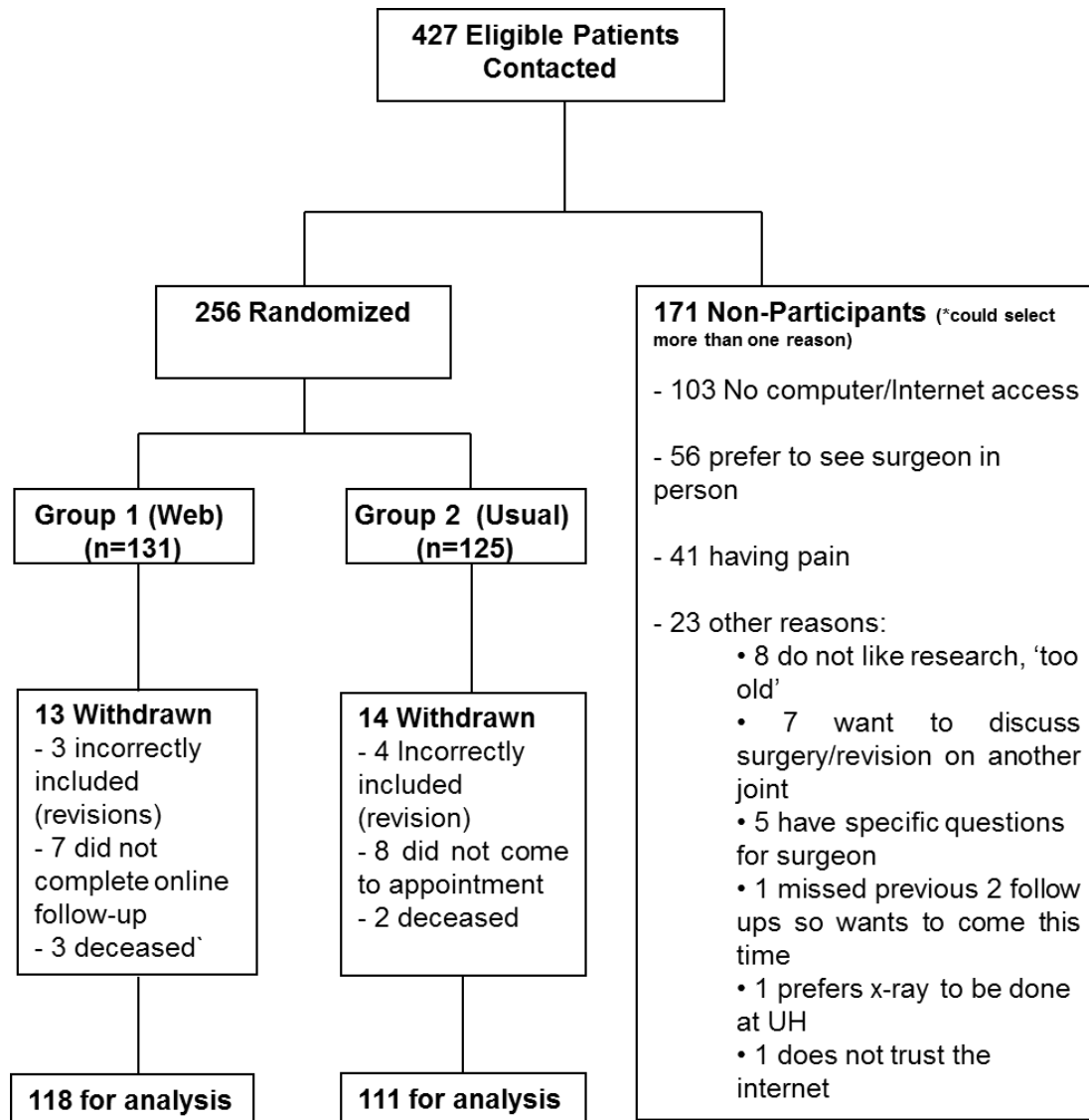


Table 3.1: Demographic characteristics of participants and non-participants

Characteristic	Web-based (n=118)	Usual Care (n=111)	Non- Participants** (n=171)	p-value
Gender				
Female	66 (55.5%)	61 (56.0%)	102 (59.6%)	0.42
Age (years)*	68.8 (10.0)	66.4 (11.5)	73.9 (12.8)	<0.01
Joint Replaced				
Hip	52 (44.1%)	53 (48.2%)	80 (46.8%)	0.53
Knee	68 (57.6%)	58 (52.7%)	93 (54.4%)	0.47
Time Post-operative (years)*	5.0 (3.4)	5.0 (3.2)	5.7 (4.1)	<0.01
Distance from UH (km)*	101.3 (119.6)	102.1 (173.3)	91.0 (146.3)	0.53
Womac Total Score*	82.0 (16.3)	81.6 (19.1)		

*Mean (standard deviation)

** Includes those who were eligible for the study but declined to participate

3.3.1 Clinical Effectiveness of Web-Based Follow-Up

There were no significant differences in any of the quality of life outcome scores between the two groups (WOMAC, SF-12, Harris Hip Score, EQ-5D) (Table 3.2).

Table 3.2: Quality of Life Scores

	Mean (SD)*		Mean Difference (95% C.I.)	p-value
	Web-based (n=118)	Usual Care (n=111)		
WOMAC	82.0 (16.3)	81.6 (19.1)	0.38 (-4.3 to 5.1)	0.87
SF-12 (PCS)	43.5 (11.1)	41.7 (11.9)	1.8 (-1.3 to 4.8)	0.25
SF-12 (MCS)	54.4 (9.5)	53.3 (10.2)	1.1 (-1.5 to 3.7)	0.41
EQ-5D	0.84 (0.15)	0.84 (0.14)	0.0 (-0.04 to 0.04)	0.97

*Mean (standard deviation)

Abbreviations: WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index, SF-12=Short-Form Health Survey, PCS=Physical Component Score, MCS=Mental Component Score.

A total of 120 patients completed the web-based follow-up with a mean age of 68.9 years. Twenty-five patients reported that they were having pain or problems in either their replaced joint or in their other hip or knee. Of these patients there were 16 who the surgeon also wanted to see based on their x-ray. All 25 patients were brought in to have an in-person consultation with their surgeon. Eight (32%) were considered to have a

significant issue that needed to be seen in clinic to address. These issues included: pain in the operative joint (3 patients), and osteoarthritis in the contralateral joint (5 patients). Two of these patients were given a steroid injection, three were booked for a joint replacement of the contralateral side, and the remaining were asked to return again in three months for review.

Of the 95 patients who had no issues at the time of their web-based follow-up, 83 have been seen back in clinic for a follow-up. Of those who did not return to clinic, three patients are hospitalized with other health issues and were unable to return, two are deceased, and the remaining seven patients have verbally indicated that they are having no issues and do not wish to come back. Of the patients who did return for review (approximately one year after the web-based assessment), there were none who the surgeon felt had problems or issues that were missed by using the web-based system.

3.3.2 Costs

The median distance travelled by patients in the web-based group was 13.5 kilometers. This included travel to the hospital or imaging centre where they had their x-ray appointment and travel to a location with a computer and internet access, if necessary. For the usual care group, the median distance travelled to University Hospital for their x-ray and follow-up appointment was 34 kilometers.

The average costs associated with the appointment for patients who completed the web-based follow-up was \$5.50, compared to \$19.00 for those in the usual care group ($p < 0.01$). Costs reported include gas, parking, taxi and public transportation fees.

The median total time spent completing the appointment for the web-based group was 90.5 minutes (including online form completion (30 min), x-ray appointment(40 min) and travel (10 min)) compared to 152.1 minutes for those who were in the usual care group

(including travel time (30 min), x-ray (45 min) and clinic appointments(60 min)) ($p < 0.01$).

The median amount of time that caregivers of patients in the web-based group spent assisting the patient with their follow-up was 30 minutes, whereas the median time assisting patients in the usual care group was 105 minutes ($p < 0.01$). (Table 3)

Table 3.3: Costs Associated with Follow-Up Assessment

	Web-Based (n=118)	Usual Care (n=111)	p-value
Travel Distance (km)	13.5 (1-600)	34 (2-1500)	<0.01
Travel Costs (CAN \$)	5.50 (0.00 to 63.50)	19.00 (8.00 to 60.00)	<0.01
Time to complete (min)	90.50 (25-500)	152.1 (40-900)	<0.01
Caregiver Assistance (min)	30 (1-120)	105 (60-480)	<0.01

*data are reported as median and range

3.4 Discussion

The continually rising incidence of osteoarthritis has led to an increased demand for total joint arthroplasty, resulting in longer wait times for surgery and overcrowded clinics with both new and post-operative review patients. Routine follow-up appointments are a time consuming and costly process for all involved. The results of this study show that a web-based follow-up assessment is feasible, clinically effective and represents a cost-saving alternative for monitoring the progress and outcomes of total hip and total knee replacement patients.

Only 23% of the eligible patients approached for the study declined to participate due to lack of computer or internet access. The average age of the patients in our study was 68 years, which is similar to the typical arthroplasty patient in Canada⁸. The mean age

however of those patients who refused participation was 74 years, suggesting that computer access may be age-related. Although age may be a barrier to web-based follow-up assessment for this older patient group, our results show that the majority of patients did in fact have computer access and felt comfortable enough using this technology to complete a follow-up. With the rapidly growing use of technology, and the new generation of patients who will be needing joint replacement surgery, we feel that a web-based assessment program will be applicable to an even greater proportion of arthroplasty patients in the near future.

Of the 41 eligible patients who declined to participate because they were having problems or pain, there were 11 who actually had an identified problem noted at their clinic visit that required further treatment or follow-up. Similarly, of the non-consenting patients who indicated that they preferred to see the surgeon in person, just four had an issue that needed to be addressed in person, suggesting that the rest of these patients could have been more efficiently assessed using the web-based method.

Our results show that there were significant time and cost savings to patients in the web-based group compared to patients who appeared in-person for their assessment. Patients who completed the web-based follow-up assessment had fewer costs associated with their appointment, and significantly reduced travel time and distance. The web-based follow up also required a shorter amount of time to complete, and involved less caregiver time and assistance.

Surgeon time is also greatly reduced with the web-based follow-up method. Each web-based patient assessment took the surgeon approximately five minutes to complete (including review of x-ray and completion of online forms), whereas previous results have shown that the average length of time for an in-person assessment at the clinic is 35 minutes (including review by a nurse practitioner, the resident or fellow, and the consultant surgeon)⁹.

Notably, there were no problems with missing data by patients who completed the questionnaires online. The database we used was programmed to instantly alert the patient and the research assistant when a form was incomplete. Previous research in our

clinic has shown that paper completion of forms results in a number of missing values⁹. For the current study, the research assistant was with the patient in clinic as they completed their paper forms, which is not our usual practice, and therefore notified the patient if there were any questions missed. In a typical clinic situation, patients complete these forms on their own in the waiting room prior to their appointment, and the data is entered at a later date, therefore no one is monitoring the completeness of data or charged with asking the patient to complete missed questions. Thus, online completion of questionnaires could help reduce the proportion of missing data, and therefore improve the quality of registry data. We have also previously shown that scores obtained on the electronic versions of the WOMAC and the SF-12 had excellent agreement with the paper versions²¹.

Perhaps most important is the fact that there was not a single patient for whom the surgeon felt that the web-based system caused them to miss an issue that would have been detected had the patient been seen in clinic. This implies that that the web-based assessment is a clinically effective means of tracking patient progress and outcomes following total hip or total knee replacement surgery. Further, the web-based program was sufficiently sensitive to detect complications, as the eight patients who did have a clinically significant issue that required further treatment were all appropriately brought back early as a result of their web-based follow-up assessment.

The use of telemedicine is becoming more widespread across numerous health care fields. There are several studies that have demonstrated the feasibility of using telemedicine in orthopaedics^{9, 22-27}, including video conferencing, telephone consultations, and Skype to conduct outpatient assessments. Results of these studies also show beneficial effects, including direct time and cost savings to patients; however the use of videoconferencing to conduct a patient follow-up assessment requires expensive equipment, and still requires the same amount of time for both surgeon and patient to conduct the review.

Wood et al.⁹ previously demonstrated that an electronic follow-up was feasible among 40 total hip and knee arthroplasty patients who completed both an electronic follow-up and

the usual clinic follow-up four weeks apart. They report direct time and cost savings of using the electronic follow-up method. Based on the encouraging results of their small pilot study, our current trial was designed to further investigate the financial impact, safety and clinical effectiveness of electronic follow-ups on a larger scale. To our knowledge, this is the first large randomized trial comparing a web-based follow-up assessment to in person consultations, in an orthopaedic population.

Further strengths of this study include the methodological design and large sample size, as well as the customized development of a web-based system, programmed specifically to facilitate the web-based follow-up process. Since our study involved patients who underwent a hip or knee replacement who were at least 12 months post-operative, further study is needed to determine whether the web-based follow-up method is effective for other types of consultation or if it is applicable to other patient populations.

A limitation of any web-based follow-up is that it does not allow for objective outcome measurements by the surgeon (e.g. Harris Hip Score and Knee Society Score). We used a patient-report version of the Harris Hip score, which has been shown to have high agreement with the original objective version²⁸, however there was no patient-reported version of the Knee Society Score available at the time of this study, therefore this outcome measure was not completed for total knee patients in the web-based group.

Although patient follow-ups after total joint arthroplasty are important for evaluating patient outcome and to monitor the performance of the implant and bearing, the majority of these visits are routine with no changes in clinical management. The ability to see new patients in place of follow-up patients, who can be effectively assessed electronically, can redirect limited outpatient resources to those patients awaiting first consultation, and therefore reduce overall wait times. Web-based follow up assessments reduce patient and caregiver burden by decreasing travel distances, and reduce financial and time requirements of attending annual follow-up appointments in-person.

3.5 Conclusions

Web-based follow-up assessment is a feasible and clinically effective means of tracking patient progress and outcomes following total hip or total knee replacement surgery. Moreover, web-based assessment significantly decreases costs to patients and time requirements associated with their annual follow-up appointments and significantly reduces the amount of time required by the surgeon to complete the assessment.

3.6 References

1. Kopec JA, Rahman MM, Berthelot JM, Le Petit C, Aghajanian J, Sayre EC, et al. Descriptive epidemiology of osteoarthritis in British Columbia, Canada. *J Rheumatol* 2007 Feb;34(2):386-93.
2. Perruccio AV, Power JD, Badley EM. Arthritis onset and worsening self-rated health: a longitudinal evaluation of the role of pain and activity limitations. *Arthritis Rheum* 2005 Aug 15;53(4):571-7.
3. Badley EM, Wang PP. Arthritis and the aging population: projections of arthritis prevalence in Canada 1991 to 2031. *J Rheumatol* 1998 Jan;25(1):138-44.
4. Badley EM, Rothman LM, Wang PP. Modeling physical dependence in arthritis: the relative contribution of specific disabilities and environmental factors. *Arthritis Care Res* 1998 Oct;11(5):335-45.
5. Badley EM. The effect of osteoarthritis on disability and health care use in Canada. *J Rheumatol Suppl* 1995 Feb;43:19-22.
6. Badley EM. The impact of disabling arthritis. *Arthritis Care Res* 1995 Dec;8(4):221-8.

7. Bohm ER, Dunbar MJ, Froid JJ, Johnson TM, Morris KA. Rehospitalizations, early revisions, infections, and hospital resource use in the first year after hip and knee arthroplasties. *J Arthroplasty* 2012 Feb;27(2):232,237.e1.
8. Canadian Joint Replacement Registry. Hip and Knee Replacements in Canada: Canadian Joint Replacement Registry (CJRR) 2008–2009 Annual Report. 2009.
9. Wood G, Naudie D, MacDonald S, McCalden R, Bourne R. An electronic clinic for arthroplasty follow-up: a pilot study. *Can J Surg* 2011 Dec;54(6):381-6.
10. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol* 1988 Dec;15(12):1833-40.
11. Davies GM, Watson DJ, Bellamy N. Comparison of the responsiveness and relative effect size of the western Ontario and McMaster Universities Osteoarthritis Index and the short-form Medical Outcomes Study Survey in a randomized, clinical trial of osteoarthritis patients. *Arthritis Care Res* 1999 Jun;12(3):172-9.
12. Ehrich EW, Davies GM, Watson DJ, Bolognese JA, Seidenberg BC, Bellamy N. Minimal perceptible clinical improvement with the Western Ontario and McMaster Universities osteoarthritis index questionnaire and global assessments in patients with osteoarthritis. *J Rheumatol* 2000 Nov;27(11):2635-41.
13. Ware J,Jr, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* 1996 Mar;34(3):220-33.
14. Riddle DL, Lee KT, Stratford PW. Use of SF-36 and SF-12 health status measures: a quantitative comparison for groups versus individual patients. *Med Care* 2001 Aug;39(8):867-78.

15. Blanchard CM, Cote I, Feeny D. Comparing short form and RAND physical and mental health summary scores: results from total hip arthroplasty and high-risk primary-care patients. *Int J Technol Assess Health Care* 2004 Spring;20(2):230-5.
16. Muller-Nordhorn J, Roll S, Willich SN. Comparison of the short form (SF)-12 health status instrument with the SF-36 in patients with coronary heart disease. *Heart* 2004 May;90(5):523-7.
17. 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 Jul;23(7):1080-98.
18. Fransen M, Edmonds J. Reliability and validity of the EuroQol in patients with osteoarthritis of the knee. *Rheumatology (Oxford)* 1999 Sep;38(9):807-13.
19. Hurst NP, Jobanputra P, Hunter M, Lambert M, Lochhead A, Brown H. Validity of Euroqol--a generic health status instrument--in patients with rheumatoid arthritis. Economic and Health Outcomes Research Group. *Br J Rheumatol* 1994 Jul;33(7):655-62.
20. Hurst NP, Kind P, Ruta D, Hunter M, Stubbings A. Measuring health-related quality of life in rheumatoid arthritis: validity, responsiveness and reliability of EuroQol (EQ-5D). *Br J Rheumatol* 1997 May;36(5):551-9.
21. Marsh J, Bryant D, MacDonald S, Naudie D. Patients respond similarly to paper and electronic versions of the WOMAC and SF-12 following total joint replacement. Unpublished.
22. Wallace P, Haines A, Harrison R, Barber J, Thompson S, Jacklin P, et al. Joint teleconsultations (virtual outreach) versus standard outpatient appointments for patients referred by their general practitioner for a specialist opinion: a randomised trial. *Lancet* 2002 Jun 8;359(9322):1961-8.
23. Wootton R, Bloomer SE, Corbett R, Eedy DJ, Hicks N, Lotery HE, et al. Multicentre randomised control trial comparing real time teledermatology with conventional

outpatient dermatological care: societal cost-benefit analysis. *BMJ* 2000 May 6;320(7244):1252-6.

24. Good DW, Lui DF, Leonard M, Morris S, McElwain JP. Skype: a tool for functional assessment in orthopaedic research. *J Telemed Telecare* 2012;18(2):94-8.

25. Couturier P, Tyrrell J, Tonetti J, Rhul C, Woodward C, Franco A. Feasibility of orthopaedic teleconsulting in a geriatric rehabilitation service. *J Telemed Telecare* 1998;4 Suppl 1:85-7.

26. Haukipuro K, Ohinmaa A, Winblad I, Linden T, Vuolio S. The feasibility of telemedicine for orthopaedic outpatient clinics--a randomized controlled trial. *J Telemed Telecare* 2000;6(4):193-8.

27. Harno K, Arajärvi E, Paavola T, Carlson C, Viikinkoski P. Clinical effectiveness and cost analysis of patient referral by videoconferencing in orthopaedics. *J Telemed Telecare* 2001;7(4):219-25.

28. Krause JS, Vines CL, Farley TL, Sniezek J, Coker J. An exploratory study of pressure ulcers after spinal cord injury: relationship to protective behaviors and risk factors. *Arch Phys Med Rehabil* 2001 Jan;82(1):107-13.

Chapter 4

4 Patient Experiences and Satisfaction with a Web-Based Follow-Up Assessment following Total Joint Replacement Surgery

4.1 Introduction

Osteoarthritis is one of the most prevalent chronic disorders in Canada, and is a leading cause of pain, physical disability, and health care utilization¹. Total joint replacement is a highly effective treatment option for arthritis. There were 62,196 hospitalizations for total hip and total knee replacements performed in Canada in 2006-2007¹.

The rate of post-operative complications following total joint replacement is low however annual patient review is important for evaluating patient outcomes. A web-based method of conducting patient follow-up assessments could significantly decrease wait times in orthopaedic clinics, for both new patients waiting for their first consultation with the surgeon, as well as the patients undergoing their annual visits. A more efficient process, with a shift in resources, could also potentially lead to decreased wait times for surgery. This approach could also potentially reduce patient and caregiver burden by decreasing travel, financial and time requirements involved with annual clinic follow-up visits.

We previously conducted a randomized controlled trial to investigate the costs and feasibility of a web-based follow-up assessment following total joint replacement surgery². The purpose of the current study was to gain feedback from patients who completed the web-based follow-up and to determine patient satisfaction and preference of follow-up method.

4.2 Methods

4.2.1 Randomized Controlled Trial

We randomized a consecutive sample of primary total hip and total knee replacement patients who were at least 12 months post-operative into one of two groups. Group 1 participants completed a web-based follow up assessment and Group 2 participants came to the orthopaedic clinic at University Hospital for their follow up appointment as per the usual protocol.

All participants completed a Satisfaction Questionnaire at the time of their follow-up visit for the study (either usual care or web-based). We asked them to rate their satisfaction level with the care they received at the follow-up visit, and specifically to consider whether they felt that the visit was sufficient to monitor their progress and identify any issues or complications. Patients also reported their satisfaction with the overall assessment process, in which we asked them to consider all aspects involved with completing the follow-up appointment, such as travel, time off work, wait time in x-ray, wait time at the clinic, or using the online database.

Patients who were in the web-based group also completed a second satisfaction questionnaire at their next annual follow-up visit at the clinic (approximately one year after their web-based follow-up). If not completely satisfied we asked the patient to specify which aspects of the web-based follow-up led to their dissatisfaction. The patients also indicated which method of follow-up (web-based or in person) they preferred and the factors that contributed to that choice.

4.2.2 Focus Group Session

Patients who had completed the web-based follow-up in the randomized trial were contacted by the research assistant to determine if they were interested in sharing their experiences during a focus group session. If interested, the patient was sent a Letter of Information explaining the study and its purpose. The letter was followed up with a

phone call from the research assistant to arrange a date, time and location for the focus group session.

Consenting patients were organized into homogenous groups., divided based on the distance the patient travels to University Hospital (greater than 100 kilometers or less than 100km), and the patient's age (greater than 70 years, or less than 70 years of age).

Each group of participants took part in a separately run focus group session, although the structure and content addressed was identical for each group. Each session lasted for approximately 60 minutes. The focus group sessions were videotaped and transcribed verbatim following the meeting.

We began each session with an opening question where participants introduced themselves and shared which joint was replaced and when their surgery took place. Each participant was then asked to share their experience with their follow-up appointment and provide feedback regarding aspects they liked or disliked about the procedure, according to a list of structured questions posed by the moderator. As each participant within the group shared their ideas, the session moderator recorded the contributions on a flip chart.

At the end of the session, participants were encouraged to ask any questions, share any agreements or disagreements with the points listed on the flip chart or bring up any further points they wished to discuss. The moderator provided a summary of the main ideas generated and gave participants the opportunity to clarify or add anything that they felt was missed.

4.2.3 Statistical Analysis

We used descriptive statistics to summarize the results from the satisfaction and preference questionnaires. We compared satisfaction levels between the two groups using Pearson's chi-square test.

We used a mixed methods approach to analyze the focus group data. Mixed methods research is defined as the practice of collecting, analyzing, and combining qualitative and

quantitative data within a single cohesive study for the purpose of gaining a better understanding of a specific research problem³

The focus group data was transcribed verbatim, and then coded using the classical content analysis method using a concurrent strategy³. This included assigning a code to groups of similar responses, and then placing each code into a category. Transcripts were independently coded by two of the researchers (JM and AR). Disagreements in coding and categorization were discussed until consensus was reached. We report the frequency of each code across all categories.

4.3 Results

A total of 229 participants completed in the study (111 usual care group, 118 web-based group). The mean age of participants was 68.5 years. Fifteen patients from the web-based group participated in the focus group sessions, and were divided into three separate groups: 1) less than 70 years of age and less than 100 kilometer travel distance, 2) greater than 70 years and less than 100 kilometers, and 3) less than 70 years, greater than 100 kilometer travel distance. We did not have a sufficient number of consenting patients to form the greater than 70 years, greater than 100 kilometer group. Table 4.1 provides the demographic characteristics of all study participants.

Table 4.1: Demographic Characteristics of Participants

Characteristic	Web-based (n=118)	Usual Care (n=111)	Focus Group (n=15)
Gender			
Female	66 (55.5%)	61 (56.0%)	10 (66.7%)
Age (years)*	68.8 (10.0)	66.4 (11.5)	69.4 (4.7)
Joint Replaced			
Hip	52 (44.1%)	53 (48.2%)	7 (46.7%)
Knee	68 (57.6%)	58 (52.7%)	9 (60.0%)
Time Post-operative (years)*	5.0 (3.4)	5.0 (3.2)	5.3 (3.4)
Distance from UH (km)*	101.3 (119.6)	102.1 (173.3)	67.7 (69.8)

*Mean (standard deviation)

4.3.1 Satisfaction

Results of the satisfaction questionnaire that was completed at the time of follow-up show that 102 patients (91.9%) in the usual care group were either extremely or very satisfied with the care they received from their surgeon, while 88 (73.9%) of patients who were in the web-based group were either extremely or very satisfied with their care ($p < 0.01$). Ninety patients (81.1%) in the usual care group were either extremely or very satisfied with the follow-up process, and similarly 90 patients (76.3%) who were in the web-based group were either extremely or very satisfied with the online follow-up process ($p < 0.01$) (Table 4.2).

Table 4.2: Satisfaction with Follow-Up

<i>Satisfaction with Care from Surgeon</i>		
Satisfaction Level	Web Group (n=118)	Usual Group (n=111)
Extremely Satisfied	35 (29.4%)	63 (56.8%)
Very Satisfied	53 (44.5%)	39 (35.1%)
Somewhat Satisfied	18 (15.1%)	7 (6.3%)
Neither Satisfied nor Dissatisfied	7 (5.9%)	0 (0.0%)
Somewhat Dissatisfied	5 (4.2%)	2 (1.8%)
Very Dissatisfied	1 (0.8%)	0 (0.0%)

*p-value <0.01

<i>Satisfaction with follow-up procedures</i>		
Satisfaction Level	Web Group (n=118)	Usual Group (n=111)
Extremely Satisfied	31 (26.1%)	53 (47.7%)
Very Satisfied	59 (49.6%)	37 (33.3%)
Somewhat Satisfied	17 (14.3%)	11 (9.9%)
Neither Satisfied nor Dissatisfied	6 (5.0%)	0 (0.0%)
Somewhat Dissatisfied	5 (4.2%)	10 (9.0%)
Very Dissatisfied	1 (0.8%)	0 (0.0%)

*p-value <0.01

Ninety-three patients from the web-based group have completed the satisfaction questionnaire at the one year follow-up visit. The majority indicated that they were satisfied with the web-based follow-up (29% extremely satisfied, 37% very satisfied,

20% somewhat satisfied). Reasons for dissatisfaction included: length of time it took to receive results of follow-up, difficulty using the online database, inability to ask questions and receive immediate feedback, and ability to see their x-ray in person at their appointment (Table 4.3).

Table 4.3: Satisfaction with Web-based Follow-up

	Web Group (n=118)
Extremely Satisfied	27 (29.0%)
Very Satisfied	34 (36.6%)
Somewhat Satisfied	19 (20.4%)
Neither Satisfied nor Dissatisfied	5 (5.4%)
Somewhat Dissatisfied	6 (6.5%)
Very Dissatisfied	2 (2.2%)

4.3.2 Preference

Forty-one patients (44.1%) preferred the web-based method, whereas thirty-six patients (38.7%) preferred the usual clinic follow-up, and sixteen (17.2%) had no preference. The main reasons patients preferred the web-based follow-up were: decreased travel (40%), no wait times (44%), ability to have x-rays in home town (33%), and ability to complete follow-up from home (29%). For patients who prefer the usual method of follow-up assessment at the clinic, the main reason was that they prefer to see the surgeon in person (43%), and preferred to have their x-rays done at University Hospital (28%).

There were no significant differences in age, distance travelled to the clinic or length of time post-operative between those who preferred the web-based follow-up versus those who prefer the usual in-person method of follow-up assessment (Table 4.4).

Table 4.4: Preference of Follow-up Method

	<i>Preference</i>			No preference (n=19)
	Web-Based (n=27)	Usual (n=34)	p-value	
Age (years)*	69.0 (9.0)	67.9 (9.1)	0.83	67.6 (9.2)
Distance (km)**	22.2 (37.7)	18.7 (19.0)	0.20	21.7 (36.3)
Time Post-operative (years)**	4.8 (3.3)	5.5 (3.4)	0.32	3.7 (3.4)

*mean and standard deviation

**median and range

4.3.3 Focus Groups

Analysis of the focus group data revealed five main categories: 1) Follow-up Procedures, 2) Ability to ask questions, 3) Time, 4) Travel, and 5) Computer use. Table 5 displays all categories, with the frequency of each code within a category.

Table 4.5: Focus Group Results

Category 1: FOLLOW UP PROCEDURES	Frequency		Frequency
Usual		Web	
Prefer to see surgeon/personal contact	5	Quality of x-rays at other hospitals?	1
Prefer to see surgeon over resident/fellow	2	Convenience of completing at home	6
Ability to see x-ray at follow-up	2	Response time - too long	13
Length of review/actual time with surgeon	4	Reassurance everything was received	2
Worry will 'lose place in system'	5	Knowing when you will receive response	2
Knowing next appointment date	3		
Clinic environment - too crowded	2		
Category 2: ABILITY TO ASK QUESTIONS		Category 3: TIME	
Content of questions	10	Less X-ray wait time	6
Context of questions	1	No clinic wait time	5
Ability to ask questions	15	X-ray in home town	3
Ability to leave a comment	15	Need assistance to complete	2
		Time saving	5
		Long time to complete online forms	2
Category 4: TRAVEL		Category 5: COMPUTER USE	F
Travel distance	7	Difficulty/issues with database	11
Travel time	7	Not "computer literate"	1
Costs of travel	6	Learning curve	1
Stress of driving	3	Worry will lose answers	1
		Email communication	2

Category 1: Follow-up procedures

Participants liked the fact that with the usual method of follow-up, their x-ray was taken at the same time as their appointment with the surgeon, so they were able to get everything completed at the same time. They also liked the ability to actually see their x-ray, which was not possible with the web-based follow-up. Patients explained that this gave them reassurance that everything was okay at the time of follow-up. They also described frustrations with the long wait times, both in the clinic and in the radiology department, while their actual appointment time typically only lasted 5 minutes. Some participants felt like they were being 'brushed off' and the surgeon "only cared about

their x-ray anyway”. Others explained that they would not mind the wait involved with the appointment if they were actually able to see the surgeon, but often they only saw a resident or fellow. Two participants shared that they were concerned that they might lose their place in the system if they did not go to their appointment, and worried they would need to go through the referral procedure again if a problem were to arise.

The main concern with the online follow-up procedure was getting feedback and results of the follow-up in a timely manner. Specifically, patients felt they would like to know the exact time that they would receive the results rather than waiting and checking their email every day, not knowing when the results would come through. Many also commented that they did not receive a phone call from the administrative assistant to book their next clinic appointment, as they were told would happen in the follow-up email they received.

Category 2: Questions/comments

Every single one of the focus group participants expressed a desire to have the ability to ask questions or leave comments when using the web-based system. They stated that they would like a way to directly ask a question and receive immediate feedback, as is possible with the in person, clinic follow-up appointments.

Category 3: Time

Patients described frustrations with the time involved with usual clinic follow-up appointments, including travel time, wait time in the radiology department, and wait time in the orthopaedic clinic. Many felt it was a “waste of a day” with the majority of their time spent in the waiting rooms while their actual appointment time typically only lasted 5 minutes. They enjoyed the time savings that came with the web-based follow-up. Although some patients explained that it took them a long time to complete the forms online, it was still less time than what is usually involved with the clinic follow-up and they had the convenience of completing the questionnaires in their own home and at whatever time of day they wished.

Category 4: Travel

Several participants explained that travel time to the clinic for appointments was burdensome, and therefore enjoyed the benefit of decreased travel by using the web-based follow-up method. They also described the inconvenience of having to travel in the winter, and the stress involved if the weather was inclement. Money issues were also discussed, including the costs of parking and gas associated with coming to the hospital for their follow-up visit.

Category 5: Computer Use

Eleven of the focus group participants discussed difficulties with the online system, either signing on to the database, or difficulty completing the online forms. They required assistance from either the research assistant or a family member. Many of them explained that they are not regular computer users, and felt that they were not “computer literate”, however they felt they were more comfortable and confident using the database when they were asked to sign on the next time to complete follow-up forms.

Preference

Ten of the focus group participants (67%) stated that they prefer the online follow-up, as long as they were having no problems, and knew that they had the ability to call and book an appointment with the surgeon if any issues arose. Only one patient stated that he preferred the usual method of follow-up. Four patients did not state a preference during the focus group session.

4.4 Discussion

We have previously demonstrated that a web-based follow-up assessment is a feasible and clinically effective means of tracking patient progress and outcomes following total hip or total knee replacement surgery, with significant cost and time savings to patients². The purpose of this study was to determine patient satisfaction with the web-based follow-up method. Results from both the quantitative satisfaction questionnaire, and the

qualitative focus group data suggest that overall patients are satisfied with the web-based follow-up assessment.

A common motivation for using a mixed methods design is to help broaden the dimensions and scope of the research, allowing for a more detailed explanation of the subject being investigated and the development of a more complete picture of the results³. The results from our satisfaction surveys were similar to the feedback provided during the focus group sessions, however the focus groups allowed us to gain a more in depth view of patient's feelings towards the web-based follow-up method, and provided us with more detail than we were able to obtain from the satisfaction questionnaires alone.

The most common complaint from patients was the amount of time that it took to receive the results of their web-based follow-up and in some cases that the surgeon's office never called to book their next clinic appointment, as they were told in the follow-up email that was sent to them after completion of their web-based appointment. The time taken for the surgeon to review a patient x-ray and online data varied. Since this was a major concern of the patients, if this program were to be implemented in the future a more standardized method of reviewing web-based patients would need to be put in place. This may involve the surgeon setting aside specific online clinic time to review the web-based patients so that we are able to give patients a more definitive timeline to receive their results. It is also important for the administrative assistant to set aside time to follow-up with the web-based patients as well. Typically patients are given their next annual follow-up appointment by the orthopaedic clinic receptionist when they checkout, therefore booking appointments for web-based patients was seen as an extra task and burden for the administrative assistant, and often got put off until closer to the time the patient was actually due for their visit, which caused the patients to wonder if they had been lost in the system.

Some participants were also concerned about the quality of x-rays when taken at hospitals other than University Hospital, however quality was not reported to be an issue by any of the surgeons reviewing the x-rays. Perhaps patients did not understand that the x-rays were done according to our usual standard protocol and the surgeon was able to

view them with as much clarity as if the patient had been in clinic in person, and therefore more patient education may be required to improve their acceptance of web based follow-up method.

Another frequent comment from both the focus groups and satisfaction questionnaires was the inability to ask a question or leave further comments when using the web-based system. Although the surgeons felt that they had all of the information they needed to perform a thorough review, patients still felt there was more information they would like to share. A possible solution may be to add a space in the web-based program for patients to leave further comments, which might increase patient comfort levels with using this method of follow-up. A system may also need to be put in place that would allow patients to ask questions that do not necessarily need a booked appointment time to address, or perhaps a means to provide them with answers to frequently asked questions, such as a website or contact number.

Several patients stated that they had difficulty using the online database at first, but felt that now that they had used it successfully they felt more comfortable using the database again. In fact, 27 patients called or required assistance accessing or logging on to the database system at the time of their web-based follow-up, however when they were required to sign on to the database to complete a follow-up cost questionnaire three months later they did not require any assistance, suggesting that there is a learning curve involved for some patients with this new technology.

Although there was a significant difference in the proportion of patients in the usual group who were extremely or very satisfied compared to the web-based group, there were no web-based patients who were extremely dissatisfied and only one patient who was very dissatisfied (due to difficulty using database, lack of confidence in quality of x-ray at local facility, and preference to see surgeon in-person). If we included the web-based patients who indicated “somewhat satisfied” (15.1%), there would be no significant difference between groups. As this was a pilot study of the web-based follow-up process, we expect satisfaction levels to increase as the program is refined and feedback from the patients is taken into account. Further, those in the usual care group have never

experienced the web-based follow-up and therefore have nothing to compare it to when indicating their satisfaction level. Perhaps these patients would be less satisfied with the usual method if they had experienced the conveniences of a web-based follow-up.

Although a large proportion of patients reported that they were satisfied with the web-based follow-up assessment, 39% stated that they still preferred the usual method of follow-up. We explored possible explanations for this preference. First, we looked to see if those that preferred the usual clinic follow-up were patients who lived right in London, in close proximity to the hospital. Second, we explored whether age had an effect on preference of follow-up method. We then looked to see if those who indicated they were having problems at the time of their web-based follow-up and had to come back to the clinic anyway for assessment may have preferred the usual care method. Finally, we determined if length of time post-operative had an influence on choice of preferred follow-up. We thought that perhaps those patients who recently had surgery may have fewer concerns whereas those who were many years out from their surgery may be concerned about wear and the need for a revision, and prefer to come to the clinic for their appointment. We found no statistically significant differences in the distribution of each of these factors among each preference group, suggesting that none of these factors had an influence on choice of preference (Table 4).

The use of telemedicine is becoming more popular across numerous health care fields with methods such as video and telephone consultations being used to conduct outpatient assessments. Several studies have demonstrated the feasibility and cost-effectiveness of using telemedicine in orthopaedics⁴⁻¹¹, and also report high levels of patient satisfaction. Mair and Whitten¹² conducted a systematic review of studies that involved a patient satisfaction measure with telemedicine interventions. They reviewed 32 studies across any discipline, and concluded that although the majority report high levels of patient satisfaction, these studies also had many methodological deficiencies, such as study design and low sample sizes, that limit the validity and generalizability of their findings.

A strength of the current study is the methodological design, and specifically our use of both qualitative and quantitative methods to measure patient satisfaction. First, our study was a randomized controlled trial therefore the patients in the web-based group were representative of the entire sample. Secondly, we used both qualitative and quantitative methods to assess patient satisfaction. The use of multiple methods integrated within a single study ensures that we provided a more complete picture of the experience of web-based follow-up assessments.

Quantification of qualitative data enables a researcher to compare quantitative results with the qualitative data. A limitation of this method is that by reporting frequencies, this may only represent those who contributed to the focus group conversation, and may not be true to all who feel that way, or of those who did not feel comfortable enough to share. However since the feedback generated from the focus group sessions was similar to the results obtained from the satisfaction questionnaire, we feel that our results were comprehensive and those who were uncomfortable sharing during the focus group session had the opportunity to express their feelings on the confidential questionnaire.

A further limitation of our focus group results is that we could not get any of the web-based patients in the greater than 70 years, greater than 100 kilometer category to come in for the focus group session. Since they did not have to worry about the inconvenience and stresses involved with travelling into London for their follow-up visit, they were not interested in making a special trip in for study purposes. Although we do not have any qualitative data from this group, they did complete the one year satisfaction questionnaire therefore we still feel that we have represented this demographic subgroup in our results.

4.5 Conclusion

Web-based follow-up assessment is a feasible, effective, and cost saving method to measure patient progress following total hip or total knee replacement surgery. Although it is necessary to test the effectiveness and feasibility of new health care programs, it is perhaps more important that the patients who are most directly affected are satisfied with the changes. Our results show high satisfaction levels from patients who completed the web-based follow-up assessment. Feedback from this study will help us to further

improve the web-based follow-up system to ensure an optimal level of patient satisfaction, should this program be implemented into practice.

4.6 References

1. Canadian Joint Replacement Registry. Hip and Knee Replacements in Canada: Canadian Joint Replacement Registry (CJRR) 2008–2009 Annual Report. 2009.
2. Marsh J, Bryant D, MacDonald S, Naudie D, McCalden R, Howard J, et al. Feasibility, Clinical Effectiveness and Costs Associated with a Web-Based Joint Replacement Follow-Up Assessment. *in preparation*.
3. Creswell JW. Research Design: Qualitative, Quantitative and Mixed Methods Research. Third ed. Sage Publications Inc; 2009.
4. Wood G, Naudie D, MacDonald S, McCalden R, Bourne R. An electronic clinic for arthroplasty follow-up: a pilot study. *Can J Surg* 2011 Dec;54(6):381-6.
5. Jacklin PB, Roberts JA, Wallace P, Haines A, Harrison R, Barber JA, et al. Virtual outreach: economic evaluation of joint teleconsultations for patients referred by their general practitioner for a specialist opinion. *BMJ* 2003 Jul 12;327(7406):84.
6. Wallace P, Haines A, Harrison R, Barber J, Thompson S, Jacklin P, et al. Joint teleconsultations (virtual outreach) versus standard outpatient appointments for patients referred by their general practitioner for a specialist opinion: a randomised trial. *Lancet* 2002 Jun 8;359(9322):1961-8.
7. Wootton R, Bloomer SE, Corbett R, Eedy DJ, Hicks N, Lotery HE, et al. Multicentre randomised control trial comparing real time teler dermatology with conventional outpatient dermatological care: societal cost-benefit analysis. *BMJ* 2000 May 6;320(7244):1252-6.

8. Good DW, Lui DF, Leonard M, Morris S, McElwain JP. Skype: a tool for functional assessment in orthopaedic research. *J Telemed Telecare* 2012;18(2):94-8.
9. Couturier P, Tyrrell J, Tonetti J, Rhul C, Woodward C, Franco A. Feasibility of orthopaedic teleconsulting in a geriatric rehabilitation service. *J Telemed Telecare* 1998;4 Suppl 1:85-7.
10. Haukipuro K, Ohinmaa A, Winblad I, Linden T, Vuolio S. The feasibility of telemedicine for orthopaedic outpatient clinics--a randomized controlled trial. *J Telemed Telecare* 2000;6(4):193-8.
11. Harno K, Arajärvi E, Paavola T, Carlson C, Viikinkoski P. Clinical effectiveness and cost analysis of patient referral by videoconferencing in orthopaedics. *J Telemed Telecare* 2001;7(4):219-25.
12. Mair F, Whitten P. Systematic review of studies of patient satisfaction with telemedicine. *BMJ* 2000 Jun 3;320(7248):1517-20.

Chapter 5

5 Discussion

The following sections contain additional discussion pertaining to the study and its results including specific issues we encountered implementing the web-based follow-up, applicability of the results and directions for future research.

5.1 Implementing the web-based follow-up

There were two main components that were essential in the development of the web-based follow-up assessment method: 1) allowing patients to have x-rays taken at their local radiology facility, and 2) creating a customized database program to facilitate the web-based follow-up procedure.

The first component was made possible by the Southwestern Ontario Diagnostic Imaging Network (SWODIN). SWODIN was created in 2004 to facilitate image sharing across southwestern Ontario. There are currently 60 locations connected to the network, allowing for the instant access, exchange and storing of diagnostic images and reports among radiologists, physicians, and specialists.

Study patients who live in London had their x-ray done at University Hospital. If the patient did not live in London, we arranged for their x-rays to be taken at an imaging centre nearest to the patient's home that was connected to the imaging network, which allowed the surgeon to review the patient's x-ray online.

We did our best to arrange for patients to have their x-rays taken at a local radiology facility, however given that our patient population encompasses a wide area of southwestern Ontario it was not always possible for them to have their x-ray taken in their home town, therefore there was still some travel involved for some patients. As the imaging network continues to expand and more locations are added, the number of patients who may be able to benefit from decreased travel to have an x-ray taken will continue to rise as well.

Our next step was to develop the customized online database system that would facilitate the web-based follow-up assessment process. The database was programmed to send a series of automatic emails throughout the process: 1) to the patient with their login instructions, including a unique username and password, the link to the secure online database, and full instructions and manual of operations for using the web-based system and completing their follow-up, 2) A reminder email to the patient when their follow-up appointment was due, 3) to the patient's surgeon upon completion of the online questionnaires and indication that x-ray was complete, 4) to the surgeon's administrative assistant once he had reviewed the patient's x-ray and online data, and 5) to the patient indicating the results of their follow-up and when the surgeon would like to see them again.

Although the system was carefully designed with input from all participating surgeons, there were still some concerns that we could not address. First, and unique to centres with ongoing research registries, without in-person contact it is impossible capture outcomes like range of motion and gait without a video component. Good et al.¹ used Skype to conduct a review of shoulder patients using the Oxford and Constant shoulder scores, which also require functional assessments, including measurement of range of motion. They report that the Skype assessment provided accurate measures with no clinically significant differences from the scores obtained from the in-person assessment. This method presents a feasible solution although work to assess whether we can reproduce these results within our hip and knee patient population is first required.

Another concern from the surgeons was the current inability to bill for review of the web-based patients, since these patients did not have an actual scheduled in-person appointment time. For study purposes, the surgeons agreed to review radiographs and complete their assessment of these patients without billing, however, if such a program were to be implemented into practice, work toward defining an acceptable remuneration for patients reviewed online is required.

The time allocated for outpatient follow-up assessments is five minutes and generates an Ontario Health Insurance Plan (OHIP) billing fee payment of \$22.45, whereas new

patient assessments are allocated 15 minutes and generate a fee payment of \$67. The allocation of 5 minutes for each follow-up assessment underestimates the actual time for in-person appointments, when the non-medically related social interaction component of the appointment is factored in. In fact, a previous study at our site² found that among 40 follow-up visits, the average appointment took 35 minutes to complete, once the patient had been seen by the nurse, resident, fellow, and consultant surgeon. The ability to see new patients in place of review patients who can be effectively assessed electronically, could potentially offset the projected loss of physician income from follow-up appointments. Reducing the number of review patients allows limited outpatient resources to be used to assess new patients and would be expected to reduce wait times for patients waiting for their first consultation.

5.2 Issues with online database

As with the implementation of any new program, we faced several challenges in the early stages of the study, involving both patients, clinicians, and the administrative staff. A common problem for patients was difficulty accessing the online system, such as receiving a password, successfully signing onto the database with their password, or completing their online forms. Twenty-two percent of the web-based patients required assistance at the time of their follow-up, however when they were asked to sign onto the database to complete a follow-up cost questionnaire three months later these same patients did not require any assistance, suggesting that there is a learning curve involved with this new technology. We expect that the proportion of patients requiring assistance to use electronic technology will decrease as those without exposure to computers during their working years become fewer.

The administrative assistants also had complaints about having to schedule and phone patients for follow-up appointments. At our centre, usual practice (outside of the study) for review patient appointments is that they are scheduled by the outpatient receptionist upon conclusion of their in-person follow-up visit. As a result of the added workload for the administrative assistants, many of the web-based patients were not booked for their next follow-up visit within the time frame they were promised. This was cause for

concern for some patients. Should a web-based assessment be implemented, it is important to respect the current flow of work whenever possible or to introduce compensation for additional workload.

An important factor essential to the organization of the web-based follow-up procedure was the research assistant. Although our results show significant cost savings, we did not include research assistant time involved in coordinating the web-based follow-up, including assisting surgeons and other clinic staff, coordinating patient x-rays and dealing with issues as they arose. We have record of the time spent by the research assistant and will factor it into the planned economic analyses.

Although there was a research assistant involved for this study because it was a research project, should an online follow-up be implemented in the future, there are options to reduce the need for this role. For example, adding a ‘find a location’ functionality within the current software whereby patients provide their postal code, and the system automatically identifies the closest web-enabled imaging centre and automatically faxes the referral, would reduce this task that was completed by the research assistant for the current study. Other suspected increases in efficiency include those described above (respecting current work flow and the expected increase in patients who are computer literate), which will help eliminate the role of a research assistant in coordinating a web-based follow-up.

5.3 Applicability at other centres

There are currently no established guidelines for the frequency of follow-up after total joint arthroplasty, and there is wide variability in practices among orthopaedic surgeons. Lieberman et al.³ recently conducted a survey of members of the Hip Society to determine practice patterns regarding follow-up procedures after total hip arthroplasty. Results of the survey found that there was some consistency with respect to follow-up in the early postoperative period, but over time, the frequency and timing of follow-up visits was increasingly variable across practices.

Our study suggests that most patients are doing well following surgery and therefore the majority of follow-up visits are routine, with no changes in clinical management. Regular surveillance however is still important to ensure early detection of any complications before the issues become complex. For example, if bone loss from osteolysis is identified early especially in asymptomatic patients, a significant number of difficult revision procedures may be prevented. Although it may not be common practice for all orthopaedic surgeons to see their patients back for annual review, the web-based method offers an effective, cost and time saving method to monitor patient progress for centres who may not have the time or resources to conduct annual patient follow-up after total hip or total knee arthroplasty.

5.4 Directions for Future Research

Our current study looked only at the direct costs associated with the follow-up appointment. Patients were asked to report the time and cost associated with follow-up appointments. For reasons of feasibility, we did not validate this data (e.g collecting receipts and comparing to reported values). Future analyses of our data include a cost minimization analysis, in which we will conduct sensitivity analyses by using both over- and underestimates of the values provided by the patients to determine whether the results change.

To conduct this analysis, we require cost data from all study patients (both web-based and usual care group) for one year following the study. Patients completed a cost follow-up questionnaire at 3 months, 6 months, 9 months, and 12 months after their study follow-up visit. The cost questionnaires asked patients to report any medical or health-related appointments, tests, procedures, or surgeries, medications and other health care devices. We also asked patients to record time taken from paid employment from either themselves or a caregiver as a result of their health. We will use this information to conduct an economic analysis from four different perspectives: Societal, Ministry of Health, Patient and Surgeon.

5.5 Summary

The continuously rising incidence of osteoarthritis has led to an increased demand for total joint arthroplasty, resulting in longer wait times for surgery and overcrowded clinics with both new and post-operative review patients. Routine follow-up appointments are a time consuming and costly process for all involved. The results of this study show that a web-based follow-up assessment is a feasible and clinically effective alternative for monitoring the progress and outcomes for some total hip and total knee replacement patients. There may however still be a role for the traditional face-to-face method of assessment for select patients.

Moreover, web-based assessment significantly decreases costs to patients and time requirements associated with their annual follow-up appointments and significantly reduces the amount of time required by the surgeon to complete the assessment. Our study also found high satisfaction levels from patients who completed the web-based follow-up assessment.

5.6 References

1. Good DW, Lui DF, Leonard M, Morris S, McElwain JP. Skype: a tool for functional assessment in orthopaedic research. *J Telemed Telecare* 2012;18(2):94-8.
2. Wood G, Naudie D, MacDonald S, McCalden R, Bourne R. An electronic clinic for arthroplasty follow-up: a pilot study. *Can J Surg* 2011 Dec;54(6):381-6.
3. Lieberman JR, Leger RR, Tao JC, Clohisy JC, Meneghini RM. Total Hip Arthroplasty Surveillance: When do we see our patients postoperatively? *The Journal of arthroplasty* 2011;26(8):1161-4.

Appendices

Appendix A: Research Ethics Board Approval Letters



Office of Research Ethics

The University of Western Ontario
 Room 4180 Support Services Building, London, ON, Canada N6A 5C1
 Telephone: (519) 661-3036 Fax: (519) 850-2466 Email: ethics@uwo.ca
 Website: www.uwo.ca/research/ethics

Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. D.M. Bryant

Review Number: 16310E

Review Level: Expedited

Review Date: July 08, 2009

Protocol Title: Validity of an Electronic Version of Health Measurement Instruments

Department and Institution: Physical Therapy, University of Western Ontario

Sponsor:

Ethics Approval Date: August 10, 2009

Expiry Date: November 30, 2009

Documents Reviewed and Approved: UWO Protocol, Letter of Information and Consent (July 20, 2009), Telephone Script.

Documents Received for Information: Manual of Operations

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 study 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 UWO Updated Approval Request Form.

During the course of the research, no deviations from, or changes to, the protocol or consent form may be initiated without prior written approval from the HSREB except when necessary to eliminate immediate hazards to the subject or when the change(s) involve only logistical or administrative aspects of the study (e.g. change of monitor, telephone number). Expedited review of minor change(s) in ongoing studies will be considered. Subjects must receive a copy of the signed information/consent documentation.

Investigators must promptly also report to the HSREB:

- changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
- all adverse and unexpected experiences or events that are both serious and unexpected;
- new information that may adversely affect the safety of the subjects or the conduct of the study.

If these changes/adverse events require a change to the information/consent documentation, and/or recruitment advertisement, the newly revised information/consent documentation, and/or advertisement, must be submitted to this office for approval.

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.

Chair of HSREB: Dr. Joseph Gilbert

Ethics Officer to Contact for Further Information

<input type="checkbox"/> Janice Sutherland (jsuther@uwo.ca)	<input type="checkbox"/> Elizabeth Wambolt (ewambolt@uwo.ca)	<input checked="" type="checkbox"/> Grace Kelly (grace.kelly@uwo.ca)	<input type="checkbox"/> Denise Grafton (dgrafton@uwo.ca)
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cc: ORE File
LHRI

UWO HSREB Ethics Approval - Initial
V.2008-07-01 (rpApprovalNoticeHSREB_Initial)

16310E

Page 1 of 1



Office of Research Ethics

The University of Western Ontario
 Room 5150 Support Services Building, London, ON, Canada N6A 3K7
 Telephone: (519) 661-3036 Fax: (519) 850-2466 Email: ethics@uwo.ca
 Website: www.uwo.ca/research/ethics

Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. D.M. Bryant
Review Number: 16307E
Review Date: February 25, 2011
Protocol Title: Cost-effectiveness of web-based follow-up assessments for patients following total joint replacement
Department and Institution: Physical Therapy, University of Western Ontario
Sponsor:
Ethics Approval Date: March 08, 2011
Expiry Date: December 31, 2012

Review Level: Expedited

Revision Number: 1

Approved Local # of Participants: 1000

Documents Reviewed and Approved: Revised study end date.

Documents Received for Information:

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 UWO Updated Approval Request Form.

During the course of the research, no deviations from, or changes to, the protocol or consent form may be initiated without prior written approval from the HSREB except when necessary to eliminate immediate hazards to the subject or when the change(s) involve only logistical or administrative aspects of the study (e.g. change of monitor, telephone number). Expedited review of minor change(s) in ongoing studies will be considered. Subjects must receive a copy of the signed information/consent documentation.

Investigators must promptly also report to the HSREB:

- changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
- all adverse and unexpected experiences or events that are both serious and unexpected;
- new information that may adversely affect the safety of the subjects or the conduct of the study.

If these changes/adverse events require a change to the information/consent documentation, and/or recruitment advertisement, the newly revised information/consent documentation, and/or advertisement, must be submitted to this office for approval.

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.

Chair of HSREB: Dr. Joseph Gilbert
 FDA Ref. #: IRB 00000940

Ethics Officer to Contact for Further Information		
<input type="checkbox"/> Janice Sutherland (jsuther@uwo.ca)	<input type="checkbox"/> Elizabeth Wambolt (ewambolt@uwo.ca)	<input checked="" type="checkbox"/> Grace Kelly (grace.kelly@uwo.ca)

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UWO HSREB Ethics Approval - Revision
 V.2008-07-01 (rptApprovalNoticeHSREB_REV)

16307E

cc: ORE File
 LHRI

Page 1 of 1



Office of Research Ethics

The University of Western Ontario
 Room 4180 Support Services Building, London, ON, Canada N6A 5C1
 Telephone: (519) 661-3036 Fax: (519) 850-2466 Email: ethics@uwo.ca
 Website: www.uwo.ca/research/ethics

Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. D. Bryant

Review Number: 17345E

Review Date: August 11, 2010

Review Level: Expedited

Approved Local # of Participants: 80

Protocol Title: Patient experience with follow-up assessments following total joint replacement

Department and Institution: Physical Therapy, University of Western Ontario

Sponsor:

Ethics Approval Date: September 17, 2010

Expiry Date: September 30, 2011

Documents Reviewed and Approved: UWO Protocol, Letter of Information and Consent (July 15, 2010).

Documents Received for Information:

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 study 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 UWO Updated Approval Request Form.

During the course of the research, no deviations from, or changes to, the protocol or consent form may be initiated without prior written approval from the HSREB except when necessary to eliminate immediate hazards to the subject or when the change(s) involve only logistical or administrative aspects of the study (e.g. change of monitor, telephone number). Expedited review of minor change(s) in ongoing studies will be considered. Subjects must receive a copy of the signed information/consent documentation.

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- changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
- all adverse and unexpected experiences or events that are both serious and unexpected;
- new information that may adversely affect the safety of the subjects or the conduct of the study.

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Chair of HSREB: Dr. Joseph Gilbert
 FDA Ref. #: IRB 00000940

Ethics Officer to Contact for Further Information			
<input type="checkbox"/> Janice Sutherland (jsutherl@uwo.ca)	<input type="checkbox"/> Elizabeth Wambolt (ewambolt@uwo.ca)	<input checked="" type="checkbox"/> Grace Kelly (grace.kelly@uwo.ca)	<input type="checkbox"/> Denise Grafton (dgrafton@uwo.ca)

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

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 V.2008-07-01 (rptApprovalNoticeHSREB_initial)

17345E

cc: ORE File
 LHRI

Page 1 of 1

Appendix B: Letters of Information and Consent



Letter of Information

Study Title: Validity of Electronic Versions of Health Measurement Instruments.

Purpose:

The purpose of this study is to compare patient responses on an electronic version of a health questionnaire to the paper version of the same questionnaire to determine how closely the responses agree. Patients who have had either a total knee or total hip replacement, who are due for their 1 year follow-up or greater are being asked to participate.

Research Activity:

A random selection process (like flipping a coin) will determine whether you will complete the electronic version or the paper version of the questionnaire first. You will have an equal chance of being assigned to either group.

If you are assigned to the group which will complete the electronic version first, you will be asked to log on to a computer with internet access, and log on to an online database system to complete the questionnaires 1 week prior to your follow-up appointment.

You will receive an email reminder to log into the database and complete your questionnaires. You will also receive a username and password to access the database where you will log on and complete the questionnaires.

The following week during your follow-up appointment at the orthopaedic clinic at University Hospital, you will be asked to complete the same questionnaires on paper.

If you are assigned to the group which will complete the paper version first, you will complete the questionnaires as usual in the clinic prior to your follow-up appointment. The following week you will be asked to log on to an online database system to complete the questionnaires.

You will receive an email reminder to log into the database and complete your questionnaires. You will also receive a username and password to access the database where you will log on and complete the questionnaires.

You can still be included in the study, even if you do not complete all of the instruments.

Risks & Benefits:

There are no known risks or benefits associated with participation in this study, and no potential benefits to society.

July 20, 2009

1 of 3

Patient Initials: _____

Voluntary Participation:

Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your current or future care. You do not waive any legal rights by participating in this study.

Confidentiality:

You will not be identified personally in any publication or communication resulting from this study, and your records will be kept confidential.

Access to the database is by username and password. You will be presented at each login with an access key to copy. This prevents hackers who use automatic random password generators from accessing the system.

Your individual responses will be identified in the database by a unique identification number only and will not contain your name in part or in full. The code that matches participants' names to identification numbers will be used only for the purpose of follow-up contacts, and will be kept in a secure location. Data travels from your computer to the server via a secure socket layer (SSL), which means that it is encrypted from the moment it leaves your computer

This letter is yours to keep for future reference. Thank you for considering participation in this study. We greatly appreciate your time and interest.

July 20, 2009

2 of 3

Patient Initials: _____



Consent

Study Title: Validity of Electronic Versions of Health Measurement Instruments.

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction. I will receive a copy of the Letter of Information and this signed consent form.

_____	_____	_____
Printed Name of Participant	Signature of Participant	Date

_____	_____	_____
Printed Name of Person Obtaining Consent	Signature of Person Obtaining Consent	Date

July 20, 2009

3 of 3

Patient Initials: _____



Letter of Information

Study Title: Cost-effectiveness of web-based follow-up assessments for patients following total joint replacement

Purpose:

The purpose of this study is to compare the feasibility, cost effectiveness and patient preference for a clinic-free web-based follow-up assessment to in-clinic follow-up assessments (usual care) following total joint replacement. Only patients who are coming up to their 2 year postoperative appointment or greater are being asked to participate.

Research Activity:

If you agree to participate, you will be assigned to one of two groups. A random selection process (like flipping a coin) will determine which group you will be assigned to (web-based or usual care). You will have an equal chance of being assigned to either group.

If you are assigned to the web-based group, you will not be required to come to University Hospital for your next follow-up assessment. Instead, we will send a requisition to the nearest radiology facility, where you will have x-rays taken. These x-rays are the same as what you would have received if you had come into clinic at UH. Your surgeon will look at your x-rays online and will contact you if he or she suspects any problem.

Version: May 4, 2010

1 of 4

Patient Initials: _____



You will also be required to use a computer with internet access to complete questionnaires that you usually complete in the clinic before your appointment. You will receive a username and password to access an online database where you will answer your questions. Any information entered into the database is secure, and no one besides the study team will have access to any of your personal information.

Within the week that your follow-up is due, you will receive an email reminder to log into the database and answer your questions. This will include questions about your quality of life, ability to function, and general health.

If either your x-ray and/or your responses to the questions indicate the possibility of a complication or problem in your operated joint, or in another joint, you will be contacted by clinic staff to arrange an in-person consultation with your surgeon. If there are no concerns with your assessment, then you will receive an email to let you know that the surgeon has reviewed your file and that everything was perceived to be progressing as usual. This email will also provide the date and time of your next follow-up, which will take place at the clinic at University Hospital.

If you are assigned to the usual care group, you will have your usual follow-up visit at the orthopaedic clinic at University Hospital. All questionnaires will be completed at the London Health Sciences Centre, University Hospital and your x-rays will be taken as usual just prior to your appointment at UH.

Because we are interested in the cost-savings of a web-based follow-up, you will also be asked questions about any other health appointments, treatments or procedures you have underwent. We will ask you to complete the cost questionnaire every 3 months for the first year after your follow up visit. You can still be included in the study, even if you do not answer all of the questions.

Risks & Benefits:

There are no known risks or benefits associated with participation in this study. Potential benefits to society include decreased time and travel burden for follow-up appointments following total joint replacement, and decreases in wait times to see a surgeon for a new consultation.

Voluntary Participation:

Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your current or future care. You do not waive any legal rights by participating in this study.



Confidentiality:

You will not be identified personally in any publication or communication resulting from this study, and your records will be kept confidential.

Access to the database is by username and password. You will be presented at each login with an access key to copy. This prevents hackers who use automatic random password generators from accessing the system.

Your individual responses will be identified in the database by a unique identification number only and will not contain your name in part or in full. The code that matches participants' names to identification numbers will be used only for the purpose of follow-up contacts, and will be kept in a secure location. Data travels from your computer to the server via a secure socket layer (SSL), which means that it is encrypted from the moment it leaves your computer.

This letter is yours to keep for future reference. Thank you for considering participation in this study. We greatly appreciate your time and interest.



Consent

Study Title: Web-based, Clinic-Free Follow-Up Assessments following Total Joint Replacement

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction. I will receive a copy of the Letter of Information and this signed consent form.

Printed Name of Participant Signature of Participant Date

Printed Name of Person
Obtaining Consent Signature of Person
Obtaining Consent Date

Version: May 4, 2010

4 of 4

Patient Initials: _____



Letter of Information

Study Title: Patient experiences with follow-up assessments following total joint replacement

Purpose:

This study is part of a larger study that is investigating the feasibility and cost effectiveness of a web-based follow-up assessment compared to in-clinic follow-up assessments (usual care) following total joint replacement. Patients who participated in this study are being asked to participate in a focus group to discuss their experiences with their follow up assessment (either online or in clinic). The purpose of the focus group is to share your experiences with your last follow up appointment.

Research Activity:

If you agree to participate in this research project you will be asked to take part in a focus group session along with approximately 9 other participants. The session will take place at Elborn College at the University of Western Ontario. Your involvement will consist of one 60-minute focus group session, during which you will have the opportunity to discuss and share your experience with your last follow up assessment. We will be video-recording the discussion so that we do not miss anything. Videos from the focus group will be transcribed into written form. You will be asked not to identify yourself on the video recording and you will be given a unique identifying number for the transcription of the video. If you do not wish to be video-taped you should not participate in this study.

Your input will help us to improve the efficiency of joint replacement follow up visits and increase patient satisfaction with the assessment process. We will conduct eight focus group sessions in total, each involving 8-10 participants.

Version: July 15, 2010

1 of 4

Patient Initials: _____



Risks & Benefits:

There are no known risks or benefits associated with participation in this study. Potential benefits to society include decreased time and travel burden for follow-up appointments following total joint replacement, and decreases in wait times to see a surgeon for a new consultation.

Compensation

If you agree to participate, we will reimburse you for the cost of parking, and you will be served light refreshments during the focus group session.

Voluntary Participation:

Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your current or future care. You do not waive any legal rights by participating in this study.

Confidentiality:

We will ask you to complete a Contact Information Form that will include your full name, full mailing address, telephone number and email address (if applicable). This information will be used to follow up with you during the course of the study and to arrange the time and date of the focus groups. The Contact Information Form also includes a unique study identification number. This number appears on all research forms. Because this number is unique, your name and any other identifying information will not appear on any form.

Contact Information Forms will be kept separate from the data and stored in a locked filing cabinet in the locked office of the Principal Investigator. Once your participation in this study is complete, the Contact Information Form will be shredded and disposed of with other confidential waste. Any personal information, including your name, phone number, and address will not appear in the final database. If the results of the study are published, your name will not be used and no information that discloses your identity will be released or published.

The focus groups will be videotaped and therefore complete anonymity is not possible. There will be no identifiers on the videotape and all individuals will be asked to not identify themselves or third



parties. Focus group members are asked to keep everything they hear confidential and not to discuss it outside of the meeting. However, we cannot guarantee that confidentiality will be maintained by group members. All videotapes will be transcribed using unique codes for each participant and therefore identities will not be revealed. All video recordings will be stored on an electronic device that is password protected and only accessible by the research team.

Hard copies of data collection forms will be kept in the locked office in a locked filing cabinet of the principle investigator.

Contact Information forms are kept separate from the rest of the data collection forms and are stored at the investigating site in a locked filing cabinet with the principal investigator. All Contact Information forms will be destroyed (shredded) and disposed of with the hospital's confidential waste after study is complete.

Data collected will only be analyzed by the investigators involved in this project. All data forms and subject files will be coded and numbered with a unique identifier; the full name of the patient will not appear on the forms. All files will be shredded 5 years from the date of study completion.

Hard copies of data collection forms will be kept for 5 year after publication of the study results at which time they will be shredded and discarded in the confidential waste. The de-identified video recordings of the focus groups will be kept indefinitely.

Representatives of The University of Western Ontario Health Sciences Research Ethics Board may require access to your study related records or may follow up with you to monitor the conduct of the study.

This letter is yours to keep for future reference. Thank you for considering participation in this study. We greatly appreciate your time and interest.

Version: July 15, 2010

3 of 4

Patient Initials: _____



Consent

Study Title: Patient Experiences with Follow-Up Assessments following Total Joint Replacement

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction. I will receive a copy of the Letter of Information and this signed consent form.

Printed Name of Participant

Signature of Participant

Date

Printed Name of Person
Obtaining Consent

Signature of Person
Obtaining Consent

Date

Version: July 15, 2010

4 of 4

Patient Initials: _____

e. Other Transportation No Yes Cost of return trip: \$ _____
 (specify): _____

Length of time spent on the computer for this appointment (Please record the total amount of time you spent from the time you logged on to the database to the time you logged off)

NOTE: Do not include time spent surfing, checking email, etc., unless it was needed for this appointment.

____ hours ____ minutes

3. Assistance with Online Appointment

Did you require any assistance or contact anyone with questions regarding your online follow up appointment?

Yes No

Please indicate who assisted you with this appointment (check all that apply):

- | | |
|--|-------------------------------|
| <input type="checkbox"/> Friend/Family Member | Time: ____ hours ____ minutes |
| <input type="checkbox"/> Health Care Worker (not associated with your surgeon) | Time: ____ hours ____ minutes |
| <input type="checkbox"/> Surgeon/surgeon's secretary | Time: ____ hours ____ minutes |
| <input type="checkbox"/> Research Staff | Time: ____ hours ____ minutes |
| <input type="checkbox"/> Other (please specify): _____ | Time: ____ hours ____ minutes |

Length of Clinic Appointment (Please record the total amount of time you spent at the orthopaedic clinic, from the time you checked in, until the time you left)

___ hours ___ minutes

Web-Based Follow-Up

Employment Status and Time-Off Work From Paid Employment

Which of the following best describes your current employment status or main activity? Select one only.

- | | |
|---|--|
| <input type="radio"/> 1. Employed (full time) | <input type="radio"/> 9. Government |
| <input type="radio"/> 2. Employed (part time) | <input type="radio"/> 10. WSIB |
| <input type="radio"/> 3. Homemaking | <input type="radio"/> 11. Disability |
| <input type="radio"/> 4. Student | <input type="radio"/> 12. Litigation |
| <input type="radio"/> 5. Volunteer | <input type="radio"/> 13. Temporary Sick Leave from Work |
| <input type="radio"/> 6. Social Assistance | <input type="radio"/> 14. Self Employed |
| <input type="radio"/> 7. Retired | <input type="radio"/> 15. Other, specify: _____ |
| <input type="radio"/> 8. Accident Insurance | |

How much time did you take off of paid employment in order to attend this follow up appointment?

_____ days _____ hours _____ minutes

https://secure.empowermentresearch.ca/survey/p11110111_template/0/

Web-Based Follow-Up

Caregiver Employment Status and Time-Off Work From Paid Employment

Did you receive assistance with this appointment from a caregiver, friend, or relative?
(This includes travel to and from your appointment)

Yes No

Which of the following best describes the current employment status or main activity of your friend/relative who assisted you with this appointment? Select one only.

- | | |
|---|--|
| <input type="radio"/> 1. Employed (full time) | <input type="radio"/> 9. Government |
| <input type="radio"/> 2. Employed (part time) | <input type="radio"/> 10. WSIB |
| <input type="radio"/> 3. Homemaking | <input type="radio"/> 11. Disability |
| <input type="radio"/> 4. Student | <input type="radio"/> 12. Litigation |
| <input type="radio"/> 5. Volunteer | <input type="radio"/> 13. Temporary Sick Leave from Work |
| <input type="radio"/> 6. Social Assistance | <input type="radio"/> 14. Self Employed |
| <input type="radio"/> 7. Retired | <input type="radio"/> 15. Other, specify: _____ |
| <input type="radio"/> 8. Accident Insurance | |

How much time did your friend/relative take off of paid employment in order to assist you with this follow up appointment?

_____ days _____ hours _____ minutes

Web-Based Follow-Up

Patient History

WARNING: Your surgeon will not be able to review your online assessment until your xray is complete. Please make sure you select the box below as soon as your xray has been taken. You will hear the results of your assessment sometime in the next 3 weeks.

Please check here once your x-ray has been taken, and complete the rest of this form

Do you have any new pain or symptoms in your joint that was replaced?

Yes No

Do you have any pain or symptoms in your **other** hip/knee that is significant enough that you would like to discuss with your surgeon?

Yes No

Web-Based Follow-Up

X-Ray Assessment

FYI: This is how your patient answered the following questions

Do you have any new pain or symptoms in your joint that was replaced? Yes
 Yes No No

Do you have any pain or symptoms in your other hip/knee that is significant enough that you would like to discuss with your surgeon? Yes Yes No No

Patient Name: _____

Date of Birth: _____

 YYYY MM DD

PIN #: _____

Based on this patient's x-ray, would you like to see this patient in clinic?

Yes No

In accordance with the ethics approval, if the patient has answered 'yes' to any of the history questions (provided above), they must be seen in clinic even if their xray appears non-problematic.

Please specify when you would like to see this patient:

Immediately (next available clinic) Within the next month Within the next 6 months

Please specify when you would like to see this patient for their next annual follow up:

1 year 2 years

Web-Based Follow-Up

Results of Follow-Up Visit

1. In your opinion, is there a significant problem that the patient needed to be seen in clinic to address?

Yes No

2. What was the problem?

- Contralateral limb
- Pain in operative limb
- Wear
- Loosening
- Instability
- Infection
- Other (please specify): _____

3. What is the proposed treatment?

Web-Based Follow-Up

Satisfaction Questionnaire

1. How satisfied are you with the care you received from your surgeon at this follow up appointment? Note: Whether your visit occurred in person or over the internet, please consider whether you felt that the visit was sufficient enough to monitor your progress and identify any issues if there were any.

- extremely satisfied
 very satisfied
 somewhat satisfied
 neither satisfied nor dissatisfied
 somewhat dissatisfied
 very dissatisfied
 extremely dissatisfied

If not satisfied, please provide further comments as to why you were dissatisfied with your care:

This is completely confidential, and your surgeon will not see your response. Please be as open and honest as possible.

2. How satisfied are you with the overall assessment *process* (not including the care from your surgeon) at your last follow up appointment? Note: Please consider all aspects and events involved in visiting with your surgeon (e.g. traveling, time off work, waiting for xrays, waiting for the doctor, locating a computer, making the computer work, inconveniencing a friend or family member).

- extremely satisfied

https://secure.empowerneanresearch.ca/survey/pain/form_template/66

- very satisfied
- somewhat satisfied
- neither satisfied nor dissatisfied
- somewhat dissatisfied
- very dissatisfied
- extremely dissatisfied

If not satisfied, please select which factors contributed to your dissatisfaction
(Check all that apply):

- Travel Distance
- Travel Time
- X-ray wait time
- Clinic Wait Time
- Time Taken off Work
- Caregiver Time
- Computer Access
- Computer Use
- Other, please specify: _____

3. How would you rate your joint **PAIN** today, compared to your **PAIN** at your last follow up visit?

- Better
- The same
- Worse

If better, how much better?

- almost the same, hardly any better at all
- a little better
- somewhat better
- moderately better
- a good deal better
- a great deal better

If worse, how much worse?

- almost the same, hardly any worse at all
- a little worse
- somewhat worse
- moderately worse
- a good deal worse
- a great deal worse
- a very great deal worse

https://secure.empowerhealthresearch.ca/survey/print/form_template/86.

a very great deal better

4. How satisfied are you that your joint replacement surgery addressed your **PAIN**?

- extremely satisfied
 very satisfied
 somewhat satisfied
 neither satisfied nor dissatisfied
 somewhat dissatisfied
 very dissatisfied
 extremely dissatisfied

5. How would you rate your joint **FUNCTION** is today, compared to your last follow up visit?

- Better
 The same
 Worse

If better, how much better?

- almost the same, hardly any better at all
 a little better
 somewhat better
 moderately better
 a good deal better
 a great deal better
 a very great deal better

If worse, how much worse?

- almost the same, hardly any worse at all
 a little worse
 somewhat worse
 moderately worse
 a good deal worse
 a great deal worse
 a very great deal worse

6. How satisfied are you that your joint replacement surgery addressed your concerns with being able to **FUNCTION** as you would like?

- extremely satisfied
 very satisfied

https://secure.empowerhealthresearch.ca/survey/print/form_template/862

- somewhat satisfied
- neither satisfied nor dissatisfied
- somewhat dissatisfied
- very dissatisfied
- extremely dissatisfied

Web-Based Follow-Up

One Year Follow-Up Visit

1. Do you think that using the web-based follow-up system caused you to miss an issue with this patient? (Note: This issue must have been either probably or likely present one year ago)

Yes No

2. What is the issue?

- Contralateral limb
 Pain in operative limb
 Wear
 Loosening
 Instability
 Infection
 Other (please specify): _____

3. Why do you think you missed this issue? Check all that apply:

- Poor quality of xrays
 Inadequate views of xrays
 Unable to assess gait
 Unable to ask patient questions
 Other, Please specify: _____

4. What is the proposed treatment?

- Revision of study joint
 Primary replacement of ipsilateral hip
 Primary replacement of ipsilateral knee
 Primary replacement of contralateral hip
 Primary replacement of contralateral knee
 Physiotherapy
 Cortisone Injection
 Orthotics

https://secure.empowermeasurescience.ca/survey/pmi6/form_template/1204

- Antibiotics
- Poly exchange
- Other _____

Curriculum Vitae

Name: Jacquelyn Marsh

Post-secondary Education and Degrees: University of Western Ontario
London, Ontario, Canada
2001-2005 B.HSc.

The University of Western Ontario
London, Ontario, Canada
2006-2008 M.Sc.

The University of Western Ontario
London, Ontario, Canada
2008-2012 PhD.

Honours and Awards: Ontario Graduate Scholarship of Science and Technology
2010-2011

Ontario Graduate Scholarship
2011-2012

Related Work Experience Teaching Assistant
The University of Western Ontario
2006-2010

Research Assistant
Fowler Kennedy Sports Medicine Clinic
2009-2011

Publications:

Peer Reviewed Journal Publications

Marsh J, Hager C, Havey T, Sprague S, Bhandari M, Bryant D. (2009) Patients with osteoarthritis use complementary and alternative medicines that could adversely interact with commonly prescribed medications, *CORR*, 467(10):2705-22. (October)

Marsh J, Bryant D, MacDonald S. (2009) Older patients can accurately recall their preoperative health status six weeks following total hip arthroplasty. *Journal of Bone and Joint Surgery Am.* 2009 Dec;91(12):2827-37.

Marsh J., Bryant D. “Management Issues Unique to Regulatory Trials”. *Journal of Long-term Effects of Medical Implants. Journal of Long Term Effects of Medical Implants.* 2009;19(3):201-8.

Marsh J, Bryant D, MacDonald S, Naudie D. (2012) Patients respond similarly to paper and electronic versions of the WOMAC and SF-12 following total joint replacement. *Journal of Bone & Joint Surgery (American)*. (submitted).

Book Chapters

Marsh, J, Somerville L, Giffin R, Bryant, D. “Multi-ligament Knee Injury: Acute versus Delayed Surgical Reconstruction” In Wright, James (Ed.) Evidence Based Orthopaedics, The Best Answers to Clinical Questions (pp 648-658). Philadelphia, PA: Saunders Elsevier, 2009.

Marsh, J, Bryant D. “Results – Tables, Figures, and Appendices” In Getting Your Research Paper Published: A Surgical Perspective. M. Bhandari, A. Joensson, E. H. Schemitsch, B. Robioneck (Eds.), (pp. 83-88). New York, NY: Thieme Publishers 2011

Conference Presentations

2012/06/10 An RCT Comparing Web-Based to Clinic Follow-up: Are Routine Clinic Visits Necessary? Jackie Marsh, Steve MacDonald, Douglas Naudie, Dianne Bryant, Richard McCalden, James McAuley, Robert Bourne, Jamie Howard. Canadian Orthopaedic Association, Ottawa, Ontario, Canada, **Presenter**

2012/02/08 An RCT Comparing Web-Based to Clinic Follow-up: Are Routine Clinic Visits Necessary? Jackie Marsh, Steve MacDonald, Douglas Naudie, Dianne Bryant, Richard McCalden, James McAuley, Robert Bourne, Jamie Howard. 79th Meeting of the American Academy of Orthopaedic Surgeons, San Francisco, California, United States, **Presenter**

Peer Reviewed Funding

2010-2012. Naudie D, MacDonald S, Bryant D, Marsh J., Hoch J. “Cost Effectiveness of Web-based follow-up following total joint replacement”: Physician’s Services Incorporated Foundation (PSI) Operational Grant: \$101,500

2011-2012. Naudie D, Marsh J, Willits K, Bryant D. “A Randomized Controlled Trial Comparing Arthroscopic Surgery to Conservative Management of Femoroacetabular Impingement”: Arthroscopy Association of North America: \$25,000.00

2011-2012. Naudie D, Marsh J, Willits K, Bryant D. “A Randomized Controlled Trial Comparing Arthroscopic Surgery to Conservative Management of Femoroacetabular Impingement”: Lawson Health Research Institute, Internal Research Fund: \$15,000.00