FIRST STEPS IN DEVELOPING CLINICAL PRACTICE GUIDELINES FOR POST-ACUTE REHABILITATION AFTER PRIMARY TOTAL HIP AND KNEE ARTHROPLASTY

by

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Abstract

Total hip (THA) and total knee arthroplasty (TKA) are cost-effective interventions for advanced osteoarthritis (OA) of the knee and hip. With the rapidly growing number of these procedures performed annually in Canada and the United States, greater attention needs to be directed to identify rehabilitation practices that optimize outcomes and minimize cost. Currently, there is no consensus on rehabilitation best practice and no evidence-based clinical practice guidelines to inform clinical decision-making on post-acute rehabilitation following THA and TKA.

A multi-phase, mixed-method project integrated stakeholder perspectives, research evidence and expert opinion to develop best practice recommendations for THA and TKA rehabilitation. Chapter 2 involved 11 focus groups and eight interviews to identify key themes related from North American patients and health care professionals on rehabilitation practices and outcomes. Chapters 3-4 are Cochrane systematic reviews examining the strength of the evidence for post-acute physiotherapy after THA and TKA. Chapter 5-6 involved two parallel Delphi surveys with consumers, clinicians and researchers to develop consensus on a range of rehabilitation topics to inform best practice for THA and TKA rehabilitation.

Chapter 2: Six key themes emerged relating to communication, patient expectations, patient attitude, forms of support, barriers to recovery, and diversity of outcomes. Chapters 3-4: Systematic reviews of THA (n=8) and TKA (n=7) trials revealed limited, low to high quality evidence with mixed findings for various forms of post-acute physiotherapy on pain, function and health-related quality of life. Trial heterogeneity prevented meta-analysis. Chapters 5-6: Consensus (80% agreement) was reached on the need for post-acute rehabilitation, types of interventions, rehabilitation providers, treatment settings, outcomes and outcome measurement. Consensus was not reached regarding timing and dosage of rehabilitation. Sub-group analysis revealed few differences comparing responses by profession, primary role and country.
This thesis has taken important first steps in identifying appropriate rehabilitation interventions and health care resources to optimize individuals’ activity, participation and health-related quality of life after THA and TKA. Further, it highlights the need for more high quality research to address the knowledge gaps and inform policy on this important and understudied aspect of arthroplasty surgery.
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<th>Full Form</th>
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<tbody>
<tr>
<td>AAOS</td>
<td>American Academy of Orthopaedic Surgeons</td>
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<tr>
<td>AHP</td>
<td>Allied health professional</td>
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<td>APTA</td>
<td>American Physical Therapy Association</td>
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<tr>
<td>CCT</td>
<td>Clinical controlled trial</td>
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<tr>
<td>CI</td>
<td>Confidence interval</td>
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<tr>
<td>CJRR</td>
<td>Canadian Joint Replacement Registry</td>
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<tr>
<td>COA</td>
<td>Canadian Orthopaedic Association</td>
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<tr>
<td>CPA</td>
<td>Canadian Physiotherapy Association</td>
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<tr>
<td>CPG</td>
<td>Clinical practice guideline</td>
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<tr>
<td>CRA</td>
<td>Canadian Rheumatology Association</td>
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<tr>
<td>DVT</td>
<td>Deep vein thrombosis</td>
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<tr>
<td>FP</td>
<td>Family practitioner</td>
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<tr>
<td>HRQoL</td>
<td>Health-related quality of life</td>
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<tr>
<td>LOS</td>
<td>Length of stay</td>
</tr>
<tr>
<td>NIH</td>
<td>National Institutes of Health</td>
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<tr>
<td>NMES</td>
<td>Neuromuscular electrical stimulation</td>
</tr>
<tr>
<td>OA</td>
<td>Osteoarthritis</td>
</tr>
<tr>
<td>OT</td>
<td>Occupational therapy or occupational therapist</td>
</tr>
<tr>
<td>PAC</td>
<td>Post-acute care</td>
</tr>
<tr>
<td>PRISMA</td>
<td>Preferred Reporting Items for Systematic Reviews and Meta-Analyses</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
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</tr>
<tr>
<td>PT</td>
<td>Physiotherapist or physical therapist</td>
</tr>
<tr>
<td>RA</td>
<td>Rheumatoid arthritis</td>
</tr>
<tr>
<td>ROM</td>
<td>Range of motion</td>
</tr>
<tr>
<td>RCT</td>
<td>Randomized controlled trial</td>
</tr>
<tr>
<td>SNF</td>
<td>Skilled nursing facility</td>
</tr>
<tr>
<td>TENS</td>
<td>Transcutaneous electrical nerve stimulation</td>
</tr>
<tr>
<td>THA</td>
<td>Total hip arthroplasty</td>
</tr>
<tr>
<td>THR</td>
<td>Total hip replacement</td>
</tr>
<tr>
<td>TJA</td>
<td>Total joint arthroplasty</td>
</tr>
<tr>
<td>TJR</td>
<td>Total joint replacement</td>
</tr>
<tr>
<td>TKA</td>
<td>Total knee arthroplasty</td>
</tr>
<tr>
<td>TKR</td>
<td>Total knee replacement</td>
</tr>
<tr>
<td>WMD</td>
<td>Weighted mean difference</td>
</tr>
<tr>
<td>WOMAC</td>
<td>Western Ontario and McMaster Universities Osteoarthritis Index</td>
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This project would not have been successful without the valuable contributions and efforts of all of the consumers and health professionals that shared their time, their experiences and expertise through participating in focus groups and serving as Delphi panelists. Many colleagues and patients also provided valuable input to the pilot testing phases and thoughtful feedback on drafts of this thesis and its manuscripts.

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Dedication

This thesis is dedicated to my family. To my husband Dale who endured the long hours, a messy dining room table and sandwiches for dinner over the past 5 years. I look forward to returning to a sense of normalcy and putting my family first again. To my children Mattias and Delaney for putting up with mom always doing “homework” and for being my cheerleaders. You both helped to keep me grounded and remind me of what really matters. To my parents, Ina and Weldon Wallace, who have always believed in me and supported my efforts along the way. Mom, I am so grateful for your help in the days leading up to completing this thesis. To my mother and father-in-law, Greta and Ole Westby, who stepped in to support our family in so many ways over the past 5 years. I so appreciate every one of you and thank you for your love and support through this journey.
Co-authorship statement

Sections of this thesis have been submitted or will be submitted as multi-authored papers in refereed journals. Details of co-authors’ contributions are provided.

Chapter 2: Westby MD, Backman CL. Patient and health professional views on rehabilitation practices and outcomes following total hip and knee arthroplasty for osteoarthritis: A focus group study. BMC Health Services Research. Accepted for publication February 2, 2010.

I conceptualized and designed the study, conducted a majority of the focus groups, performed the thematic analysis and prepared and revised the manuscript. Dr. Backman contributed to the conceptual development and design of the study, provided guidance on and helped perform the data analysis, and assisted with preparing the manuscript draft and revision.


A version of this chapter will be submitted to The Cochrane Library of Systematic Reviews. I designed the study with input from all co-authors. M. Doyle-Waters performed the electronic search. S. Carr, D. Kennedy, V. Brander and I abstracted the data. I conducted the data analysis and prepared the manuscript. All co-authors contributed to the interpretation of results and provided feedback on drafts of the manuscript.

A version of this chapter will be submitted to The Cochrane Library of Systematic Reviews. I designed the study with input from all co-authors. M. Doyle-Waters performed the electronic search. D. Kennedy, D. Jones, A. Jones and I abstracted the data. I conducted the data analysis and prepared the manuscript. All co-authors contributed to the interpretation of results and provided feedback on drafts of the manuscript.

**Chapter 5: Westby MD, Brittain A, Liang M, Raglin Block M, Backman CL.** Best practices for post-acute rehabilitation following primary total hip arthroplasty for osteoarthritis: A Delphi study.

I designed this study with input from A. Brittain, C. Backman and M. Liang. The on-line version of the survey was created and administered by M. Raglin Block. A. Brittain and I performed the data analysis and all authors contributed to the interpretation of data and preparation of the manuscript.

**Chapter 6: Westby MD, Brittain A, Liang M, Raglin Block M, Backman CL.** Best practices for post-acute rehabilitation following primary total knee arthroplasty for osteoarthritis: A Delphi study.

I designed this study with input from A. Brittain, C. Backman and M. Liang. The on-line version of the survey was created and administered by M. Raglin Block. M. Westby and A. Brittain performed the data analysis and all authors contributed to the interpretation of data and preparation of the manuscript.
Chapter 1: Introduction and overview of rehabilitation after total hip and knee arthroplasty

1.1 Background

Total hip (THA) and total knee (TKA) arthroplasty surgeries are elective surgical procedures recommended for individuals with advanced end-stage osteoarthritis (OA) that is not responsive to conservative therapies such as analgesics, anti-inflammatory agents, physiotherapy, activity modification, weight loss and use of walking aids (1). Approximately 62,000\(^1\) primary THA and TKA surgeries were performed in Canada in 2006-07 (2) and more than ten times that in the United States (US) (3, 4). The volume of THA and TKA procedures in Canada grew by 60% and 141% respectively in the preceding ten-year period (2). The largest ten-year growth occurred in the 45-54 years and 85+ years age groups, although the majority of these procedures continue to be performed on patients aged 65-74 years (2, 4). This rapid rise in total joint arthroplasty (TJA) surgeries is projected to continue in an almost exponential fashion with the aging population and the increased prevalence of OA (5-8). Other factors thought to be contributing to the rise include the increasing prevalence of obesity, a leading risk factor in the development of knee OA, public demand and higher public expectations for enhanced quality of life, and improved surgical and anaesthetic techniques making these surgeries appropriate and safer for both older and younger patients (9-11). Data from the US National Hospital Discharge Survey (1996-1999) suggested that THA and TKA combined will equate to more than 748,000 procedures by the year 2030 (12), a figure that has already been surpassed (3, 4). More recent projections forecast that the

\(^1\) For the 2006-07 fiscal year, the CJRR annual report does not include data from Quebec and therefore under represents the total number of THA/TKA procedures performed in Canada that year.
demand for primary THA procedures in the US will grow to 572,000 and TKA to 3.48 million by 2030 (13).

Osteoarthritis is the primary reason for 81% (2) to 94% (14) of all THA and TKA procedures. The Canadian Joint Replacement Registry (CJRR) reports that both procedures were more common in women in 2006-07 with age-standardized THA rates in women and men of 86 and 76 per 100,000 and TKA rates of 148 and 110 per 100,000 (2). The number of overweight and obese individuals undergoing THA and TKA is on the rise with 73% of THA and 87% of TKA patients being overweight or obese (2).

1.2 Relevance

Joint replacement surgery is a cost-effective treatment for advanced OA of the hip and knee joints and decreases pain, increases mobility and function, and improves health-related quality of life (HRQoL) (7, 15-19). High rates of patient satisfaction are also reported (20). However, due to the rapid growth in primary and revision procedures, TJA surgeries place a significant burden on healthcare budgets (8, 9). The American Academy of Orthopaedic Surgeons (AAOS) using 2002 data reported total hospitalization costs for primary THA and TKA procedures were $5.91 and $11.38 billion US dollars respectively (3). Just three years later, the estimated in-hospital costs had risen to more than $9.2 and $17.7 billion US dollars for THA and TKA (3). An earlier cost comparative study based on 1997 - 2001 data from Canadian and US teaching hospitals revealed that in-hospital costs in US dollars per THA procedure were $6,766 ± $119 and $13,339 ± $131 at Canadian and US hospitals respectively (21). In 2005, mean hospitalization charges per THA and TKA procedure in the US had grown to $39,000 and $36,000 respectively (3). Exact figures are not available in Canada; however recent data suggests costs associated with THA and TKA surgery and the period up to six months post-op average more than $14,700 per
patient leading to an informal estimate of current Canadian expenditures in excess of $911 million dollars annually (2, 22).

Approximately one-third of total costs of THA procedures in Canada are related to the post-operative rehabilitation phase (21). Based on 2003 data, direct and indirect costs associated with primary THA and TKA rehabilitation were estimated to be $3.4 billion annually in the US (23). Significant out-of-pocket costs have also been reported by patients during the first year following surgery (24).

In the past decade, length of hospitalization following THA and TKA has decreased by 38% and 50% respectively in Canada with 2006-07 data showing the average acute hospital length of stay (LOS) to be seven days for THA procedures and six days for TKA procedures including revisions (2). International data confirm a shorter LOS when only primary procedures are considered (3, 9).

Earlier discharge to home or community services decreases the time available for physical recuperation, acute rehabilitation, patient and family education and counseling, and discharge planning. A reduced LOS places additional burden and responsibility on the patients, their family and their post-acute health care providers to monitor for and address post-operative complications such as inadequate pain control, infection and deep vein thromboses. Further, the shortened acute care stay puts more emphasis on preadmission education and the role and timing of post-discharge physiotherapy and other rehabilitation interventions (11). In an editorial examining LOS after THA and TKA, Johanson comments that "it remains unclear just how far this process [of reducing LOS] can be taken without either compromising quality of care or simply shifting costs to a less regulated outpatient environment" (25)(p.1).
1.3 Rehabilitation practices

The majority of patients undergoing TJA receive some form of post-operative rehabilitation to facilitate functional recovery and optimal surgical outcomes; however, there are no North American estimates of the actual proportion. Rehabilitation is defined as “a process aimed at enabling people with disabilities to reach or maintain their optimal physical, sensory, intellectual, psychological and social functional levels” (26). Rehabilitation after TJA is available through inpatient, outpatient or home care services. Inpatient rehabilitation settings include inpatient rehabilitation facilities (IRFs) and transitional care or skilled nursing facilities (SNFs). Discharge data for Ontario hospitals for the one-year period 2001/02 revealed that 44% and 42% of patients undergoing THA and TKA respectively received post-acute rehabilitation from an inpatient rehabilitation hospital (27). Since then, efforts have been made to reduce the number of patients discharged to inpatient rehabilitation; however, there remain marked differences amongst provinces (28, 29). Following an inpatient rehabilitation stay, a majority of patients go on to receive further therapy in outpatient settings (30). Variation in discharge destinations and availability of inpatient rehabilitation is reported worldwide (31-35).

Clinical and non-clinical factors influence discharge destinations and setting for post-acute rehabilitation (36) including older age, length of acute care stay, co-morbidity (27, 34), functional independence, cognitive function, marital status (34), race and ethnicity (36), obesity (37), living alone (37), patient preference, gender and knowledge of TJA care (38).

Worldwide, there is tremendous variation in the type, timing, frequency and duration of rehabilitation treatments and outcome assessment (31, 33, 34, 39). Therapeutic exercises and rehabilitation protocols are largely based on clinical experience and preferences (40-42), local customs and facility-based protocols (43-45), available resources, the acute care phase of recovery (46, 47) and outdated approaches (48). Essentially there is no guidance or evidence-
based practice guidelines to inform clinical decision-making and identify best practices for post-acute rehabilitation after THA and TKA surgery. Finally ‘best practice’ has been confused by the pressure to reduce LOS from both acute and post-acute care, without adequate evidence regarding the downstream effect of these decisions. There has been no prospective, systematic follow up regarding patients’ long-term functioning and surgical outcomes following different rehabilitation practices.

Rehabilitation interventions may enhance surgical outcomes; however, their exact contribution to long-term outcomes such as functional mobility, participation and HRQoL is not clear. The National Institutes of Health (NIH) conferences on TJA concluded that “the use of rehabilitation services is perhaps the most understudied aspect of the peri-operative management of TKA patients” (49) (p.6) and also recommended that:

“The contribution of pre-hospital, in-hospital and post-hospital education and rehabilitation programs to the eventual outcome of the surgical procedure deserves an organized, in-depth study to determine optimum regimen, duration of treatment, and expected outcomes” (50) (p.8).

1.4 Functional impairments, activity limitations and participation restrictions following THA and TKA

Despite the fact that outcomes of TJA are amongst the few surgical procedures that are both cost-effective and improve quality of life, persistent pain, prolonged physical impairments, gait abnormalities, activity limitations and participation restrictions are evident two or more years following THA and TKA in some individuals even though some form of postoperative rehabilitation was undertaken (15, 51-57). It has been suggested that current exercise programs performed during the early phase of (55) rehabilitation are insufficient to restore muscle strength, balance, proper gait pattern and more complex functional activities (51, 54). As well, reduced physical capacity coupled
with further reduction of physiological reserve capacity seen with normal aging may lead to declining independence in daily living for older adults (55). Multiple studies have demonstrated that weakness in the lower extremities is a major risk factor for falls in the geriatric age group (50) and that falls remain an issue even after joint replacement surgery (58).

More than a decade has passed since the original NIH conference on THA and few studies have been published addressing these concerns. There continues to be a notable lack of consensus regarding which rehabilitative peri-operative practices should be used and few well-designed studies testing the efficacy and effectiveness of such practices (49).

1.5 Canadian versus American health care systems

Our work is intended for North America but it is important to acknowledge the differences between the American and Canadian health care systems. The Canadian health care system is characterized by universal access and government funded health care for physician and hospital-based services, few for-profit providers, and lower national health care expenditures than in the US (59), with its varied access to public and private providers depending on one’s insurance. In the first half of 2008 in the US, 42.8 million or 14.3 % of individuals of all ages had no health insurance (60). Thus, a large number of patients may have limited access to surgical and rehabilitation services (61). In 1965, the US Government established the Medicare program, a health insurance program for people age 65 or older and some disabled individuals under age 65 (www.Medicare.gov). That same year, Medicaid was started to provide medical benefits to eligible groups of low-income people, some who may have no medical insurance or inadequate medical insurance. Based on 2001-2003 data, approximately 80% of primary THA and TKA procedures on adults aged 65 years and older in the US are covered by Medicare and Medicaid programs (62).
To address escalating costs incurred by Medicare and Medicaid, a prospective payment system (PPS) was introduced in 1983 for acute hospital care and later for post-acute care (PAC) with SNFs in 1998, home health services in 2000, and inpatient rehabilitation in 2002 (36, 63). The PPS established new rules governing access to inpatient rehabilitation (i.e. Medicare 75% Rule) and resulted in fewer patients with a primary THA or TKA for OA being eligible for this form of rehabilitation (36) yet increased overall spending for PAC (11, 63). Under the PPS, Medicare caps payments to home health providers based on a patient’s classification in one of 80 home health resource groups and a 60-day episode of care. Rehabilitation professionals providing post-arthroplasty care have had to adapt to these reimbursement changes and find ways to optimize the allotted 10-visit therapy sessions (64).

In Canada, roles and responsibilities for health care are shared between the federal and provincial-territorial governments according to the Canada Health Act (CHA) (www.hc-sc.gc.ca). Using funds transferred from the Federal Government, provincial and territorial governments are responsible for the management, organization and delivery of health services for their residents. Addressing wait times for elective TJA surgery has been a national and provincial priority for most of the past decade (65-67). However, national median/mean wait times of 127/182 and 169/237 days for THA and TKA surgery respectively are still reported (2). These are far longer than the three to four weeks waiting times reported in the US (68). In turn, these differences in funding schemes and access to surgical and rehabilitation care influence health outcomes (59). These fundamental differences and factors need to be integrated into practice guidelines that will be relevant to both countries.

1.6 Clinical practice guidelines

Clinical practice guidelines (CPGs) are “systematically developed statements about specific clinical problems to assist practitioners and patients in making decisions about appropriate health
Guidelines are “generated from a systematic, rigorous and explicit methodology, including a review of all available scientific evidence” (69)(screen 3). Clinical practice guidelines aim to close the gap between evidence and practice, address unexplained variations in clinical practice and improve the quality, efficiency and effectiveness of health care by using the best available scientific evidence and expert opinion to make clinical recommendations (70, 71).

Criteria for selecting a clinical topic or question for guideline development include prevalence of the clinical condition, variations in current health practices, cost of current practice, availability of high quality evidence to support practice, potential to change health outcomes and costs, and feasibility (70), all of which are met by our topic of THA and TKA rehabilitation.

1.7 Guideline development framework

A number of theoretical models and frameworks on the development, dissemination and implementation of guidelines were examined for their applicability to this project (72-75). Davis and colleagues identified a four-stage approach in the development of clinical practice guidelines (74):

1. Select clinical problem
2. Synthesize data
3. Develop guidelines
4. Disseminate, implement and evaluate guidelines.
Our multidisciplinary advisory group (Appendix A) felt at least two additional steps were important for developing guidelines for THA and TKA rehabilitation: 1) identify current rehabilitation practices, issues and post-operative outcomes from various stakeholder perspectives; and 2) conduct a formal consensus process to complement the scientific data in areas where the evidence is weak, inconsistent or nonexistent (Figure 1.1).

### 1.8 Other guidelines initiatives

The French Society of Physical and Rehabilitation Medicine (SOFMER) attempted to develop evidence-based guidelines for ambulatory physiotherapy following THA (76) and TKA (77). Following a systematic review of the French and English literature, however, they restricted their work to orthopaedic surgeon, physiatrist and rheumatologist expert opinion, with little patient or allied health professional input and used a survey of current practice patterns rather than a formal consensus process, to establish best practice and supplement those areas where there was little or no published evidence (78). Stakeholder involvement is recognized as being extremely important to the guideline process and ensures that differing perspectives, expectations and practice variation are addressed and that complete data are available (71).
In 2005, two separate reviews were conducted to inform rehabilitation practice and education in Ontario. The review by the Medical Advisory Secretariat of the Ministry of Health and Long-Term Care examined the effects of pre- and post-operative physiotherapy on functional outcomes after THA and TKA. While practice guidelines were not their objective, their final recommendations were designed to inform THA and TKA referral, discharge and rehabilitation practice patterns in order to increase efficiencies in the delivery of rehabilitation services in that province (79).

Several focus groups with patients and health professionals followed by an English-only literature review informed the Greater Toronto Area Rehabilitation Network's development of an online discussion forum to promote collaboration and education among patients and health professionals throughout the continuum of TJA care (80). Based on this review spanning pre-operative, acute and post-operative care, rehabilitation was found to be an effective component in TJA management at various stages of recovery. However, best practice recommendations were not clearly differentiated for hip versus knee replacement. Soever and MacKay concluded that comparison of outpatient care to other rehabilitation approaches warranted further study to determine the optimal processes of care following TJA (80).

1.9 Purpose

The overall aim of this thesis was to complete the first step in the development of multidisciplinary clinical practice guidelines for the post-acute rehabilitation of patients undergoing primary THA and TKA for OA. The post-acute phase extends from immediately following discharge from the acute care setting and up to 12 months post-surgery (Figure 1.2).
1.10 Overview of thesis chapters

This thesis consists of five manuscript chapters, placed between this introductory chapter and a concluding chapter. Together, they address the initial three phases of clinical guideline development. The primary aim of each manuscript chapter is briefly described below:

Chapter 2: Using focus group methodology key themes were identified related to current rehabilitation practices and outcome assessment following THA and TKA surgery across different stakeholder groups in Canada and the United States.

Chapters 3 and 4: The evidence for post-acute physiotherapy on pain, function and HRQoL following primary THA (Chapter 3) and TKA (Chapter 4) for osteoarthritis was examined following Cochrane systematic review methods.
Chapters 5 and 6: Delphi surveys with separate expert panels were conducted to develop best practice recommendations for post-acute rehabilitation after primary THA (Chapter 5) and TKA (Chapter 6).

While the long term goal is comprehensive rehabilitation guidelines, the thesis is limited to synthesizing the physical aspects of rehabilitation. However, recognizing the multidisciplinary nature of rehabilitation, I used broad inclusion criteria and incorporated other professions in the focus groups and Delphi processes.
1.11 References


68. Westby MD, Backman CL. Patient and health professional views on rehabilitation practices and outcomes following total hip and knee arthroplasty: A focus group study. BMC Health Services Research. Accepted for publication 2010 Feb 2.


Chapter 2: Patient and healthcare professional views on total hip and knee replacement rehabilitation and outcomes: A focus group study

2.1 Background

Total hip arthroplasty (THA) and total knee arthroplasty (TKA) surgeries are highly successful orthopaedic procedures for more than 62,000 Canadians (1) and 773,000 Americans (2) each year. The growth in number of THAs and TKAs exceeds the aging of our population due in part to both younger and older individuals electing joint replacement surgery as a feasible option for their advanced hip and knee osteoarthritis (OA) (3).

Most patients receive post-operative physical therapy and/or other rehabilitative services in the hospital, as an outpatient or through home care services (4). However, the setting, timing, amount and treatment approaches differ widely (5-8). Despite the cost effectiveness of THA and TKA, in-hospital and rehabilitation costs associated with these surgeries place significant burdens on North American healthcare systems (2, 9-11). Rehabilitation interventions (e.g., physical therapy, occupational therapy, nursing care) may enhance surgical outcomes; however, their precise contribution to long-term outcomes such as physical function, mobility, participation in life roles and health-related quality of life (HRQoL) is not clear. A National Institutes of Health (NIH) conference concluded that “…rehabilitation services are perhaps the most understudied aspect of the peri-operative management of TKA patients” (12)(p.6).

Disparate views on need for total joint arthroplasty (TJA) surgery, expectations and outcomes of surgery have been reported for physicians and patients (13-15), and between surgeons and other health professionals (16). Hewlett suggests that patients’ assessments may differ from those of

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2 A version of this chapter has been accepted for publication. Westby MD, Backman CL. Patient and healthcare professional views on rehabilitation practices and outcomes following total hip and knee arthroplasty for osteoarthritis: A focus group study. BMC Health Services Research. Accepted February 2, 2010.
health professionals due to the influence of needs, attitudes, priorities, experiences and expectations (17). It is therefore necessary to explore patient and provider expectations to inform clinical practice guidelines.

The Canadian health care system is characterized by universal access and government funded health care for physician and hospital-based services, few for-profit providers, and lower national health care expenditures than in the US (18), with its varied access to public and private providers depending on one’s insurance. These differences in turn influence surgical wait times (1), access to and funding for rehabilitation services, and health outcomes (18); thus the need to incorporate both perspectives.

2.2 Purpose
The purpose of this study was to move beyond the existing literature and explore patient and health professional experiences with current rehabilitation practices and outcomes following THA and TKA to inform the development of clinical practice guidelines applicable for North America.

2.3 Methods
2.3.1 Sampling frame
We were interested in perspectives from four stakeholder groups: 1) individuals who had a primary THA or TKA for OA within the past year; 2) allied health professionals (AHP, e.g., physical therapist (PT), occupational therapist (OT), nurse, medical social worker) currently providing THA or TKA rehabilitative care, education or counselling; 3) physicians (e.g., rheumatologist, physiatrist, family practitioner) who provide THA or TKA care; or 4) orthopaedic surgeons currently performing THA or TKA. Patients were excluded if they were less than 19 years of age, could not converse in English; or had undergone THA or TKA surgery
for inflammatory arthritis, acute fracture/trauma or tumour. Spouses were permitted to join the patient discussion groups.

2.3.2 Recruitment

We therefore used strategies to accrue a purposive sample across stakeholder group, demographics, geographic areas (e.g. rural (<10,000 inhabitants) and urban areas) and level of experience. Notices, inviting interested individuals to contact the local study coordinator, were posted in clinics, waiting rooms, seniors’ centers and arthritis consumer groups’ newsletters as applicable to each stakeholder group. E-mail notices were distributed using staff directories for all types of health professionals.

2.3.3 Focus groups/interviews

Focus groups are particularly suited to studying diverse perspectives to gain insight into participants’ experiences (19, 20) and were the primary means of gathering data, where possible. Focus groups encourage contributions from less verbal individuals who feel supported by other group members with shared experiences (21). However, individual interviews were conducted when a participant was unable to attend their group. Both focus groups and interviews have been used previously in studying various aspects of THA and TKA care, patient experiences and expectations (22-27), but we are not aware of studies that examine THA and TKA rehabilitation practices and outcomes from multiple stakeholders’ perspectives.

A discussion guide was developed with input from a multi-disciplinary group of clinicians experienced in THA and TKA rehabilitation and researchers experienced in focus group methodology. Open-ended questions progressed from general and uncued to more specific questions with accompanying probes (20, 28). The discussion guide was tested twice and revised to improve clarity based on health professional and patient feedback. Key questions and probes
(Appendix B) were rephrased for each stakeholder group to ensure relevance to participants (20). Separate focus groups were conducted with each set of stakeholders to avoid a perceived hierarchy among mixed professional and professional-patient participants (29).

A pair of moderators led each focus group using the standardized discussion guide. The four moderators were female PTs with experience in TJA rehabilitation and group process and included the lead author. Prior to the first focus group, moderators were given written and videotaped instructions on focus group methodology, moderating tips and use of the data collection forms, and each pair conducted a pilot session to gain skill and confidence in moderating sessions and trouble shoot problems related to audiotaping, timing and logistics. Focus group sessions lasted 90 minutes for health professionals and 120 minutes for patient groups (allowing for a stretch break). Individual semi-structured interviews (face-to-face or telephone) of 30-60 minutes were conducted with participants unable to participate in a focus group; they followed the discussion guide. Sessions were audiotaped and transcribed verbatim for analysis. Participants recorded thoughts on a response form prior to sharing their perspectives with other group members. Forms were collected and together with the moderators' field notes served to enrich transcripts and study rigor (30). Member checking was incorporated into focus groups and interviews by inviting participant feedback on the moderator’s summary of the session (21). Immediately following each focus group, the moderators met to debrief, identify issues that may influence analysis and suggest possible modifications to the discussion guide (21).

2.3.4 Ethics

Approval was received from the UBC Behavioral Research Ethics Board (Appendix C) and the Vancouver Coastal Health Research Institute for the primary site and as required by institutional
policy for each of the other sites. All participants provided informed consent prior to participation, and were offered a small token ($10 gift certificate).

2.3.5 Data analysis

A thematic content analysis occurred concurrently with data collection to allow for revision of questions and development of new lines of inquiry (20, 21, 29, 31). After checking transcripts for accuracy, the two authors independently read the transcripts and performed line-by-line, open coding (29), and, following the process outlined in Figure 1, developed sub-themes for ‘within group analysis’ and subsequently refined these into key themes for ‘across group analysis’.

Disagreements in coding and categorization were discussed and the coding framework refined as necessary using a constant comparison approach (29). Minority opinions or outliers (negative cases) were identified and discussed (30).

Data collection was discontinued when it was agreed that no new ideas or issues were likely to be raised (20, 29). A decision audit trail was maintained throughout the data collection and analysis phases. Once key themes were identified, transcripts were reviewed and representative quotes selected for each theme. Portions of the coding framework and final analysis were shared with an independent, experienced qualitative researcher for peer checking (30). (See Figure 2.1)
2.4 Results

Eleven focus groups and eight semi-structured interviews were conducted in five Canadian and one US site. Participants included 32 patients and four spouses, 30 AHPs, five physicians and nine surgeons (Tables 2.1 and 2.2). Focus groups ranged in size from four to 10 participants.
Table 2.1 Patient participant demographics

<table>
<thead>
<tr>
<th>Patients* (Type of surgery)</th>
<th>Age (Range, years)</th>
<th>Gender (♀/♂)</th>
<th>English as first language</th>
<th>Education (No. some college or higher)</th>
<th>Post-op stage (Range, months)</th>
<th>Rehab status (Completed rehab)</th>
<th>Work status (Retired)</th>
<th>Lives in urban community</th>
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<td>46 - 81</td>
<td>7/6</td>
<td>13</td>
<td>10</td>
<td>1 – 11</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>TKA n = 19</td>
<td>46 - 78</td>
<td>11/8</td>
<td>18</td>
<td>15</td>
<td>1 – 10</td>
<td>9</td>
<td>10</td>
<td>14</td>
</tr>
</tbody>
</table>

* - patient participants only (does not include the 4 spouses)

Table 2.2 Health professional participant demographics

<table>
<thead>
<tr>
<th>Professions</th>
<th>Age (Range, years)</th>
<th>Gender (♀/♂)</th>
<th>English as first language</th>
<th>TJA experience1 (Range, years)</th>
<th>TJA patient volume2 (Cases/year)</th>
<th>Practice setting3</th>
<th>Urban-based practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHPs n = 30</td>
<td>28 – 62</td>
<td>26/4</td>
<td>25</td>
<td>1 – 35</td>
<td>&lt;50/yr = 7</td>
<td>Inpt acute = 4</td>
<td>22</td>
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<td></td>
<td></td>
<td>50-100/yr = 8</td>
<td>Inpt rehab = 4</td>
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<td></td>
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<td>&gt;100/yr = 15</td>
<td>Outpatients = 15</td>
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<td>33 – 64</td>
<td>0/9</td>
<td>7</td>
<td>1 – 30</td>
<td>50-100/yr = 1</td>
<td>Teaching hospital = 8</td>
<td>9</td>
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<td>&gt;100/yr = 8</td>
<td>Regional hospital = 1</td>
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<td>Physicians n = 5</td>
<td>41 - 60</td>
<td>1/4</td>
<td>4</td>
<td>6 – 35</td>
<td>&lt;50/yr = 1</td>
<td>Inpt acute = 1</td>
<td>5</td>
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<td>Private practice = 3</td>
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</table>

Legend: AHPs = allied health professionals; TJA = total joint arthroplasty
1 - Years of experience providing surgical, treatment or counseling services to patients with THA or TKA
2 - Number of combined THA and TKA patients treated or operated on each year
3 - Number of professionals practicing in each setting; for AHPs “Other” = recreational setting
2.4.1 Key themes

Subthemes for each stakeholder group were compared and contrasted across the groups and six major themes emerged. Quotes are attributed to participants by noting their age, sex and group, e.g., 41, F, FP is a 41 year old, female, family practitioner. Other participants are identified as follows: PT=physiotherapist; OT=occupational therapist; RN=nurse; SW=social worker; SURG=surgeon; PHYS=physiatrist; RHEUM=rheumatologist; THA=individual with a THA; TKA=individual with a TKA.

2.4.1.1 Theme 1: Let’s talk

A substantial amount of focus group time was spent discussing communication issues. The greatest energy and strongest group interaction occurred over the issues of inter-professional communication and collaboration across settings and throughout the continuum of care. While participants offered descriptions of both positive and negative patient-provider and inter-provider communication, most examples described how poor or lack of communication decreased efficiency, effectiveness and collaboration.

“Communication amongst all the people involved is pretty much non-existent. There’s no communication between surgeons and family doctors anymore.” [41, F, FP]

“So we have this parade of people with total hips, for example, coming through as though they’re all the same and they’re not. And I think there’s a real need for us all to get better information from the surgeon and I’ve crowed about this for a long time and it hasn’t yet happened, but I think that’s a major weakness…. I think this lack of information leads to rote [physiotherapy] procedures that don’t have very much thinking going on with them.” [62, M, PT]

Poor communication across settings (e.g., from in-patient rehab to family practitioner or private PT) was believed to contribute to inconsistent and poorly coordinated services and negatively impact clinical outcomes and patient satisfaction. Centralized information, a communication
form that stays with the patient, better links between facilities and providers, and practice guidelines were suggestions shared by AHPs and physicians as ways to address this issue. ‘Team care’ was another approach to enhance communication and was acknowledged as more feasible in inpatient rehabilitation settings where different healthcare providers were housed under the same roof, shared charting and participated in regular team meetings. Inadequate staffing, part-time positions and staff turnover negatively impacted team dynamics and consistencies in care. A lack of a collaborative, multidisciplinary approach was felt to lead to inefficiencies, duplication of services and patient dissatisfaction.

“The problem in our health care system is that the bureaucratic aspect of things precludes us from being efficient…” [36, M, SURG]

Patients suggested that surgeons could improve their communication and understanding of what is important to patients by:

“Giving more time and listening to the patient. Assessing what they’re saying, what the patient is saying. To give the patient time so that they feel comfortable enough to really express themselves.” [73, F, TKA]

A good patient-provider relationship and open communication were believed to motivate the patient and facilitate recovery. Suggestions for opening channels of communication included providing patients with contact phone numbers, calling them when they had missed appointments and liaising with the next health care provider in the rehabilitation continuum to ensure timely and efficient ‘hand offs’.

“One of the things I feel is really important is that physiotherapy departments and physicians don’t forget their patients. …call and see what’s going on. Many people seem to feel like they were forgotten and that after physio and they were out on their own, nobody cared.” [73, M, TKA]
2.4.1.2 Theme 2: Expecting the unexpected

Patients identified a number of unexpected challenges in the post-operative period for which they felt inadequately prepared: pain management, sleep disturbances, psychological issues and unrealistic activity expectations.

“Nobody said how much pain and swelling there was going to be.” [76, F, TKA]

“I think a lot of surgeons forget you’ve got to sleep – honest to God, they should have to go through it. The first thing is you’d be offered, you know, adequate pain medication post-operative and then that sleep is the biggest factor that you’re faced with.” [73, M, TKA and retired health professional]

“I don’t know how many people [with TKA] I’ve had in the last little while that come in and they’re stunned that they have pain postoperatively…They’re so not prepared for the amount of pain they have.” [43, F, PT]

“…after surgery I felt like the bull AND the china shop. Like I feel I am potentially the source of my demise and I feel fragile.” [57, F, THA]

Of equal concern to many patients and health professionals were the issues of who to go to when post-operative pain was not well-managed and inconsistent advice on whether additional analgesics (e.g. narcotics) were appropriate after the initial acute care period.

“I don’t think anybody tells the patients, so they go home, they’ll be getting some T3’s or something by their surgeon or surgical RN and sometimes that’s enough, but usually it’s not enough… and they just don’t think to call or they don’t know who to call.” [41, F, FP]

“…the knowledge of pain management from the patient’s perspective and their primary care provider’s perspective is very poor.” [55, M, SURG]

All study participants viewed the pre-operative education and preparatory phase as being critical for clarifying expectations and empowering the patient.
“What I’ve noticed is the [acute care] discharges tend to go better if patients are clear on the expectations, you know, that they’re informed of the possible date of discharge so psychologically they can start to prepare themselves. Involving social work early on to assist with addressing the barriers or obstacles I find goes well. [42, F, SW]

Unclear or unrealistic patient expectations were felt to lead to greater post-operative pain, significant anxiety and depression, and disappointment around the rate of recovery.

“I think my expectations on the recovery period were overly optimistic.” [57, M, TKA]

“They should be realistic in what they project for you.” [69, M, THA]

Differing expectations and views between surgeons and rehabilitation providers on patients’ functional status, ongoing need for supervised physical therapy and achievable outcomes lead to inconsistent advice, patient confusion, premature discontinuation of therapy and less than optimal outcomes. A PT described a common scenario whereby the surgeon’s assessment differed from that of the treating therapist.

[The surgeon tells the patient at the 6-8 week follow-up visit] “‘Oh, you’re doing great. You don’t need to do any more (physical therapy).’ Well, they’re not doing great. I don’t think they’re gotten the best bang for their buck as far as the surgery, and … you’d like to see them progress a lot further than they are…” [43, F, PT]

Health professionals voiced concerns about misinformation available through the popular press and commercial Internet sites and said this was a growing problem leading to unrealistic expectations and a negative impact on patient recovery.

“Patients learn just enough to be dangerous [from the Internet].” [39, M, PT]
2.4.1.3 Theme 3: It’s attitude that counts
Health providers and patients alike stressed the importance of the patient’s attitude when it came to being an active participant in the rehabilitation process and remaining motivated during the typical ups and downs of recovering from TJA surgery. Physicians and AHPs felt a key part of their roles was to help the patient in this regard: “I like to empower the patient first and foremost.” [47, M, PHYS]

Patients were considered an integral part of the team and their active participation in the rehabilitation process vital to good outcomes and greater satisfaction.

“I tell them ‘This is what you need to do at home’ and they go home and don’t practice, definitely that makes a huge difference when you see the patient next time. People are afraid to move or people are really reluctant to do it, so I think patient compliance with home exercises is very effective, it’s huge.” [42, M, PT]

“I would think that a person should be checked to make sure that they are continuing to exercise, they are using the leg. I think it’s such a waste of money and time if you don’t become better.” [61, F, TKA]

Having a positive attitude and taking a proactive approach to the surgery and subsequent rehabilitation phase while acknowledging the mind-body connection were strategies used by many patient participants.

“I learned to recognize that my body was wiser and far cleverer than I was so I had better just obey it.” [77, M, THA]

“You have to be willing to give not just 100 percent but 150 percent to your own recovery.” [46, F, THA]

2.4.1.4 Theme 4: It takes all kinds of support
Participants reported how different ‘facets’ of support contributed to health outcomes and overall satisfaction with the surgery and rehabilitation process. Patients and AHPs were more likely than
physicians to describe peer and spousal/family support as having favorable effects on an individual’s rehabilitation process.

“Hearing from another patient first hand and how they experienced it really helps the fear part of it.” [43, F, RN]

“The support from my spouse and my family immediately after surgery was the most invaluable and wonderful. Because we are sent out of the hospital faster now and you’ve just got to have that help at home.” [64, F, TKA]

The important role of family was acknowledged in descriptions of one health care facility where a family member was given the designation of ‘coach’ and encouraged to participate in all aspects of the patient’s rehabilitation. Involving a family member was also ideal in cases where cultural differences and language barriers impeded rehabilitation instruction. When spousal and/or family support was lacking, there was greater need for home support services. In several communities, a lack of such services coupled with few transitional care units/beds was felt to contribute to longer acute hospital stays and a group of patients “who fall into the cracks”.

Patients wanted to be recognized as a whole person and valued a holistic approach, which was sometimes lacking. Patients shared stories of how feeling supported enhanced their recovery and coping.

“After the [physical therapy] program she phoned me and asked me how I was doing, so that was pretty good. It gives a little bit of feedback to the people and they feel inside that at least somebody cares about them.” [58, M, THA]

Physicians discussed their role in supporting and counseling TJA patients, however, both family practitioners and specialists expressed concerns over their ability to spend sufficient time with patients. The ‘system’ was most often blamed for not allowing for protracted conversations with patients: “Physicians don’t get paid adequately to provide counseling on an ongoing basis to
patients.” [62, M, FP] Patients also expressed their frustration in accessing their surgeon post-operatively.

“Does anyone find it important to have access to your surgeon, which is almost impossible? Anything, just hearing him, you know, on the phone even. Maybe you want to say something that’s been bothering you and I’m sure you’re not the only one that’s ever bothered, but you feel reassured.” [75, M, TKA]

Another area of professional support overlapped with communication concerns; it was believed that health professional advice and guidance should be more consistent to be helpful:

“… and I know that we can’t all give the same exercises but I think everyone – we all have slightly different messages, we say slightly different things as to how long it’s going to take or talking about the wound or talking about pain management. It would be really good if we could have some sort of education or something that’s a little bit more consistent as far as the message that’s going out for people.” [43, F, PT]

“They’re not standardized. I’m just thinking, there’s all sorts of physiotherapy clinics around and they all do different kinds of things….” [57, F, THA]

“… it’s really inconsistent among physicians in terms of who gets referred to home care and who gets referred to outpatient. There’s no consistency… especially between health regions.” [31, F, OT]

2.4.1.5 Theme 5: Barriers to recovery
Participants identified patient, provider and system level factors as being barriers to recovery after TJA. Patient factors such as pain coping, motivation, attitude, state of readiness for treatment, psychological distress and self-efficacy were felt to influence the acute care hospital stay, course of recovery and participation in rehabilitation.

“…pain management after total knee replacement is probably one of the biggest barriers to recovery.” [55, M, SURG]
“One of the most common [concurrent] diagnoses that gets noticed is depression in the patients … which hugely affects motivation, adherence to the protocols, and follow up, and it doesn’t get addressed frequently because primary care physicians don’t take the time to diagnose it appropriately. It’s probably the most widely under diagnosed and under treated condition.” [53, F, RN]

Physicians and surgeons saw the role of rehabilitation after TJA as being “to enhance the safety of the [surgical] procedure and make it easier for the patient to recover.” [64, M, SURG]

However, the quality of rehabilitation, and in particular physical therapy services, was frequently thought to be poorly administered and therefore more detrimental to patients’ recovery than helpful.

“…I have little faith in the ability of the external providers to provide appropriate care for my patients and I tend to dissuade them from pursuing outpatient physical and occupational therapy after surgery. …my experience has been that they [therapists] tend to do more harm than good.” [55, M, SURG]

While several surgeons described having a good relationship with rehabilitation professionals and expressed confidence in their referral to post-operative physical therapy services, others did not: “We are sending them into a dark, black hole.” [60, M, SURG]

At both patient and provider levels, language barriers and lack of translated educational materials were believed to compromise AHPs’ ability to provide effective and timely education and support in a variety of rehabilitation settings. At the system level, issues related to access to rehabilitation were common to both Canadian and American participants; however, the contributing factors differed in important ways. Prolonged waits for surgical consultation, TJA surgery and in some cases, outpatient rehabilitation were unique to Canadian experiences.

“…the Canadian system should be very clearly differentiated from the American. Their healthcare system is totally different. There’s no similarity at all …we have the longest waiting list in the Western world.” [60, M, SURG]
“…when it comes to the physio after, there don’t seem to be more physiotherapy spaces. We all experienced longer waits. And we’ve all felt we’ve developed slower because of this extra wait.” [64, F, TKA]

Caps on physical therapy and rehabilitation services through private health insurers and managed health care practices were at issue in the American experience. Limited healthcare resources, ever-changing funding formulas and costs of rehabilitation services concerned all stakeholder groups in both countries.

“If [patients] don’t do physio it’s usually because it’s going to be expensive and they don’t have extended health [insurance].” [41, F, FP]

“Medicare has put a cap on the amount of money that you can get in terms of the physical therapy and I think that’s wrong. People vary too much in how they respond to surgery and to put a dollar value on that is totally crazy.” [72, F, TKA]

With limited access to supervised rehabilitation, patients and providers had to decide how and when to use their ‘allotment’. While some surgeons routinely sent people for physical therapy before surgery (pre-hab), others felt that rehabilitation postoperatively was of greater value.

Barriers to rehabilitation services included limited access outside urban settings and larger hospitals. Patients typically had fewer if any options for publicly funded therapy in more remote areas of Canada. Travel and associated costs with receiving rehabilitation outside of their home community were problematic for patients.

“It’s been hard because I live so far away. It’s about a two and half hour drive from here to [my rehabilitation setting].” [51, M, TKA]

“I think the farther you get away from a hospital and whether you’re talking doctors or physiotherapists, oftentimes you do move away from evidenced based practices…” [63, M, PHYS]
Suggestions for addressing issues related to access and quality of care in rural communities included greater use of tele-rehab and enhanced training for rehabilitation providers.

2.4.1.6 **Theme 6: Back to normal**
This final theme reflects the common view that patients wanted nothing more than to return to a sense of normalcy after surgery. While being pain-free and mobile was of primary importance, a more holistic view of ‘normal’ was repeatedly expressed.

“I want to get back to be able to walk distances and participate in cross-country skiing, snow shoeing and hiking and fitness class, you know, things I did before.” [76, F, THA]

“…I can only think of emerging from this cocoon of pain, which pulls you into a very small horizon. And so I really just wanted to get my vitality back.” [77, M, THA]

“…to do my work is really just life’s blood to me.” [64, F, TKA]

“I was on crutches for 4 years and I have an 8-year-old daughter, so she’d never really seen me walk without crutches and now I don’t have them. So that was really important. She sees me more as a normal person – now I can be the parent again.” [46, F, TKA]

“…you don’t want people losing their independent community skills so that they can stay out of nursing homes.” [53, F, RN]

There was strong support for a holistic approach to conceptualizing and measuring outcomes from the patients’ perspective.

“Look at the whole person. The psychosocial aspect is not always surgeons’ strong suit.” [63, F, TKA]
“…I’ve had times where I felt that everyone had an area of expertise and that me as a whole person, nobody was addressing or even wanting to hear about the total person going through this.” [64, F, TKA]

Consistent with the diverse conceptualization of ‘normal’ as the desired outcome, ways of measuring outcomes varied greatly with no agreement on measurement approaches or the value of using standardized tools in clinical settings. Measures that could be used throughout the rehabilitation continuum were thought to be ideal.

“…it would be nice for people to actually use the same outcome measures pre-operatively, immediately post-op… so you could actually see a difference.” [43, F, PT]

“Some people I believe use the WOMAC. Some people use the Oxford. Some people have their own little compilation of different things, and I really don’t know what they use off in private practice frankly. So big weaknesses and we don’t have a standardized approach to this yet.” [63, M, PHYS]

Others questioned the value of administering outcome tools and questionnaires.

“…I think that you have got to be very careful about trying to quantify it at all. Questionnaires, I’ve come across them before and I think this is stupid! And you put something down, you don’t know how it’s going to be interpreted.” [81, M, TKA]

“I don’t ask patients to fill out questionnaires. That’s highly inefficient.” [56, M, SURG]

When prompted to discuss the need for ongoing follow-up or long term monitoring of patients’ outcomes, with the exception of surgeons, most felt that surgeons, primary care physicians and AHPs should be involved in follow-up care. Physical therapists were named most often as being able to offer an important complementary role to the surgeon’s evaluation.
“The same team should follow the same patient, because the [surgeon] now, what’s the first thing he does? “Okay, your x-ray looks great.” But the patient says, “I’m not walking good.” We don’t treat x-rays, we treat people, right?” [42, M, PT]

2.5 Discussion

This paper describes the results of the initial exploratory phase of a mixed method project to develop practice guidelines for THA and TKA rehabilitation. A pragmatic approach was used to identify recurrent issues and important concepts for each of the broad discussion points in order to inform guideline development and ensure stakeholders’ views were captured at the outset. A lack of communication coupled with poor appreciation for each other’s roles and expertise appeared to be major issues among our study participants. This was most apparent with family physician-surgeon and PT-surgeon dyads, in less rural communities and between health care settings. Trust was also a dominant factor with many surgeons sharing concerns about the quality and safety of treatment approaches thought to be provided by outpatient PTs; PTs also lacked trust about other PT providers. Lack of trust could potentially be alleviated by improved communication to reduce the misunderstandings, conflicts, inefficiencies and role confusion that may arise and severely hamper patient care and outcomes (15, 32-34). Different professional training and cultures may explain some of the disparity in how health professionals communicate.

For change to occur, it will require support at both the provider and system level (35). Greater opportunity for inter-professional dialogue is needed to truly enact team care within programs and across the continuum of care. Patients’ perception of poor and inconsistent communication among their healthcare providers can negatively impact patient adherence, confidence, outcomes and satisfaction (36). Participants in this study spoke to the need for patient-provider communication to improve professionals’ understanding of patients’ beliefs and preferences and
clear, shared expectations regarding rehabilitation outcomes of TJA surgery. Disparities in expectations and evaluation of surgical outcomes are well documented with surgeons tending to rate outcomes more favorably than patients (13, 14). The intensity and duration of post-operative pain was common yet unexpected among patient participants in our study. Despite this information being readily available through previous studies (37-41), inadequate provider-patient communication and education may once again be at fault. We found there was both uncertainty and disagreement among patient and physician participants concerning professional responsibility for ensuring adequate pain control beyond the immediate post-operative period. Similarly, sleep disturbances described by patients in our study have been previously reported (39, 42) yet not adequately covered in pre-operative education sessions and virtually ignored during the early recovery phase. This was problematic for both patients and their spouses.

Post-operative anxiety, depression, fear and vulnerability were widely reported by patients and of concern to many AHPs. While pre-operative psychological factors were not specifically probed in our study, the literature suggests that pre-operative depressive symptoms are strongly related to post-operative outcomes and satisfaction (37, 38, 41, 43). Study participants recommended pre-operative screening for depression and other factors that may contribute to protracted pain and psychological distress and improved surgeon awareness of such psychological factors.

Emotional well being including more positive attributes (e.g., self-worth, hope, confidence, empowerment) is increasingly recognized as an important factor in coping and health outcomes of a number of chronic conditions and surgical procedures (36). Few studies examining the role of patient factors’ in determining TJA need and outcomes have included these attitudinal factors in their analyses of important characteristics. Further, current orthopaedic outcome tools fail to capture the concepts of patient attitude, self-efficacy and empowerment (38) despite the evidence suggesting self-efficacy, for example, impacts patient expectations (44), long-term functional
outcome (45) and adherence to prescribed exercise (46). Poor adherence was a commonly held assumption of AHPs in our study and felt to be strongly related to patients’ overall attitude about their role and outcome expectations of rehabilitation. Adherence to therapeutic protocols is problematic in many studies of TJA rehabilitation and warrants subgroup analysis to determine whether higher adherence (e.g., greater treatment dosage) results in larger treatment effects. These findings support adoption of self-efficacy theory to guide interventions, such as adopting efficacy enhancing strategies like contracting and role-modeling to enhance patient’s confidence regarding the adoption of habits that will support their recovery (47).

Our findings show that undergoing TJA surgery magnifies the need for support in the short term, consistent with other qualitative reports regarding the value of family and peer support to patients post-operatively (23). Better social support is associated with lower complication rates, better functional outcomes and higher post-operative quality of life (48). Patients described feeling supported by health professionals when they were ‘heard’ and given sufficient time to have their questions and concerns addressed. Similarly, health professionals were most satisfied with their support efforts when they had adequate time to spend with the patient. Surgeons on the whole admitted to having little time to provide the support and guidance sought by most patients and this is equally problematic in Canada and the US.

Concerns about poor health professional support were linked mostly to the follow-up (FU) phase, once supervised rehabilitation was completed. While the patients in our study had a TJA within the past year, several had undergone TJA surgery on another joint previously and expressed their dissatisfaction and feelings of being forgotten after rehabilitation ended. In a survey and chart review of 622 THA patients from three US states, only 41% reported consistent FU visits with their orthopaedic surgeons over a 6-year period and 16% reported they had no FU care (49). Older individuals and those with lower socioeconomic status were less likely to receive regular
FU. Our study patients suggested they would feel more supported in the year following TJA with regular phone calls, drop-in FU clinics with both surgeons and PTs, and group classes to review exercises, monitor progress and address any concerns.

Personal, provider and system-level factors were identified by our study participants as creating barriers to patients’ recovery after TJA. Hoppe et al. acknowledged rehabilitation as an important tool in reducing costs of disability regardless of cause (50). However, with “the rapid proliferation of private rehabilitation services currently operating with little regulation” (p.18), those using, prescribing and paying for the services are finding it increasingly difficult to determine if in fact, these services are of good quality, justified and cost-effective (50). In addition to other strategies, routine use of outcome measures and practice guidelines is suggested as a means of justifying and standardizing treatment approaches to address the structure, process and outcomes of the rehabilitation system. Capping the number of visits or duration of rehabilitation may help to control costs but as identified in our study, such limits were felt to hinder the rehabilitation process, ignore individual patient needs, and potentially lead to poorer outcomes and an overall increase in direct and indirect costs (50).

The issue of timely access to surgical care has been a priority of provincial healthcare ministries in Canada for several years and the focus of several innovative quality improvement strategies (34, 51, 52). However, little attention and additional funding have been directed toward addressing barriers to quality rehabilitative care following surgery. Access, including transportation concerns, to rehabilitation services continues to be problematic for Canadians and Americans living in more rural settings. Greater use of technology including telerehabilitation (e.g., videoconferencing, remote monitoring) was voiced as a possible solution and deserves further investigation in this patient population (53).
Sanderson et al. reported clinicians and patients have different perspectives on outcomes and whereas patients’ conceptualization of valued outcomes is broad, health professionals tend to focus on pathology and functional disability (54). We found a similar trend with patients describing a wide range of anticipated and expected outcomes covering many dimensions of health and psychosocial well-being while health professionals, in particular physicians and surgeons, focused more on impairment, basic function (e.g. walking, using stairs) and surgical parameters (e.g., fixation of implant). These incongruent views may play a role in the reported discrepancies between patients’ and health professionals’ evaluation of surgical outcomes in which there are moderate correlations at best between patient and clinician assessment of symptoms and disability (55).

Few health professionals reported routinely using standardized outcome measures in their surgical and clinical practices, despite considerable support for their use. Participants’ negative views on the utility (e.g., meaningfulness of numerical scores) and feasibility of using such instruments in clinical practice (e.g., time to administer and score) contributed to the low rate of standardized outcome evaluation. Jette et al. reported that a lack of support (e.g., technology, staffing) and irrelevant and confusing questions were barriers to routine use (56). Further, the apparent confusion among health professionals regarding what constituted an outcome measure may have led to underreporting and suggests more education is needed.

Across all themes was the overarching view that “hips and knees are two different beasts” with different patterns of recovery and rehabilitation needs. Equally stressed was that younger and more active individuals have different outcome expectations and rehabilitation needs than older or more sedentary patients. Study participants saw little value in a ‘one size fits all’ approach when designing rehabilitation programs, identifying recovery milestones and determining
outcomes. This is important to keep in mind as we design rehabilitation practice guidelines for a broad target audience.

2.5.1 Strengths of the study

The credibility and trustworthiness of findings were enhanced by using a standardized discussion guide, multiple data sources, peer and member checking, independent coding and maintenance of an audit trail throughout the data collection and analysis phases. This study provides new data on specific inter-professional communication issues and barriers to recovery after TJA and shares insight from two vastly different health care systems. Further, it adds to the research on protracted post-operative pain, sleep disturbance and anxiety well beyond the immediate post-operative stage, which all stakeholders agree are inadequately and inconsistently managed. The perspectives of patients and health care providers alike are important to ensuring the relevance of practice guidelines, which are extremely time-consuming and expensive to produce (57) and it is imperative to guideline adoption that all viewpoints be carefully considered. The patient perspective was maintained by having patient-only focus groups and using their language to label the themes.

Racial differences in patient-provider communication and the expectations and utilization of joint replacement therapy have been described elsewhere (58, 59), however, we could find no published information specifically on the experiences of Native North Americans undergoing TJA. The issues of geographical isolation and access to TJA rehabilitation care in a remote First Nation community identified in this study warrant further exploration.

2.5.2 Limitations

Due to delays in the ethical review process incompatible with project timelines, only one US site was involved. It is unlikely that we heard the diversity of experiences and health care delivery
issues that are inherent in a country with no universal healthcare program and varied access to health insurance. As well, the attitudes, functional limitations, access to specialty care, and rehabilitation experiences of uninsured individuals were not captured and may differ from the individuals in our study. Secondly, physician/surgeon focus groups were challenging to organize and did not include as much practice settings diversity as intended. Physicians’ views may not be transferable to those practicing in more rural settings with less access to rehabilitation resources for their patients. Similarly, despite efforts to ensure maximum diversity in patient participants, the experiences of less educated individuals and those not receiving formal rehabilitation services were underrepresented.

2.5.3 Clinical implications

There are several take home messages for clinicians, most of which are directly aligned with principles of client-centered practice (60) aiming to individualize intervention for optimal client outcomes as well as best use of therapeutic resources:

- Prior to surgery, ensure patient and provider expectations are clearly communicated and realistic;

- Prior to surgery, develop a plan for addressing post-acute pain management, psychological distress and sleep disturbances for several weeks following surgery;

- Use strategies to enhance self-efficacy and empower patients to adopt a positive attitude and take an active role in their rehabilitation;

- Incorporate efficient approaches to optimize health professional support and follow-up care beyond three months after TJA;
Where possible, engage family members and peers in education, counseling and exercise instruction;

Select meaningful outcome measures and consistently use to evaluate effects of interventions throughout the care continuum and across health care settings.

2.5.4 Future research directions

This study raises a number of questions that could be addressed through future research including an examination of communication and information technologies (e.g., telerehabilitation) on patient-provider and inter-provider communication and delivery of TJA rehabilitation services. Development and testing of a decision aide or screening tool would assist health care providers in identifying patients at risk for protracted pain, emotional distress and functional impairment. Further, there is a need to design, implement and evaluate the effects of a range of FU programs on patient satisfaction and long-term outcomes after TJA.

2.6 Conclusions

This qualitative, exploratory study provides valuable insight into rehabilitation experiences, attitudes and expectations of individuals who have undergone THA or TKA surgery and the health professionals directly involved in their care. Patients offered a perspective that differed, but overlapped, with the perspectives of health professionals regarding rehabilitation practices and outcomes. Themes arising from all stakeholder groups related to communication, unexpected events, importance of patient attitude and active involvement, professional and social support, barriers to recovery and a return to normalcy. Awareness of the facilitators and barriers to achieving optimal outcomes that emerged from this study will help clinicians and administrators in the design and delivery of pre- and post-operative interventions aimed at helping patients reach their desired goals after TJA. Stakeholders’ views on rehabilitation for TJA will inform the
next phases of guideline development and ensure all perspectives shape guideline priorities, scope, and format.
2.7 References


Chapter 3: Post-acute physiotherapy following primary total hip arthroplasty for osteoarthritis: A Cochrane systematic review

3.1 Background

For individuals with advanced osteoarthritis (OA) that is not successfully managed with conservative measures such as use of analgesics, anti-inflammatory agents, walking aids, exercise and activity modifications, joint replacement surgery becomes the recommended treatment. Total hip arthroplasty (THA) surgery or total hip replacement (THR), is the most common surgical procedure for advanced end-stage OA of the hip. Approximately 22,000 primary THA surgeries were performed in Canada in 2006/07 (not including Quebec) (1). In the United States (US), this number is more than 10-fold greater (2). The number of THA procedures in Canada grew by 101% in the preceding 10-year period and by 7% in the preceding year (1). Similar one year growth rates are reported in other countries (2, 3). This number is projected to rise in an almost exponential fashion with the aging population, increasing prevalence of obesity and increased prevalence of OA (4-7). Other factors contributing to the increase are greater patient demand and public expectations for improved quality of life, shortened acute care length of stay (LOS) allowing for a greater number of procedures, advances in prosthetic design and materials, and improved surgical and anaesthetic techniques that have made these surgeries appropriate and safer for individuals who were not previously eligible (3, 5, 7, 8). In the US, an increase in number of orthopaedic surgeons with a focus on total joint arthroplasty (TJA) has further fueled the growth in number of these procedures (7). International data show that OA is the primary reason for surgery and contributes to between 81% (1) and 94% (9) of all primary THA procedures.

3 A version of this chapter will be submitted for publication. Westby MD, Carr S, Kennedy D, Brander V, Bell M, Doyle-Waters M, Backman C. Post-acute physiotherapy following primary total hip arthroplasty for osteoarthritis: A Cochrane systematic review.
While joint replacement surgery decreases pain, improves mobility and function, and improves quality of life (10-12) with minimal complications, THA surgeries place a significant burden on healthcare budgets (3, 5). Data from the American Academy of Orthopaedic Surgeons (AAOS) indicate that 2005 total hospitalization costs for primary THA procedures in the US was $9.2 billion (USD) (2).

In the past decade, days spent in hospital for THA has decreased by 38% in Canada (1) and by 49% (1993 to 2005) in the US (7). Data from 2006/07 show that the average acute hospital length of stay (LOS) in Canada to be seven days (median five days) for all THA procedures, including revisions (1). A significantly shorter hospital stay (mean LOS 4.2 days) is reported in the US when only primary procedures are considered (2). Earlier discharge decreases the time available for recuperation, early rehabilitation, and patient and family education and counseling. Reduced LOS places additional burden and responsibility on the patients, their family and their post-acute health care providers to monitor for and address post-operative complications such as wound infection and deep vein thrombosis (DVT). The short stay puts more emphasis on preadmission education and the role and timing of post-acute physiotherapy interventions following discharge. In an editorial examining LOS after TJA, Johanson comments that "it remains unclear just how far this process [of reducing LOS] can be taken without either compromising quality of care or simply shifting costs to a less regulated outpatient environment" (13) (p.1).

To date, no evidence-based practice guidelines exist to inform best practice for post-acute rehabilitation following THA in North America and specific rehabilitation practices vary greatly among providers (14-16). Current therapeutic interventions are based largely on clinical experience (17), clinician and surgeon preferences (18), the acute care phase of recovery (19, 20), facility-based protocols (21), health insurance funding schemes (7) and outdated approaches
Furthermore, little or no guidance exists on recommended activities following discharge from the acute care setting (23). All but two international joint replacement registries (8, 24) limit their data collecting and reporting to surgical outcomes such as peri-operative complications and revision rates. Rehabilitation and its contribution to both surgical and patient-centred outcomes are an overlooked aspect of the total episode of care for THA patients.

There are a number of reports suggesting that some patients are not reaching their physical potential following THA and that post-operative pain, physical impairments and functional limitations are still issues more than one year following THA (10, 25-27). Current exercise programs during the early phase of rehabilitation are insufficient to restore muscle strength, normal gait and more complex functional activities in some patients (25). However, we do not know exactly what kind of physiotherapy performed over what period of time is effective or necessary to enhance short- and long-term surgical outcomes and optimize patient activity, participation and health-related quality of life (HRQoL). The National Institutes of Health (NIH) conference on THA concluded:

“The contribution of pre-hospital, in-hospital and post-hospital education and rehabilitation programs to the eventual outcome of the surgical procedure deserves an organized, in-depth study to determine optimum regimen, duration of treatment, and expected outcomes.” (28)(p. 8).

As part of the larger project to develop evidence-based clinical practice guidelines for post-acute rehabilitation after primary THA and total knee arthroplasty (TKA), systematic reviews were undertaken to examine the current literature on various rehabilitation approaches and interventions in this patient population. Previous reviews have addressed multidisciplinary
rehabilitation for primary and revision THA and TKA (29), pre-operative education for THA and TKA (30) and most recently, therapeutic exercise after discharge from hospital for THA (31).

3.2 Purpose

The primary aim of this review is to assess the effects of post-acute physiotherapy following primary THA for OA on patient-centred outcomes of pain, physical function and HRQoL.

3.2.1 Objectives

The specific objectives are to:

1. Document the short-term and long-term effects of post-acute physiotherapy on pain, physical function and HRQoL in persons undergoing primary THA for OA
2. Compare outcomes across different clinical settings and treatment approaches, timing and dosages
3. Make recommendations for clinical practice based on the strength of the evidence
4. Identify research needs in post-acute physiotherapy in the THA population

3.3 Methods

3.3.1 Criteria for considering studies for this review

We considered both randomized controlled trials (RCTs) and controlled clinical trials (quasi-randomized and controlled before-after designs) for inclusion in this review. Designs not included were cohort, case-control, single case studies, single subject, case series and pre/post studies with no control group.

3.3.2 Types of participants

Primary trials of individuals aged 19 years and older who underwent an elective, primary THA for primary (idiopathic) or secondary OA due to chronic trauma, developmental or congenital
problems were considered. Surgical procedures included all forms of fixation (cemented, hybrid or cementless with/without porous coating), surgical approaches (anterolateral, lateral, posterolateral, minimally invasive) and types of prosthetic bearing surfaces (metal, polyethylene, ceramic). Studies were excluded if participants had:

- undergone a revision THA, hemi-arthroplasty or resurfacing procedure;
- an inflammatory arthritis diagnosis (i.e. rheumatoid arthritis, ankylosing spondylitis);
- an acute fracture;
- significant pre- or peri-operative complications (e.g., intraoperative fracture, nerve palsy, deep wound infection, severe anaemia, DVT)
- an extended acute hospital stay beyond the standard LOS for that hospital facility.

Studies with mixed pre-surgical diagnoses were included if 90% or more of the participants had an OA diagnosis.

### 3.3.3 Types of interventions

#### 3.3.3.1 Experimental

Post-acute physiotherapy includes physiotherapy provided in any setting (in-patient, outpatient or home/community). The 'post-acute' phase was determined to extend from immediately following discharge from the acute care ward or setting and up to 12 months post-surgery. The time frame selected reflects patients’ views on the duration of rehabilitation services (32). Physiotherapy includes 1 to 1 treatments and group interventions supervised by the physiotherapist (PT) and/or a trained physiotherapy assistant under the direct supervision of a PT. Interventions could include alone or in combination:

- therapeutic exercise;
- hydrotherapy;
- use of thermal or electrical modalities (i.e. cryotherapy, heat, transcutaneous electrical nerve stimulation (TENS) and neuromuscular electrical stimulation);
- postural, proprioceptive and balance training;
- gait training;
- functional exercises;
- cardiovascular training;
- manual therapy techniques (i.e. soft tissue massage, passive range of motion (ROM), hold-relax);
- patient education and self-management techniques.

Interventions not included in this review were splinting or bracing, and chiropractic or osteopathic manipulation.

We characterized interventions by:

- timing of when treatment initiated (immediate = < 2 weeks post-surgery, intermediate = between 2 weeks and 3 months post-surgery or delayed = > 3 months post-surgery)
- setting (outpatient, inpatient or home-based)
- dosage (lower = < 6 visits or 3 weeks of intervention and higher = ≥ 6 visits or 3 weeks of intervention)

3.3.3.2 Control
Supervised physiotherapy was compared to control situations in which participants received ‘routine care’ (standard or traditional physiotherapy of a given institution or surgeon), ‘attention only’ (no active intervention), unsupervised home exercises or other operationalized comparators (which may include comparing one physiotherapy program or therapeutic setting to another).
3.3.4 Types of outcome measures

The primary outcomes of interest were:

- Post-operative pain (at rest or with activity);
- Physical function (as measured by validated functional assessment self report tools, surgeon-rated tools or performance-based measures);
- HRQoL (as measured by validated generic, condition-specific, individualized or preference-based instruments);
- Adverse events due to rehabilitation (e.g. increased pain, fall).

Secondary outcomes were categorized according to the International Classification of Functioning (ICF) (33) but were not included in the analysis:

- Body structure and function (e.g. hip ROM, lower extremity muscle strength and endurance, soft tissue flexibility, proprioception, cardiovascular fitness)
- Activity (i.e. those not captured under physical function outcomes)
- Participation (e.g. paid/unpaid work, care giving, leisure activities, social activities)
- Personal contextual factors (e.g. age, gender, body mass index, patient satisfaction, self-efficacy, anxiety, motivation)
- Environmental factors (e.g. health insurance coverage, waiting time for surgery)

Process measures:

- Timing of treatment intervention
- Timing of baseline assessment (pre-surgery or post-surgery/pre-intervention)
- Treatment setting (inpatient, outpatient, home)
- Treatment dosage (e.g. frequency, duration, number of sessions)
• Adherence to treatment

### 3.3.5 Search methods for identification of studies

We searched the following electronic databases to identify relevant studies published between January 1990 and August 31, 2008. The period of time covered was recommended by the expert panel and covers the period of time when inpatient LOS fell and diagnostic related groups (DRGs) became widespread basis for reimbursement in the US by this year.

- Cochrane Musculoskeletal Group Trials Register (September 17, 2008)
- Cochrane Central Register of Controlled Trials (CENTRAL)(Issue 3, 2008)
- MEDLINE (OVID) (1950 to August 31, 2008)
- EMBASE (OVID) (1980 to 2008 Week 39)
- CINAHL (EBSCO) (1981 to August 31, 2008)
- Cochrane Database of Systematic Reviews (Issue 3, 2008), ACP Journal Club and DARE (OVID)
- PEDro (Physiotherapy Evidence Database) (August 31, 2008)
- Web of Science (ISI) (August 31, 2008)

Articles in any language were reviewed. See Appendix D for an example of the search strategy for MEDLINE using a combination of MeSH and key words. The quality filter recommended by the Cochrane Musculoskeletal Review Group was applied.

We scanned articles, review papers and textbooks for additional papers. Known experts in the field and authors of existing, high quality studies were contacted for further references. A grey literature search was conducted to identify published and unpublished papers, reports and other documents. We searched papers and proceedings from congresses and symposiums through the databases PapersFirst and ProceedingsFirst. Additionally, we hand searched conference
proceedings of key professional organizations, highly relevant orthopaedic and rehabilitation journals, professional organizations' websites, and national joint arthroplasty registries.

### 3.3.6 Data collection and analysis

A team of four primary reviewers (MW, SC, DK and VB) and two adjudicators (CB and MB) was assembled. Three of the four reviewers were trained in the Cochrane review methodology. The lead reviewer (MW) and one other primary reviewer (SC) independently screened all identified papers by scanning titles and abstracts for appropriateness (first level screening). Pairs of reviewers then evaluated potentially relevant studies to see if they met our inclusion criteria (second level screening).

The same pair then independently extracted data from accepted papers using a standardized form. Any disagreement was resolved through discussion and consensus. There was no situation in which a tie breaker was needed. If necessary, study authors were contacted for additional information to complete the screening and abstraction process. A Swedish (E.R.) and German (M.B.) colleague reviewed and translated some papers and abstracted the necessary data. These were then checked by two independent reviewers and any further questions were discussed with the foreign language colleague.

### 3.3.7 Assessment of methodological quality

We assessed the risk of bias and overall methodological quality of the studies using the scale by van Tulder et al. (34) for RCTs and controlled clinical trials (CCTs). This 11-item quality assessment scale developed by the Cochrane Back Review Group was chosen for its relevance (Table 3.1). While designed as a checklist for aggregating items and generating a single quality score, this process is no longer favoured (35) and we present the individual quality criteria results for each trial.
Table 3.1 Quality Assessment and Risk of Bias Checklist

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was the method of randomization adequate?</td>
<td>yes no don't know</td>
</tr>
<tr>
<td>2. Was treatment allocation concealed?</td>
<td>yes no unclear</td>
</tr>
<tr>
<td>3. Were groups similar at baseline regarding most important prognostic factors?</td>
<td>yes no don't know</td>
</tr>
<tr>
<td>4. Was the patient blinded to the intervention?</td>
<td>yes no don't know</td>
</tr>
<tr>
<td>5. Was the therapist/care provider blinded to the intervention?</td>
<td>yes no don't know</td>
</tr>
<tr>
<td>6. Was the outcome assessor blinded to the intervention?</td>
<td>yes no don't know</td>
</tr>
<tr>
<td>7. Were co-interventions avoided or similar?</td>
<td>yes no don't know</td>
</tr>
<tr>
<td>8. Was compliance acceptable in all groups?</td>
<td>yes no don't know</td>
</tr>
<tr>
<td>9. Was the drop-out rate described and acceptable (20% or less for post-test, 30% or less for long term follow up)</td>
<td>yes no don't know</td>
</tr>
<tr>
<td>10. Was the timing of the outcome assessment similar in both groups?</td>
<td>yes no don't know</td>
</tr>
<tr>
<td>11. Was data for at least one key outcome analyzed by intention-to-treat (ITT)?</td>
<td>yes no don't know</td>
</tr>
</tbody>
</table>

Initial inter-observer reliability of both the screening and quality assessment was determined on two papers prior to the actual review process. These related studies were drawn from a pool of articles that did not meet the inclusion criteria due to publication date or difference in intervention or patient population (34). Poor agreement on some items during this pilot test phase led to revisions to the screening and data extraction forms. After further discussion, agreement was reached on the screening and data abstraction process. Comprehensive guidelines for data abstraction were prepared and used by all reviewers.

3.3.8 Data analysis and synthesis

Continuous data from individual trials were recorded as means and standard deviations. We contacted several authors for missing data. Evidence tables were created and a qualitative
analysis performed using the GRADE approach recommended by the Cochrane Musculoskeletal Group (36) (Table 3.2). Detailed methods for upgrading or downgrading studies are described in the Chapter 12.2.1 of the Cochrane Handbook for Systematic Reviews (35).

Table 3.2 GRADE approach to assessing overall levels of quality of a body of evidence

<table>
<thead>
<tr>
<th>Underlying methodology</th>
<th>Quality rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randomized trials; or double-upgraded observational studies.</td>
<td>High</td>
</tr>
<tr>
<td>Downgraded randomized trials; or upgraded observational studies.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Double-downgraded randomized trials; or observational studies.</td>
<td>Low</td>
</tr>
<tr>
<td>Triple-downgraded randomized trials; or downgraded observational studies; or case series/case reports.</td>
<td>Very low</td>
</tr>
</tbody>
</table>

All raters independently examined the evidence tables for clinical and methodological heterogeneity taking into account the participants, interventions, controls (comparators), outcomes, timing of assessments, measurement tools and methodological quality of the original studies (34). Due to lack of both clinical and methodological homogeneity among trials, we were unable to pool the data and perform a meta-analysis. This is a common problem among Cochrane reviews of allied health interventions (37). We do, however, present the individual studies' treatment effect sizes using weighted mean differences (WMD) for those with mean post-test values and sufficient data. In addition, for those trials with small sample sizes (less than 50 subjects per group) (38) and differing baseline values, we also calculated WMDs using mean change scores to better reflect the true effect. Since original data sets were not available, we used the formula suggested in the Cochrane Handbook, Chapter 16.1.3.2 (39) and a conservative imputed value of 0.8 as the correlation between pre- and post-test scores. Smaller correlation coefficients are known to overestimate effect sizes and thus the more conservative value was
chosen (40). Forest plots were created to display effect estimates with 95% confidence intervals and samples are provided for select outcomes within individual trials.

### 3.4 Results

#### 3.4.1 Description of studies

A total of 1,538 English and non-English papers were identified. Of these, 98 were retained for second level screening and eight for full review (six RCTs, two CCTs) (Figure 3.1). Three of the eight articles were published in languages other than English (41-43) and all but one study was conducted outside of North America. All trials were published between 1998 and 2008.
Figure 3.1 PRISMA flow chart for THA systematic review

Potentially relevant RCTs & CCTs identified and screened for retrieval (n = 1,538)

RCTs & CCTs excluded with reasons (n = 1,440)
Main reasons:
- Not THA-related
- Not intervention study
- Not a rehabilitation intervention
- No control group

RCTs & CCTs retrieved for more detailed evaluation (n = 98)

RCTs & CCTs excluded with reasons (n = 90)
Main reasons:
- Multidisciplinary intervention
- Significant pre-op component
- Acute care intervention
- No THA subgroup data
- Mixed diagnoses (no OA subgroup data)
- Not within review timeframe

Potentially appropriate RCTs & CCTs to be included in the meta-analysis (n = 8)

RCTs & CCTs excluded from meta-analysis with reasons (n = 8)
(Due to clinical & methodological heterogeneity among trials)

RCTs included in meta-analysis (n = 0)
Several studies initially screened as being appropriate and subsequently excluded from this review are listed in Table 3.3.

Table 3.3 Excluded studies and main reason for exclusion

<table>
<thead>
<tr>
<th>Study</th>
<th>Main reason for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gilbey HJ et al. 2003 (44)</td>
<td>Included significant pre-op component</td>
</tr>
<tr>
<td>Jan M-H et al. 2004 (45)</td>
<td>Initiated more than 1 year post-THA</td>
</tr>
<tr>
<td>Mahomed NN et al. 2008 (46)</td>
<td>No subgroup data for THA</td>
</tr>
<tr>
<td>Weaver FM et al. 2003 (47)</td>
<td>Included significant pre-op component</td>
</tr>
<tr>
<td>Maire J et al. 2003 (48)</td>
<td>Less than 10 subjects per group</td>
</tr>
<tr>
<td>Sashika H et al. 1996 (49)</td>
<td>Less than 10 subjects per group</td>
</tr>
<tr>
<td>Siggeirsdottir K et al. 2005 (50)</td>
<td>Included significant pre-op component</td>
</tr>
</tbody>
</table>

3.4.2 Methodological quality

The range in methodological quality of the included studies was very low to moderate. Randomization procedures were adequate in three trials, inadequate in one, and not clear in four. Concealed allocation, where neither the researcher nor participants are aware of group assignment in advance, occurred in three studies. Only three trials reported blinding the outcome assessor. Blinding of the provider and patients is not possible in most cases in physiotherapy intervention studies; however, authors of one trial stated the participants were blind to the important details of the intervention. Short-term drop out rates were satisfactory in five studies and exceeded the acceptable short-term rate of 20% (34) in three. Two studies included a long-term follow-up phase (12 months or more) with satisfactory drop out rates in one and not in the other. (See Table 3.4)
### Table 3.4 Methodological quality and risk of bias in included trials

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Concealment</td>
<td>?</td>
<td>Y</td>
<td>Y*</td>
<td>N</td>
<td>?</td>
<td>Y</td>
<td>Y*</td>
<td>Y</td>
</tr>
<tr>
<td>3. Groups similar</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>4. Patient blinded</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>5. Therapist blinded</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>6. Assessor blinded</td>
<td>?</td>
<td>Y</td>
<td>Y*</td>
<td>N</td>
<td>?</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>9. Acceptable drop-out rate (short term)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>?</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>10. Timing of outcome assessment similar</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>11. ITT analysis</td>
<td>NA</td>
<td>Y</td>
<td>NA</td>
<td>N</td>
<td>N</td>
<td>?</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

Legend: Y = criterion was met; * = positive response was obtained by contacting the author and not from published article; ? = unclear, incomplete or no data provided; N = criterion was not met; NA = not applicable as there were no drop outs reported

### 3.4.3 Participants

A total of 497 participants were included in this review. Individual study sample sizes ranged from 23 to 219 participants. Mean participant ages ranged from 54 to 79 years and a majority was female in all trials. Race was not identified in any studies. General health, presence of co-morbidities and details of the surgery were poorly described or not mentioned (Table 3.5).
Table 3.5 Summary of study characteristics

<table>
<thead>
<tr>
<th>Study/language</th>
<th>Design/ quality</th>
<th>Setting/country</th>
<th>Participants (1° THA for OA)</th>
<th>Exclusion criteria</th>
<th>Intervention</th>
<th>Comparison</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Galea 2008 (English)</td>
<td>RCT (n=23) Low</td>
<td>Outpatient rehabilitation centre, Australia</td>
<td>TG = mean age 69 (10) yrs, 63% ♀. CG = mean age 67 (8) yrs, 50% ♀.</td>
<td>Uncontrolled systemic disease, neurologic or orthopaedic condition affecting walking, &gt; 4 wks of post-op physiotherapy</td>
<td>Start: 8 wks post-op. Centre-based progressive exercise program, 2x/wk for 8 wks</td>
<td>Home-based program with illustrated exercise guide, no further instruction</td>
<td>Baseline: post-op TUG, stair climbing, 6MWT, WOMAC, AQoL. Adverse events not reported No LT follow-up</td>
</tr>
<tr>
<td>Hesse 2003 (English)</td>
<td>RCT (n=80) Moderate</td>
<td>Inpatient rehab facility, Germany</td>
<td>Cementless THA. Combined mean age = 65 (13) yrs, 70% ♀.</td>
<td>Orthopaedic/ neurologic disease impairing gait, history of DVT, symptomatic heart disease</td>
<td>Start: 3 wks post-op. Body weight supported treadmill training + standard physio program, 5x/wk for 2 wks</td>
<td>Standard inpatient physio program</td>
<td>Baseline: post-op Harris Hip Score, walking speed, hip abduction strength. Adverse events reported 12 month follow-up</td>
</tr>
<tr>
<td>Mayer 2005 (German)</td>
<td>RCT (n=24) Low</td>
<td>Outpatient physio dept, Germany</td>
<td>Cementless THA. Combined mean age = 61 (range 40-85) yrs, 67% ♀.</td>
<td>Hip fracture</td>
<td>Start: 2 wks post-op Mental gait training + standard physio program, 3x/wk for 3 wks</td>
<td>Standard outpatient physio program</td>
<td>Baseline: post-op Walking speed, step length, stance phase. No adverse events reported No LT follow-up</td>
</tr>
<tr>
<td>Nyberg 2002 (Swedish)</td>
<td>CCT (n=45) Very Low</td>
<td>Outpatient dept, University Hospital, Sweden</td>
<td>Cemented or hybrid THA. TG = mean age 69 (5) yrs, 65% ♀. CG = mean age 68 (5) yrs, 53% ♀.</td>
<td>Revision surgery</td>
<td>Start: 8 wks post-op Group “THR school” 2x/wk for 15 wks + standard home exercise program</td>
<td>Standard home exercise program for 15 wks</td>
<td>Baseline: post-op Pain (VAS), MACTAR, general health satisfaction (VAS), rating of exercise importance. Adverse events reported No LT follow-up</td>
</tr>
</tbody>
</table>
Table 3.5 Summary of study characteristics (continued)

<table>
<thead>
<tr>
<th>Study/language</th>
<th>Design/quality</th>
<th>Setting/country</th>
<th>Participants (1° THA for OA)</th>
<th>Exclusion criteria</th>
<th>Intervention</th>
<th>Comparison</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scherak 1998</td>
<td>CCT, 3 treatment arms (n=219)</td>
<td>Inpatient rehab hospitals, Austria</td>
<td>Combined mean age = 66 (8) yrs, 67% ♂</td>
<td>Unclear</td>
<td>Start: Grp 1 = within 2 months post-op; Grp 2 = 3-4 months post-op; Grp 3 = 11 months post-op All grps received standard inpatient rehab program of exercises, gait training &amp; hydrotherapy 5x/wk for 4 wks.</td>
<td>Different start times for inpatient rehab program</td>
<td>Baseline: post-op Walking speed, gait pattern, disablement tool, ROM. Adverse events not discussed Partial LT follow-up</td>
</tr>
<tr>
<td>Ström 2006</td>
<td>RCT (n=36)</td>
<td>Setting not clear (gym-based?), Sweden</td>
<td>Cementless THA. Combined mean age = 54 (range 25-63) yrs, 53% ♂</td>
<td>None given</td>
<td>Start: immediately post-op Unrestricted weight bearing &amp; supervised, progressive exercise program (gym + pool based) 2-3x/wk for 12 wks</td>
<td>Partial weight bearing &amp; unsupervised home exercise program for 12 wks</td>
<td>Baseline: pre-op Merle d’Aubigne Score, hip abduction strength &amp; ROM, peak weight bearing load. Adverse event reported 12 month follow-up</td>
</tr>
<tr>
<td>Suetta 2004</td>
<td>RCT, 3 arms (n=36)</td>
<td>Outpatient hospital &amp; home, Denmark</td>
<td>Cemented THA, ASA score I-II. Combined mean age = 69 (range 60-86) yrs. TG 1 = 46% ♂; TG 2 = 55%, CG = 58% female</td>
<td>Cardiopulmonary, neurological or cognitive problems</td>
<td>Start: immediately post-op TG 1: outpatient based progressive resistance training 3x/wk for 12 wks. TG 2: NMES to quadriceps starting post-op day 1 then at home 1-2x/day for 12 wks.</td>
<td>CG 3: home based exercise program with weekly visits from PT for 12 wks.</td>
<td>Baseline: pre-op Walking speed, timed stair climb, sit-to-stand test, quads strength (isokinetic), muscle cross sectional area No adverse events reported No LT follow-up</td>
</tr>
</tbody>
</table>
Table 3.5 Summary of study characteristics (continued)

<table>
<thead>
<tr>
<th>Study/language</th>
<th>Design/quality</th>
<th>Setting/country</th>
<th>Participants (1° THA for OA)</th>
<th>Exclusion criteria</th>
<th>Intervention</th>
<th>Comparison</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trudelle-Jackson 2004</td>
<td>RCT, 2 treatment arms (n=34) Moderate</td>
<td>Home-based, Dallas, USA</td>
<td>Adult of any age, race or gender, 1° THA 4-12 months ago. Combined mean age = 60 (11) yrs, 54% ♀.</td>
<td>Pain with weight bearing, current low back pain, diagnosed vestibular problems, central or peripheral nervous system problems, dementia</td>
<td>Start: 8-12 months post-op TG 1: Set of 7 progressive weight bearing exercises including functional strength, balance &amp; trunk stability 3-4x/wk for 8 wks. TG 2: Set of 7 basic active ROM &amp; isometric strength exercises commonly prescribed in acute phase of recover, 3-4x/wk for 8 wks.</td>
<td>No other comparator</td>
<td>Baseline: post-op Oxford Hip Score, hip strength, postural stability (portable force platform) Adverse events reported No LT follow-up</td>
</tr>
</tbody>
</table>

TG = treatment or experimental group; CG = control or comparator group; TUG = timed up & go test; 6MWT = 6 minute walk test; WOMAC = Western Ontario & McMaster Universities OA Index; AQoL = Assessment of Quality of Life instrument; LT = long term; DVT = deep vein thrombosis; VAS = visual analogue scale; MACTAR = McMaster Toronto Arthritis patient preference questionnaire; ROM = range of motion; ASA score = American Society of Anesthesiologists score; NMES = neuromuscular electrical stimulation.
3.4.4 Interventions

No two trials evaluated similar post-acute physiotherapy interventions following primary THA with regards to timing, duration, dosage, setting and type of rehabilitation. The timing of the start of the intervention ranged from immediately after surgery to more than eight months following surgery. Most studies fell into the intermediate range delivering the intervention between two weeks and eight weeks post-operatively. Treatment duration ranged from two weeks to 15 weeks. Overall dosage was difficult to calculate in two trials and ranged from three times a week for three weeks (nine sessions in total) to three times a week for 12 weeks (36 sessions in total). All trials were classified as 'higher dosage' according to our categories established a priori. Treatment settings included inpatient rehabilitation facilities in two trials, outpatient departments/clinics in four, participants' homes in one, and not clear in one.

Adherence to the physiotherapy protocol or intervention was rarely discussed and prospective adherence data were only collected in three trials. No studies included a subgroup analysis of high versus low adherers with regards to treatment effects.

3.4.5 Controls

Control or comparator situations were not consistent among trials and included standard or routine physiotherapy in three studies, unsupervised home exercises in three, delayed treatment (wait list) in one, and a different type and intensity of exercise in one. No trials compared a physiotherapy intervention to a “no active intervention” or placebo control group. Baseline characteristics of the treatment and control groups were similar in all trials; however, only minimal baseline information was provided in most studies (Table 3.5).
3.4.6 Outcomes

More than 23 different outcome tools were used in the eight trials again making comparison across studies difficult. Post-operative pain (ICF level: body function) was evaluated in three trials. Physical functioning (ICF level: activity) was assessed in seven studies and included performance measures (e.g. walking speed), self-report tools (e.g. WOMAC OA Index) and surgeon-rated tools (e.g. Harris Hip Score). One study used a self-report tool developed for rheumatoid arthritis (RA) and not validated in the OA population. Only one trial reported on HRQoL using the Assessment of Quality of Life (AQoL) measure.

For the secondary outcomes of interest, data on hip muscle strength was most frequently reported; however, methods for assessing strength varied and included manual muscle testing using a 0 - 5 scale and dynamometry to evaluate isometric and isokinetic strength of a variety of lower extremity muscle groups. Additional secondary outcomes included gait parameters (e.g. step length, symmetry), passive and active ROM and self-rated exercise importance. We do not include any further discussion on secondary outcomes due to their inconsistent use and reporting methods.

Baseline assessments occurred immediately prior to THA surgery in two studies and post-operatively, prior to the intervention in six. The timing of subsequent assessments was similar for treatment and control groups in all trials. Two trials included a long-term follow-up assessment at one year post-op.

Adverse events during the intervention study period were documented in four studies:

- Pulmonary embolus resulting in death in one treatment group participant (51)
- Two DVTs and one hip dislocation in control group participants and one hip dislocation in a treatment group participant (41)
• Pulmonary embolism in one participant (group not specified) (52)

• Pain on non-surgical side in one standard care group participant and unspecified pain resulting in drop out in one functional exercise group participant (53)

Authors of three of the trials reported the adverse events were not related to the treatment intervention while the other stated it was not clear. Three studies reported there were no adverse events while the remaining trial did not provide any information. Patient satisfaction with the physiotherapy intervention or outcomes was not reported in any trials.

3.4.7 Risk of bias in included studies

All trials had design or methodological issues putting them at risk for bias. Allocation (selection) bias may have been present in five studies that did not describe adequate randomization with concealed allocation. Correspondence with the authors of two of these studies suggested appropriate randomization techniques may have been used; however, this information was not included in the published reports. Measurement bias is of concern in the five trials that did not report using a blinded outcome assessor. Performance bias, attributable to unblinded participants, may have been an issue in all but one trial. Attrition bias due to higher than anticipated dropouts was evident in one study and unclear in another.

Another issue potentially contributing to performance bias is the lack of data on adherence to study protocols and exercise regimes. Only three trials reported monitoring participants' adherence to the intervention and/or comparator in a prospective fashion (e.g. attendances, exercise logs). This makes it difficult to determine the true effects of the intervention on the outcomes of interest or if there was a dose-response effect. That is, were there greater treatment effects in the subgroup of participants that adhered to the intervention compared to those who only partially completed the program? Similarly, the issue of therapist or provider adherence to the intervention protocol was not addressed in any of the trials. While there is always the need
for some individualization of therapeutic interventions to address the needs and preferences of patients, deviating from the study protocol complicates matters and introduces elements of co-intervention and even contamination that cannot be controlled for in the analysis if not monitored.

Small sample sizes (less than the 50 participants per group standard) (38) in all but one trial may have contributed to underpowered studies and the risk of false conclusions (Type II error) about lack of treatment effect. Only one study reported performing a power calculation to determine an appropriate sample size a priori. A recent study reported that trial sample size (> 100 participants) more so than trial quality, predicted a positive study outcome (54).

3.4.8 Effects of interventions

As noted earlier, we were unable to pool the data and perform a quantitative analysis due to trial heterogeneity. Therefore, we performed a qualitative analysis and best evidence synthesis for the primary outcomes using the GRADE approach (36). For trials with adequate data, WMDs and 95% confidence intervals for the primary outcomes are summarized below and sample forest plots are provided in Figures 3.2 to 3.7. Where appropriate, we present a comparison of effect sizes based on mean change versus those based on post-test values for select studies.

3.4.8.1 Pain

Three studies reported on post-operative pain following different interventions and at two different time points. Galea et al. found no significant between group difference (WMD -16.80, [-5.13, 11.53]) after an 8-week supervised, centre-based physiotherapy program initiated eight weeks post-op compared to an unsupervised home program during the same time frame (55). This difference remained non-significant using mean change scores (Figures 3.2 and 3.3). Nyberg and colleagues reported no difference in pain at rest (WMD -3.20, [-11.78, 5.38]) or with
activity (WMD -0.50, [-10.23, 9.23]) after a 15-week group "THR school" when compared to home exercises alone at six months post-THA (41). These differences remained non-significant using mean change scores. We could not calculate an effect size for the third trial as the author did not respond to our request for missing data (52).

There is consistent low quality evidence that:

- Delayed outpatient physiotherapy of either eight or 15 weeks duration results in no differences in pain at rest or with activity when compared to home-based exercise programs.

**Figure 3.2 Forest plot for WOMAC pain comparing mean post-test values**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Treatment (outpatient)</th>
<th>Control (home-based)</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Total</td>
<td>Mean</td>
</tr>
<tr>
<td>Galea 2008</td>
<td>39.5</td>
<td>31.3</td>
<td>11</td>
<td>56.3</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>11</td>
<td>12</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Heterogeneity: Not applicable
Test for overall effect: Z = 1.16 (P = 0.25)

**Figure 3.3 Forest plot for WOMAC pain comparing mean change scores**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental (outpatient)</th>
<th>Control (home-based)</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Total</td>
<td>Mean</td>
</tr>
<tr>
<td>Galea 2008</td>
<td>22.7</td>
<td>22.8</td>
<td>11</td>
<td>20.9</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>11</td>
<td>12</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Heterogeneity: Not applicable
Test for overall effect: Z = 0.17 (P = 0.87)

3.4.8.2 **Function**

Seven trials included one or more functional measures as outcomes. Function was assessed through self-report, surgeon-rated and performance-based tools.
Self-reported function

Two studies reported on function using different self-report measures following different interventions. Galea et al. found no significant between-group difference (WMD -54.40, [-168.08, 59.28]) in WOMAC function after eight weeks of supervised, centre-based physiotherapy initiated eight weeks post-op compared to an unsupervised home program (55). This difference remained non-significant using mean change scores. Trudelle-Jackson and colleagues reported that a late-phase (eight to 12 months post-op) functional exercise program resulted in a 5-point improvement in the Oxford Hip Score compared to a 2-point improvement with a standard home exercise program (53); however, only median values were provided and effect sizes could not be calculated.

There is low quality evidence that:

- Delayed outpatient physiotherapy results in no differences in self-reported function when compared to a home-based program.

Surgeon-rated function

Two studies reported on function using surgeon-rated tools following different interventions. Hesse et al. found significant between-group differences for the Harris Hip Score at 10 days (WMD 13.60, [7.58, 19.62]), three months (WMD 8.90, [3.17, 14.63]) and 12 months (WMD 16.50, [11.55, 21.45]) after two weeks of body weight supported treadmill training as an adjunct to standard inpatient physiotherapy compared to standard physiotherapy alone (both initiated three weeks post-op) (51). Between-group differences at all measurement points remained significant when using change scores (Figures 3.4 and 3.5). Strom et al. reported no significant differences in the function subscale of the Merle d'Aubigne score at 12 weeks, six and 12 months when comparing an immediate, supervised progressive training program with unrestricted weight
bearing to an unsupervised, home exercise program with partial weight bearing instructions; however, missing data precluded calculation of effect sizes (52).

There is moderate level evidence that:

- Treadmill training with body weight support in addition to standard inpatient physiotherapy results in greater short- and long-term improvements in surgeon-rated function when compared to 'standard' care alone.

**Figure 3.4 Forest plot for Harris Hip Score comparing mean post-test values**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Mean</th>
<th>SD</th>
<th>Total</th>
<th>Control Mean</th>
<th>SD</th>
<th>Total</th>
<th>Weight</th>
<th>Mean Difference IV, Fixed, 95% CI</th>
<th>Mean Difference IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hesse 2003</td>
<td>78.3</td>
<td>1.4</td>
<td>39</td>
<td>81.8</td>
<td>15.9</td>
<td>40</td>
<td>100.0%</td>
<td>16.50 [11.55, 21.45]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Not applicable

Test for overall effect: Z = 6.54 (P < 0.00001)

**Figure 3.5 Forest plot for Harris Hip Score comparing mean change scores**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Mean</th>
<th>SD</th>
<th>Total</th>
<th>Control Mean</th>
<th>SD</th>
<th>Total</th>
<th>Weight</th>
<th>Mean Difference IV, Fixed, 95% CI</th>
<th>Mean Difference IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hesse 2003</td>
<td>31</td>
<td>9.7</td>
<td>32</td>
<td>17.5</td>
<td>16.6</td>
<td>40</td>
<td>100.0%</td>
<td>13.50 [9.02, 17.98]</td>
<td></td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Not applicable

Test for overall effect: Z = 6.91 (P < 0.00001)

Performance-based function

Six studies reported on function using six different performance measures (6-minute walk test (6MWT); walking speed over 10 to 15 metres; timed up-and-go (TUG); sit-to-stand test; timed stair climbing; and postural stability) and following varied interventions.

6MWT and walking speed

Walking speed was assessed in five studies. Galea et al. reported no significant between group differences in 6-minute walking distance (WMD -30.50, [-1.09, 48.02] after an eight week
supervised physiotherapy program compared to unsupervised home exercises (55). This difference remained non-significant using change scores.

There were no significant between group differences in self-selected walking speed as assessed in a gait lab at 10 days (WMD 0.10, [-0.02, 0.22]), three months (WMD 0.07, [-0.04, 0.18]) and 12 months (WMD 0.13, [-0.01, 0.27]) following two weeks of bodyweight supported treadmill training in addition to standard inpatient physiotherapy compared to standard physiotherapy alone (51). Using changes scores, a between group difference favouring the experimental group was found at 12 month follow-up only.

Three weeks of mental gait training as an adjunct to standard out-patient physiotherapy resulted in no between group difference in walking speed (WMD 0.10, [-0.11, 0.31]) when compared to standard out-patient care alone (43). However, an improvement favouring the experimental group was significant (WMD 0.16, [0.02, 0.30]) when change scores were used (Figures 3.6 - 3.7).

**Figure 3.6 Forest plot for walking speed comparing mean post-test values**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Mean (m/sec)</th>
<th>SD (m/sec)</th>
<th>Total</th>
<th>Control Mean (m/sec)</th>
<th>SD (m/sec)</th>
<th>Total</th>
<th>Weight</th>
<th>Mean Difference IV, Fixed, 95% CI</th>
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</thead>
<tbody>
<tr>
<td>Mayer 2005</td>
<td>0.61</td>
<td>0.27</td>
<td>13</td>
<td>0.71</td>
<td>0.25</td>
<td>11</td>
<td>100.0%</td>
<td>0.10 [-0.11, 0.31]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td></td>
<td></td>
<td>13</td>
<td></td>
<td></td>
<td>11</td>
<td></td>
<td>0.10 [-0.11, 0.31]</td>
</tr>
</tbody>
</table>

Heterogeneity: Not applicable
Test for overall effect: Z = 0.94 (P = 0.35)

**Figure 3.7 Forest plot for walking speed comparing mean change scores**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Mean (m/sec)</th>
<th>SD (m/sec)</th>
<th>Total</th>
<th>Control Mean (m/sec)</th>
<th>SD (m/sec)</th>
<th>Total</th>
<th>Weight</th>
<th>Mean Difference IV, Fixed, 95% CI</th>
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<tr>
<td>Mayer 2005</td>
<td>0.2</td>
<td>0.18</td>
<td>13</td>
<td>0.04</td>
<td>0.17</td>
<td>11</td>
<td>100.0%</td>
<td>0.16 [0.02, 0.30]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td></td>
<td></td>
<td>13</td>
<td></td>
<td></td>
<td>11</td>
<td></td>
<td>0.16 [0.02, 0.30]</td>
</tr>
</tbody>
</table>

Heterogeneity: Not applicable
Test for overall effect: Z = 2.24 (P = 0.03)
Scherak et al. found significant between group differences in 15-metre walking speeds with four weeks of inpatient rehabilitation provided within two months of THA surgery compared to the same treatment started at three to four months post-op (WMD 2.30, [0.12, 4.48]) and at 11 months (WMD 3.70, [2.39, 5.01]) post-op (42). For this study, we calculated effect sizes using change scores as it was not appropriate to calculate the WMD using the pre and post-test data with the markedly different baseline values and time points.

Significant between group differences in maximum walking speed were found after 12 weeks of daily home-based exercise program with electrical stimulation (WMD 0.40, [0.03, 0.77]) but not with out-patient resistance training (WMD 0.33, [-0.08, 0.74] when compared to 'standard' rehabilitation (56). Using mean change scores, also resulted in a non-significant difference with outpatient resistance training (WMD 0.23 [-0.01,0.47]) compared to 'standard' care. Interestingly, use of mean change scores to compare the electrical stimulation group and 'standard' care shows a non-significant between group difference (WMD 0.04, [-0.18, 0.26]) most likely due to the faster mean walking speed at baseline in the electrical stimulation group coupled with the very small sample size.

Timed up and go test (TUG)
The TUG test was used in one trial and significant between group differences (WMD 1.80, [0.15, 3.45]) were reported following an 8-week supervised, outpatient physiotherapy program provided eight weeks post-op compared to an unsupervised home program (55). This difference was not significant using mean change scores.

Sit-to-stand test

Suetta et al. reported significant between group differences in the sit-to-stand test (5 repetitions) after 12 weeks of out-patient resistance training (WMD -4.50, [-7.09, -1.91]) and daily home-
based exercise program with electrical stimulation (WMD -3.00, [-5.97, -0.03]) compared to standard rehabilitation (56). Using mean change scores, the difference remained significant for the resistance training group (WMD 2.90, [0.93, 4.87]) but not the electrical stimulation group (WMD 2.10, [-0.22, 4.42] compared to 'standard' care.

Timed stair climbing
Timed stair climbing was assessed in two trials. Non-significant between group differences (WMD -0.20, [-0.17, 0.57]) in timed stair climbing were found following an 8-week supervised, outpatient physiotherapy program provided eight weeks post-op compared to an unsupervised home program (55). This difference remained non-significant using mean change scores.

Timed to ascend 10 stairs did not differ after 12 weeks of daily home-based exercises with electrical stimulation (WMD -1.40, [-3.42, 0.62]) and outpatient resistance training (WMD -1.20, [-3.35, 0.95]) compared to 'standard' rehabilitation (56). This difference remained non-significant using mean change scores.

Postural stability
Postural stability improved after an eight week home-based functional exercise program delivered eight to 12 months post-op compared to a 'standard' exercise program; however, the difference was not statistically significant when effect sizes were calculated with post-test means (WMD 13.45, [-3.07, 29.97]). Using mean change scores, a significant difference was found (WMD 23.73, [4.47, 42.99]) (53).

For performance-based function, there is conflicting, low to moderate level evidence that:

- Daily home-based exercises plus electrical stimulation result in favourable outcomes for walking speed compared to 'standard' home exercises alone.
- Early inpatient rehabilitation results in greater improvements in walking speed when compared to intermediate and delayed rehabilitation.

- Outpatient physiotherapy started eight weeks post-op results in better TUG scores when compared to unsupervised home exercises.

- Outpatient resistance training and home-based training with daily electrical stimulation result in better sit-to-stand scores than 'standard' home exercises.

- Outpatient physiotherapy and home-based training with daily electrical stimulation result in no differences in timed stair climbing values when compared to 'standard' home exercises.

- A late-phase home-based functional exercise program results in better postural stability compared to 'standard' exercises (based on mean change scores)

Results mostly favoring the intervention groups differ in several trials when effect sizes are calculated using mean change scores compared to mean post-test values.

3.4.8.3 Health-related quality of life

One study reported on HRQoL after an 8-week outpatient physiotherapy program and found no significant between group difference (WMD 0.05, [-0.13, 0.23]) when compared to unsupervised home exercises (55). The lack of between-group difference was also found using mean change scores.

There is low quality evidence that:

- Delayed, outpatient physiotherapy results in no short-term differences in HRQoL compared to an unsupervised home-based program.
3.5 Discussion

3.5.1 Summary of main results

This review synthesized the research published between 1990 and August 2008 that examined the effects of post-acute physiotherapy after primary THA on pain, function and HRQoL. There was limited evidence of very low to moderate quality to support the use of various forms of post-acute physiotherapy for self-reported, surgeon-rated and performance-based function. We found favourable results for physical function with: body weight supported treadmill training as an adjunct to inpatient physiotherapy; a progressive, functional home exercise program initiated eight months post-op; outpatient resistance training and daily electrical muscle stimulation as an adjunct to 'standard' home exercises; inpatient rehabilitation initiated within two months of surgery; and outpatient physiotherapy initiated eight weeks post-surgery. We determined there were no significant between-group differences for pain and HRQoL based on mean post-test values. However, in several cases, differences were evident when mean change scores were used.

Due to the heterogeneity among studies, it was not possible to perform a meta-analysis and draw conclusions across studies as to whether one form of physiotherapy was superior to another following THA surgery. The limited between-group differences are largely explained by the fact that no trials compared a physiotherapy intervention to a ‘no treatment’ or placebo control group. Clinically important within-group benefits were evident in most groups that received the targeted or experimental intervention, but one cannot draw conclusions about the magnitude of the added benefit of physiotherapy compared to the natural course of recovery after THA. This lack of accumulated evidence is not evidence of a lack of effectiveness, but speaks to the need for high quality trials with carefully specified interventions and uniform outcome measures.
3.5.2 Quality of the evidence

The overall quality of trials included in this review was very low to moderate with many trials being downgraded due to lack of concealed allocation and unblinded assessors (36). As noted earlier, it is almost impossible to blind patients and providers due to the nature of the interventions. It is troubling however, to see this number of studies with unblinded outcome assessors. A majority of trials were underpowered to detect meaningful between group differences.

Reporting issues were also evident in the included trials with few studies identifying their primary outcome and only one study reporting they performed a power calculation using this outcome to determine necessary sample size. Participant demographics, particularly presence and severity of co-morbidities, were poorly described in most trials. A growing body of research demonstrates that co-existing health problems are prevalent in individuals undergoing THA (57, 58) and influence the post-operative course of recovery and THA outcomes (58, 59). Therefore, co-morbidities should be reported and considered in the analyses of outcomes after THA rehabilitation.

3.5.3 Strengths of this review

To our knowledge, this is the most comprehensive systematic review to date examining the varied forms of physiotherapy commonly delivered during the first year after THA surgery. Our extensive search strategy resulted in a large body of published and unpublished studies and our inclusion of non-English trials reduced the risk of language bias. Five different countries and respective health care systems are represented in our review. However, it is possible that some relevant trials are missing and those published since August 2008 are not included. There remain large gaps in the evidence and a paucity of high quality trials related to physiotherapy after THA.
3.5.4 Weaknesses and potential biases of this review

Due to trial heterogeneity, we were unable to perform the planned meta-analysis and make definitive statements about the strength of the evidence and magnitude of treatment effects for physiotherapy interventions after THA. Limiting our review to RCTs and CCTs precluded other study designs that may have contributed additional evidence on the topic of post-acute physiotherapy after THA. We made every effort to avoid various forms of bias by pursuing unpublished reports in our search strategy, including non-English studies, having two authors independently screen and review papers, and performing a rigorous and standardized quality assessment process. We did not create funnel plots to examine the possibility of publication bias due to the small number of included trials.

3.5.5 Agreements and disagreements with other studies or reviews

A recently published Cochrane review compared the effect of multidisciplinary rehabilitation interventions to single discipline care following primary and revision THA and TKA for OA and RA (29). This review, however, focused on the acute care phase of rehabilitation and included use of clinical pathways, formal patient education programs, post-operative pain management and dietary interventions in its range of outcomes. Studies examining physiotherapy interventions alone were excluded. Due to clinical heterogeneity and low study quality, a meta-analysis was not performed. The authors concluded that there was silver level (low to moderate) evidence to support early multidisciplinary rehabilitation in improving activity and participation outcomes; however, optimal intensity, frequency and effects of rehabilitation warranted further study.

In order to support their development of evidence-based guidelines for ambulatory physiotherapy following THA, the French Society of Physical and Rehabilitation Medicine (SOFMER) conducted a systematic review of French and English language articles from an unspecified time
frame (60). A meta-analysis was not possible due to trial heterogeneity. Based on their analysis of 16 studies of mixed methodologies and inclusion criteria, the authors concluded that there are some advantages of ambulatory physiotherapy on muscle strength and function. From their limited economic analysis, no differences were found comparing home therapy to other approaches.

In 2005, two separate reviews were conducted to inform rehabilitation practice and education in Ontario, Canada. In a review by the Medical Advisory Secretariat of the Ministry of Health and Long-Term Care, it was concluded that there was limited high-quality evidence (from one published abstract) to support the use of home-based physiotherapy instead of inpatient treatment after THA and TKA (61). The English-only literature was reviewed up to 2004 to inform the Greater Toronto Area Rehabilitation Network's development of an online discussion forum to promote collaboration and education among patients and health professionals (62). Based on this review of experimental and observational studies spanning pre-operative, acute and post-operative care, rehabilitation was found to be an effective component in TJA management at various stages of recovery. Best practice recommendations were not clearly differentiated for hip versus knee replacement. Soever and MacKay also concluded that comparison of outpatient care to other rehabilitation processes warrants further study to determine the optimal processes of care following TJA (62).

In the month prior to completion of our review, a systematic review on the effects of therapeutic exercise after discharge from hospital for primary THA surgery was published (31). This review of trials up to April 2007 included interventions delivered beyond one year post-op and excluded those that involved inpatient rehabilitation and electrical modalities as a treatment adjunct. While there is obvious overlap in the trials included in this and our review, our review is more comprehensive in that it includes inpatient treatment, which is routine rehabilitation practice in
many countries (14, 15, 63). The authors also determined a full meta-analysis was not appropriate; however, calculated pooled effect sizes for walking speed and hip abductor strength despite marked clinical heterogeneity among the four trials. Regardless of these differences, Minns Lowe et al. similarly concluded that trial availability, quality and diversity prevented definitive answers regarding effectiveness of post-discharge physiotherapy exercise for primary THA (31).

3.6 Conclusions

3.6.1 Implications for practice

There is insufficient evidence from the studies included in this review, to suggest that any one type, setting, timing or amount of post-acute physiotherapy for THA is superior to another. The tremendous variety in the timing, duration, intensity and content of the interventions make developing clinical recommendations problematic. Additional high quality trials with sufficient power and standardized outcome assessment methods are needed to establish specific treatment recommendations for post-acute PT after THA.

With the longstanding impairments, functional limitations and participation restrictions present in individuals awaiting primary THA (57, 59, 64-66) and still evident as much as a year post-op (10, 25, 26), it may be inappropriate and unethical to withhold post-operative physiotherapy all together. The physiotherapy setting may be less important than the type, quality, dosage and adherence to the intervention; however, dose-response calculations were not possible and limited adherence data were available in the trials selected, and further evidence is required to support this conclusion.

Despite the limitations in the availability and quality of evidence, there are a number of implications for clinical practice:
• There is low to moderate evidence to support the use of inpatient body weight supported treadmill training, outpatient resistance exercises, and home-based exercise with and without electrical muscle stimulation for improving surgeon-rated and performance-based function after THA;

• There is limited, moderate evidence to support the use of a late-phase, functional and progressive exercise approach for improving balance and self-reported function;

• There is limited, low quality evidence to suggest that earlier participation in inpatient rehabilitation results in greater walking speed than with delayed rehabilitation;

• There is limited, low quality evidence to support the use of group exercise programs following THA surgery and conflicting evidence that PT supervised exercise programs result in better outcomes than unsupervised programs.

3.6.2 Implications for research

The heterogeneity among trials regarding the timing and types of interventions, control situations, outcomes and measures highlights the need for greater standardization in the conducting, evaluating and reporting of future research trials in THA rehabilitation. Additional suggestions for future research in this field include:

• Conduct trials with stronger study designs including concealed group allocation, blinded outcome assessors and larger sample sizes

• Prospectively monitor participants' adherence to the study protocol (intervention) with subgroup analysis of treatment effects for high and low adherers (dose-response)

• Prospectively monitor treatment providers' adherence to the study protocol

• Provide more detailed descriptions of the therapeutic interventions including timing, duration, frequency, intensity and progressions
• Provide more detailed descriptions of 'standard' or 'usual' care to ensure appropriate comparisons are made
• Determine what baseline and post-operative contextual factors (personal and environmental) are most strongly related to rehabilitation outcomes and patient satisfaction and perform appropriate subgroup analyses
• Assess how patient preference for type, timing and/or setting for rehabilitation affects outcomes
• Identify a core set of outcome measures for each of the ICF domains to allow for consistent, standardized reporting of outcomes and comparison among interventions
• Include measures that capture participation, HRQoL and patient satisfaction
• Include a follow-up phase of at least 12 months
• Monitor and report on physical activity levels and use of other medical or rehabilitative therapies during the follow-up period
• Use multiple research sites to increase sample sizes and generalizability of findings
• Include an economic analysis including both direct and indirect costs, and patient out-of-pocket expenses of varied physiotherapy interventions and follow-up services
3.7 References


32. Westby MD, Backman CL. Patient and health professional views on rehabilitation practices and outcomes following total hip and knee arthroplasty: A focus group study. Submitted 2009 Sep 3.


Chapter 4: Post-acute physiotherapy following primary total knee replacement for osteoarthritis: A Cochrane systematic review

4.1 Background

Total knee arthroplasty (TKA) surgeries are highly successful, commonly performed orthopaedic procedures for individuals with advanced knee osteoarthritis (OA). Also termed total knee replacement (TKR), more than 37,900 of these primary procedures were performed in Canada in 2006/07 (1). This number is far greater in the United States (US) with more than 0.6 million TKA surgeries reported in 2007(2). Total knee arthroplasty procedures out number total hip arthroplasty (THA) in most countries (1, 3-6) or are expected to surpass THA numbers within the next few years (7). The one-year increase in number of TKAs was 12.5% in Canada (1) and was similar to that reported in other international joint registries (8, 9). The number of TKA surgeries is projected to grow with the aging population, rising obesity rates and increased prevalence of OA (10-13). Other factors contributing to the increase are patient demand and higher expectations for improved quality of life, shorter acute care length of stay (LOS), technical advances, and safer anaesthetic techniques that have expanded the indications for joint replacement surgery (9, 11, 13, 14). In the US, an increase in number of orthopaedic surgeons with a focus on total joint arthroplasty (TJA) has further fueled the growth in these procedures (13). International data indicate that OA is the primary reason for TKA surgery (4-6, 15) and in Canada accounts for 93% of all TKAs (1).

Total knee arthroplasty surgery decreases pain, restores mobility and function, improves health-related quality of life (HRQoL) and is associated with a high patient satisfaction rate (16-18).

4 A version of this chapter will be submitted for publication. Westby MD, Kennedy, Jones D, Jones A, Doyle-Waters M, Backman C. Post-acute physiotherapy following primary total knee arthroplasty for osteoarthritis: A Cochrane systematic review.
While a cost effective surgical procedure for advanced knee OA, the rapid increase in TKA surgeries places significant burdens on healthcare budgets (9, 11, 19). Based on 2007 data from the Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample in the US, mean hospital charges per TKA procedure were more than $42,000 suggesting annual total hospitalization charges in excess of $25 billion US (2). Nationwide costs of TKA surgeries in Canada are not available; however, recent data suggests costs associated with TKA surgery and the period up to six months post-op average more than $14,700 per patient leading to an informal estimate of current Canadian expenditures in excess of $557 million dollars annually (1, 20).

In the past decade in Canada, hospitalization following TKA has decreased by 50% (1). Data from 2006/07 show that the mean and median acute care length of stay (LOS) to be six and four days respectively for primary TKA and revision surgeries (1). Data suggest a shorter LOS when only primary (2, 8, 9) and non-complex procedures are considered (21). Earlier discharge to home or community settings decreases the time available for physical recovery, acute care rehabilitation, and patient and family education and counseling. A reduced LOS places additional burden and responsibility on the patients, their family and their post-acute health care providers to monitor for and address post-operative complications such as wound infection and deep vein thrombosis (DVT). As well, the short acute care stay puts more emphasis on preadmission education and the role and timing of post-acute physiotherapy interventions. In an editorial examining LOS after THA and TKA, Johanson comments that "it remains unclear just how far this process [of reducing LOS] can be taken without either compromising quality of care or simply shifting costs to a less regulated outpatient environment" (22)(p.1).

Currently, no evidence-based practice guidelines exist to inform best practice for post-acute rehabilitation following TKA in North America and specific rehabilitation practices vary greatly among providers (23-28). Current therapeutic interventions are based largely on clinical
experience (29), clinician and surgeon preferences (23, 30), facility-based protocols (31), the acute care phase of recovery (32, 33), health insurance funding schemes (13, 34) and outdated approaches (35). Furthermore, little or no guidance exists on recommended activities following discharge from the acute care setting (36). All but two international joint replacement registries (5, 14) monitor purely surgical end-points, such as peri-operative complications and number of revision procedures. Rehabilitation and its contribution to both surgical and patient-centred outcomes are an overlooked aspect of the total episode of care for TKA patients.

There are a number of reports to suggest that some patients are not reaching their physical potential following TKA and that post-operative pain, physical impairments and functional limitations are still issues as long as two years after surgery (37-45). Persistent psychological distress and reduced HRQoL below population norms have also been reported 12 months post-surgery (46). Current exercise programs performed during the early phase of rehabilitation are insufficient to restore muscle strength, normal gait and more complex functional activities lost during the pre-operative period (40, 43). Additionally, inadequate quadriceps strength and reduced physical capacity coupled with further reduction of reserve capacity seen with normal aging and progressive OA may lead to an increased fall risk and declining independence in daily living for older adults (44, 47, 48). However, we do not know exactly what kind of physiotherapy performed over what period of time is effective or necessary to enhance short- and long-term surgical outcomes and optimize patient activity, participation, and HRQoL. The National Institutes of Health (NIH) conference on TKA concluded "the use of rehabilitation services is perhaps the most understudied aspect of the peri-operative management of TKA patients"(34)(p. 6).

As part of the larger project to develop evidence-based clinical practice guidelines for post-acute rehabilitation after TKA and THA, systematic reviews were undertaken to examine the current
literature on various rehabilitation approaches and interventions in this patient population. Previous reviews have addressed continuous passive motion (CPM) following TKA (49), multidisciplinary rehabilitation for primary and revision THA and TKA (50), and therapeutic exercise after discharge from hospital for TKA (51). A Cochrane review currently underway is investigating the effects of surface neuromuscular stimulation to the quadriceps pre- and post-TKA (52).

4.2 Purpose
The primary aim of this review is to assess the effects of post-acute physiotherapy following primary TKA for OA on patient-centred outcomes of pain, physical function and HRQoL.

4.2.1 Objectives
The specific objectives are to:

1. Document the short-term and long-term effects of post-acute physiotherapy on pain, physical function and HRQoL in persons undergoing primary TKA for OA.
2. Compare outcomes across different clinical settings and treatment approaches, timing and dosages.
3. Make recommendations for clinical practice based on the strength of the evidence.
4. Identify research needs post-acute physiotherapy in the TKA population.

4.3 Methods
4.3.1 Criteria for considering studies for this review
We considered both randomized controlled trials (RCTs) and controlled clinical trials (quasi-randomized and controlled before-after designs) for inclusion in this review. Designs not
included were cohort, case-control, single case studies, single subject, case series and pre/post studies with no control group.

4.3.2 Types of participants

Primary trials of individuals aged 19 years and older who underwent an elective, primary TKA for primary (idiopathic) or secondary OA due to chronic trauma, developmental or congenital problems were considered. Surgical procedures included all forms of fixation (cemented, hybrid or cementless), surgical approaches (medial, lateral, parapatellar, minimally invasive) and types of prostheses (constrained, semi-constrained, mobile platform). Studies were excluded if participants had:

- undergone a revision, uni-compartmental or bilateral procedure;
- an inflammatory arthritis diagnosis (e.g. rheumatoid arthritis);
- an acute fracture;
- a tumour;
- significant pre- or peri-operative complications (e.g., nerve palsy, deep wound infection, severe anaemia, DVT)
- an extended acute hospital stay beyond the standard LOS for that hospital facility.

Studies with mixed pre-surgical diagnoses were included if 90% or more of the participants had an OA diagnosis.

4.3.3 Types of interventions

4.3.3.1 Experimental

Post-acute physiotherapy includes physiotherapy provided in any setting (in-patient, outpatient or home/community). The 'post-acute' phase was determined to extend from immediately following discharge from the acute hospital ward or setting and up to 12 months post-surgery. The time
frame selected reflects patients' views on the duration of rehabilitation services after TKA surgery (53). Physiotherapy includes 1 to 1 treatments and group interventions supervised by the physiotherapist (PT) and/or a trained physiotherapy assistant under the direct supervision of a PT. Interventions could include alone or in combination:

- therapeutic exercise;
- hydrotherapy;
- use of thermal or electrical modalities (i.e. cryotherapy, heat, transcutaneous electrical nerve stimulation and neuromuscular electrical stimulation (NMES));
- postural, proprioceptive and balance training;
- gait training;
- functional exercises;
- cardiovascular training;
- manual therapy techniques (i.e. soft tissue massage, passive range of motion);
- patient education and self-management techniques.

Interventions not included in this review were CPM, splinting or bracing, and chiropractic or osteopathic manipulation.

We characterized interventions by:

- timing of the onset of treatment (immediate = < 2 weeks post-surgery, intermediate = between 2 weeks and 3 months post-surgery or delayed = > 3 months post-surgery)
- setting (outpatient, inpatient or home-based)
- dosage (lower = < 6 visits or 3 weeks of intervention and higher = ≥ 6 visits or 3 weeks of intervention)
4.3.3.2 Control
Supervised physiotherapy was compared to control situations in which participants received ‘routine care’ (standard or traditional physiotherapy of a given institution or surgeon), ‘attention only’ (no active intervention), unsupervised or self-directed home exercises, or other operationalized comparators (which may include comparing one physiotherapy program or therapeutic setting to another).

4.3.4 Types of outcome measures
The primary outcomes of interest were:

- Post-operative pain (at rest or with activity)
- Physical function (as measured by validated functional assessment self-report tools, surgeon-rated tools or performance-based measures)
- Health-related quality of life (as measured by validated generic, condition-specific, individualized or preference-based instruments)
- Adverse events due to rehabilitation (e.g. increased pain, fall)

Secondary outcomes were categorized according to the International Classification of Functioning (ICF) (54) but were not included in the analysis:

- Body structure and function (e.g. knee ROM, lower extremity muscle strength and endurance, soft tissue flexibility, proprioception, cardiovascular fitness)
- Activity (i.e. those not captured under physical function outcomes)
- Participation (e.g. paid/unpaid work, care giving, leisure activities, social activities)
- Personal contextual factors (e.g. age, gender, body mass index, patient satisfaction, self-efficacy, anxiety, motivation)
- Environmental factors (e.g. health insurance coverage, waiting time for surgery)
Process measures:

- Timing of treatment intervention
- Timing of baseline assessment (pre-surgery or post-surgery/pre-intervention)
- Treatment setting (inpatient, outpatient, home)
- Treatment dosage (e.g. frequency, duration, number of sessions)
- Adherence to treatment

4.3.5 Search methods for identification of studies

We searched the following electronic databases to identify relevant studies published between January 1990 and August 31, 2008. Alerts were set up in several databases to continue to identify potentially relevant articles up until May 31, 2009. The period of time covered was recommended by the expert panel and covers the period of time when inpatient LOS fell and diagnostic related groups (DRGs) became widespread basis for reimbursement in the US by this year. Articles in any language were reviewed.

- Cochrane Musculoskeletal Group Trials Register (September 17, 2008)
- Cochrane Central Register of Controlled Trials (CENTRAL)(Issue 3, 2008)
- MEDLINE (OVID) (1950 to August 31, 2008)
- CINAHL (EBSCO) (1981 to August 31, 2008)
- EMBASE (OVID) (1980 to 2008 Week 39)
- Cochrane Database of Systematic Reviews (Issue 3, 2008), ACP Journal Club and DARE (OVID)
- PEDro (Physiotherapy Evidence Database) (August 31, 2008)
- Web of Science (August 31, 2008)
- SPORTDiscus (EBSCO) (August 31, 2008)
See Appendix E for an example of the search strategy for MEDLINE using a combination of MeSH and key words. The quality filter recommended by the Cochrane Musculoskeletal Review Group was applied.

We scanned articles, review papers and textbooks for additional papers. Known experts in the field and authors of existing, high quality studies were contacted for further references. A grey literature search was conducted to identify published and unpublished papers, reports and other documents. We searched papers and proceedings from congresses and symposiums through the databases PapersFirst and ProceedingsFirst. Additionally, we hand searched conference proceedings of key professional organizations, highly relevant orthopaedic and rehabilitation journals, professional organizations' websites, and national joint arthroplasty registries.

### 4.3.6 Data collection and analysis

A team of four primary reviewers (MW, DK, AJ and DJ) and one adjudicator (CB) was assembled. Two of the four reviewers were trained in the Cochrane review methodology. The lead reviewer (MW) and one other primary reviewer (AJ) independently screened all identified papers by scanning titles and abstracts for appropriateness (first level screening). Pairs of reviewers then evaluated potentially relevant studies to see if they met our inclusion criteria (second level screening).

The same pair then independently extracted data from accepted papers using a standardized form. Any disagreement was resolved through discussion and consensus. There was no situation in which a tiebreaker was needed. If necessary, study authors were contacted for additional information to complete the screening and abstraction process.
4.3.7 Assessment of methodological quality

We assessed the risk of bias and overall methodological quality of the studies using the scale by van Tulder et al. (55) for RCTs and controlled clinical trials (CCTs). This 11-item quality assessment scale developed by the Cochrane Back Review Group was chosen for its relevance (Table 4.1). While designed as a checklist for aggregating items and generating a single quality score, this process is no longer favoured (56) and we present the individual quality criteria results for each trial.

Table 4.1 Quality Assessment and Risk of Bias Checklist

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Was the method of randomization adequate?</td>
<td>yes</td>
</tr>
<tr>
<td>2. Was treatment allocation concealed?</td>
<td>yes</td>
</tr>
<tr>
<td>3. Were groups similar at baseline regarding most important prognostic factors?</td>
<td>yes</td>
</tr>
<tr>
<td>4. Was the patient blinded to the intervention?</td>
<td>yes</td>
</tr>
<tr>
<td>5. Was the therapist/care provider blinded to the intervention?</td>
<td>yes</td>
</tr>
<tr>
<td>6. Was the outcome assessor blinded to the intervention?</td>
<td>yes</td>
</tr>
<tr>
<td>7. Were co-interventions avoided or similar?</td>
<td>yes</td>
</tr>
<tr>
<td>8. Was compliance acceptable in all groups?</td>
<td>yes</td>
</tr>
<tr>
<td>9. Was the drop-out rate described and acceptable (20% or less for post-test, 30% or less for long-term follow up)</td>
<td>yes</td>
</tr>
<tr>
<td>10. Was the timing of the outcome assessment similar in both groups?</td>
<td>yes</td>
</tr>
<tr>
<td>11. Was data for at least one key outcome analyzed by intention-to-treat (ITT)?</td>
<td>yes</td>
</tr>
</tbody>
</table>
Initial inter-observer reliability of both the screening and quality assessment was determined on two papers prior to the actual review process. These related studies were drawn from a pool of articles that did not meet the inclusion criteria due to publication date or difference in intervention or patient population (55). Poor agreement on some items during this pilot test phase led to revisions to the screening and data extraction forms. After further discussion, agreement was reached on the screening and data abstraction process. Comprehensive guidelines for data abstraction were prepared and used by all reviewers.

4.3.8 Data analysis and synthesis

Continuous data from individual trials were recorded as means and standard deviations. We contacted several authors for missing data. Evidence tables were created and a qualitative analysis performed using the GRADE approach as recommended by the Cochrane Musculoskeletal Review Group (57) (Table 4.2). Detailed methods for upgrading or downgrading studies are described in the Chapter 12.2.1 of the Cochrane Handbook for Systematic Reviews (56).

Table 4.2 GRADE approach to assessing overall levels of quality of a body of evidence

<table>
<thead>
<tr>
<th>Underlying methodology</th>
<th>Quality rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randomized trials; or double-upgraded observational studies.</td>
<td>High</td>
</tr>
<tr>
<td>Downgraded randomized trials; or upgraded observational studies.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Double-downgraded randomized trials; or observational studies.</td>
<td>Low</td>
</tr>
<tr>
<td>Triple-downgraded randomized trials; or downgraded observational studies; or case series/case reports.</td>
<td>Very low</td>
</tr>
</tbody>
</table>

All authors independently examined the evidence tables for clinical and methodological heterogeneity taking into account the participants, interventions, controls (comparators), outcomes, timing of assessments, measurement tools and methodological quality of the original
studies (55). Due to lack of both clinical and methodological homogeneity among trials, we were unable to pool the data and perform a meta-analysis. This is a common problem among Cochrane reviews of allied health interventions (58). We do, however, present the individual studies' treatment effect sizes using weighted mean differences (WMD) from mean post-test values where possible. In addition, for the papers with small sample sizes (less than 50 per group) (59) and differing baseline values, we also calculated WMDs using mean change scores to better reflect the true effect. Since original data sets were not available, we used the formula suggested in the Cochrane Handbook, Chapter 16.1.3.2 (60) and a conservative imputed value of 0.8 as the correlation between pre- and post-test scores. Smaller correlation coefficients are known to overestimate effect sizes and thus the more conservative value was chosen (61). Forest plots were created to display effect estimates with 95% confidence intervals and samples are provided for select outcomes within individual trials.

4.4 Results

4.4.1 Description of studies

A total of 2,534 English and non-English papers were identified. Of these, 47 were retained for second level screening and seven for full review. All of the articles were RCTs published in English and four of the trials were conducted outside of North America. The included trials were published between 2003 and 2009. (See Figure 4.1)
Figure 4.1 PRISMA flow chart for TKA review

Potentially relevant RCTs identified and screened for retrieval (n = 2,534)

RCTs excluded with reasons (n = 2,460)
Main reasons:
- Not TKA-related
- Not an intervention study
- Not a rehabilitation intervention
- No control group

RCTs retrieved for more detailed evaluation (n = 74)

Potentially appropriate RCTs to be included in the meta-analysis (n = 7)

RCTs excluded with reasons (n = 67)
Main reasons:
- Multidisciplinary intervention
- Significant pre-op component
- Acute care intervention
- No TKA subgroup data
- Mixed diagnoses (no OA subgroup data)

RCTs included in meta-analysis (n = 0)

RCTs excluded from meta-analysis with reasons (n = 7)
(Due to clinical & methodological heterogeneity among trials)
Several studies initially screened as being appropriate and subsequently excluded from this review are listed in Table 4.3.

**Table 4.3 Excluded studies and main reason for exclusion**

<table>
<thead>
<tr>
<th>Study</th>
<th>Main reason for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulthuis Y et al. 2007 (62)</td>
<td>No TKA subgroup data available</td>
</tr>
<tr>
<td>Johnson AW 2007 (63)</td>
<td>Less than 10 participants per group</td>
</tr>
<tr>
<td>Kumar PJ et al. 1996 (64)</td>
<td>Acute care interventions</td>
</tr>
<tr>
<td>Mahomed NN et al. 2008 (65)</td>
<td>No TKA subgroup data available</td>
</tr>
<tr>
<td>Oehlert K et al. 2004 (66)</td>
<td>Could not confirm key aspects of trial methodology; no response from author</td>
</tr>
<tr>
<td>Rajan RA et al. 2004 (67)</td>
<td>Only ROM data reported</td>
</tr>
<tr>
<td>Tal-Akabi A et al. 2007 (68)</td>
<td>No TKA subgroup data available</td>
</tr>
</tbody>
</table>

### 4.4.2 Methodological quality

The range in methodological quality of the included studies was low to high. Adequate randomization procedures were reported in five trials, not clear in one and satisfactory in one after discussion with the author. Concealed allocation, where neither the researcher nor participant is aware of group assignment in advance, was reported in four studies. Contacting authors subsequently confirmed appropriate concealment procedures in two further trials. Six of the seven trials reported blinding the outcome assessor. Blinding of the provider and patients is not possible in most cases in physiotherapy intervention studies. Short-term drop out rates were satisfactory in five studies, unclear in one and exceeded the acceptable short-term rate of 20% (55) in one. Only four studies included a long-term follow-up phase (12 months or more) with long-term drop out rates satisfactory in two and greater than the acceptable long-term rate of 30% in two. (See Table 4.4)
### Table 4.4 Methodological quality and risk of bias of included trials

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Randomization</td>
<td>Y</td>
<td>?</td>
<td>Y</td>
<td>Y*</td>
<td>Y</td>
<td>Y</td>
<td>Y*</td>
</tr>
<tr>
<td>2. Concealment</td>
<td>Y*</td>
<td>?</td>
<td>Y</td>
<td>Y*</td>
<td>Y</td>
<td>Y</td>
<td>Y*</td>
</tr>
<tr>
<td>3. Groups similar</td>
<td>?</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>4. Patient blinded</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>5. Therapist blinded</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>?</td>
<td>N</td>
<td>N</td>
<td>?</td>
</tr>
<tr>
<td>6. Assessor blinded</td>
<td>Y*</td>
<td>Y*</td>
<td>Y</td>
<td>Y</td>
<td>?</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>8. Acceptable compliance</td>
<td>Y</td>
<td>Y*</td>
<td>Y*</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>10. Timing of outcome assessment similar</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>11. ITT analysis</td>
<td>N</td>
<td>?</td>
<td>Y</td>
<td>†</td>
<td>†</td>
<td>†</td>
<td>†</td>
</tr>
</tbody>
</table>

Legend: Y = criterion was met; * = positive response was obtained by contacting the author and not from published article; ? = unclear, incomplete or no data provided; N = criterion was not met; NA = not applicable as there were no drop outs reported; † = performed but results not reported or only partially reported.

### 4.4.3 Participants

A total of 779 participants were included in this review. Individual study sample sizes ranged from 30 to 200 participants. Mean patient ages ranged from 65 to 75 years and a majority was female in all but one trial. Race was not identified in any studies. General health, presence of co-
morbidities and details of the surgery were poorly described or not mentioned in most. (See Table 4.5)
### Table 4.5 Summary of study characteristics

<table>
<thead>
<tr>
<th>Study</th>
<th>Design/ quality</th>
<th>Setting/ Country</th>
<th>Participants (1° TKA for OA)</th>
<th>Exclusion criteria</th>
<th>Intervention</th>
<th>Comparison</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avramidis 2003</td>
<td>RCT (n=30) Low</td>
<td>Not clear; UK district hospital</td>
<td>TG = mean age 68 (11) yrs, 80% ♀. CG = mean age 71 (8) yrs, 66% ♀</td>
<td>Symptomatic hip or ankle OA; history of epilepsy; use of pacemaker; pathologic skin condition in area of stimulation</td>
<td>Start: 2 days post-op NMES to quads muscles, 2 hrs, 2x/day for 6 wks + conventional physio program</td>
<td>‘Conventional physio’ program for 6 wks</td>
<td>Baseline: pre-op HSS Knee Score, 3MWT, Physiologic Cost Index. Adverse events not discussed. No LT follow-up</td>
</tr>
<tr>
<td>Codine 2004</td>
<td>RCT (n=60) Low</td>
<td>IRF; France</td>
<td>TG = mean age 75 (13) yrs, 70% ♀. CG = mean age 71 (15), 53% ♀</td>
<td>Significant muscular deficit, neurological disease or inflammatory reaction to isokinetic testing</td>
<td>Start: 10 days post-op Isokinetic, eccentric hamstring training for 15 mins + standard rehab, 2 hrs, 5x/wk for 3 wks</td>
<td>‘Standard rehab’ program of 2 hrs, 5x/wk for 3 wks</td>
<td>Baseline: post-op KSS (post-test only), active knee ROM, isometric quads. Adverse events reported. No LT follow-up</td>
</tr>
<tr>
<td>Harmer 2009</td>
<td>RCT with 2 treatment arms (n=102) High</td>
<td>Outpatient dept, public hospital; Australia</td>
<td>TG 1 = mean age 68 (6) yrs, 57% ♀. TG 2 = mean age 69 (9), 57% ♀</td>
<td>Deep joint infection, bilateral surgery or surgery on other joint within 6 months, dementia or other neurologic problem</td>
<td>Start: 2 wks post-op TG 1: PT-led group exercise program in outpt dept, 2x/week for 6 weeks</td>
<td>TG 2: PT-led group exercise program in community pool, 2x/wk for 6 wks</td>
<td>Baseline: post-op 6MWT, WOMAC, pain (VAS), stair climbing power, passive knee ROM. Adverse events reported. 6 month follow-up</td>
</tr>
<tr>
<td>Kramer 2003</td>
<td>RCT with 2 treatment arms (n=160) Moderate</td>
<td>Outpatient (multi-site); Ontario, Canada</td>
<td>At least 90° knee flex’n &amp; ‘functional’ hip on surgical side. TG 1 = mean age 68 (7) yrs, 59% ♀; TG 2 = mean age 69 (8) yrs, 55% ♀</td>
<td>RA, major neurologic conditions</td>
<td>Start: 2 wks post-op TG 1: Outpt physio for 1 hr, 2x/wk for 10 wks + daily home exercises</td>
<td>TG 2: Home-based, 2-staged exercise program 3x/day, daily for 10 wks with periodic telephone consultation with PT</td>
<td>Baseline: pre-op KSS, WOMAC, SF-36, 6MWT, stair climbing, active knee ROM. Adverse events partially reported. 12 month follow-up</td>
</tr>
</tbody>
</table>
Table 4.5 Summary of study characteristics (continued)

<table>
<thead>
<tr>
<th>Study/language</th>
<th>Design/quality</th>
<th>Setting/country</th>
<th>Participants (1° THA for OA)</th>
<th>Exclusion criteria</th>
<th>Intervention</th>
<th>Comparison</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mockford 2008</td>
<td>RCT (n=150) High</td>
<td>Outpatient dept; Ireland</td>
<td>TG = mean age 69, 65%♀. CG = mean age 71, 58%♀. 4% had RA.</td>
<td>Not described</td>
<td>Start: mean 25 days post-op (range 6-54 days) Supervised outpt physio for 30 mins, 1-2x/wk for 6 wks</td>
<td>Unsupervised home-based exercise program for 6 wks</td>
<td>Baseline: pre-op Knee ROM, Oxford Knee Score, SF-12, Bartlett patellar score Adverse events reported 12 month follow-up</td>
</tr>
<tr>
<td>Moffett 2004</td>
<td>RCT (n=77) High</td>
<td>Outpatient dept of rehab hospital; Quebec, Canada</td>
<td>TG = mean age 67 (9) yrs, 63%♀. CG = mean age 69 (8) yrs, 56%♀ Previous leg surgery affecting gait, planned revision surgery on other leg joint, neuromuscular or degenerative disease, comorbidities limiting locomotion, major post-TKA complication</td>
<td></td>
<td>Start: 2 months post-op Individual, PT-led progressive, functional task-oriented exercises &amp; aerobic conditioning for 60-90 mins, 2x/wk for 6-8 wks.</td>
<td>‘Standard care’ which included PT home visits for 26% of participants. Home program not described.</td>
<td>Baseline: post-op 6MWT, WOMAC, SF-36 No adverse events reported 12 month follow-up</td>
</tr>
<tr>
<td>Petterson 2009</td>
<td>RCT with 2 treatment arms + non-rand standard of care cohort (n=200) Moderate</td>
<td>Outpatient; not-for-profit clinic; USA</td>
<td>TG 1 = mean age 65 (9) yrs, 45%♀. TG 2 = 65 (8) yrs, 47%♀. (Note: Only the 2 randomized groups considered.) Uncontrolled hypertension or diabetes, symptomatic OA in other knee, leg orthopaedic problem limiting function, neurologic impairment</td>
<td></td>
<td>Start: 3-4 wks post-op TG 1: NMES to quads (10 reps) + progressive strength training program 2-3x/wk for 6 wks.</td>
<td>TG 2: Progressive strength training program 2-3x/wk for 6 wks.</td>
<td>Baseline: post-op Quads strength &amp; voluntary activation, TUG, stair climbing test, 6MWT, SF-36, KOS ADL scale, knee ROM Adverse events reported 12 month follow-up</td>
</tr>
</tbody>
</table>

Legend: TG = treatment or experimental group; CG = control or comparator group; IRF = inpatient rehabilitation facility; NMES = neuromuscular electrical stimulation; HSS = Hospital for Special Surgery; 3/6MWT = 3 or 6 minute walk test; KSS = Knee Society clinical rating system; ROM = range of motion; WOMAC = Western Ontario & McMaster Universities OA Index; VAS = visual analogue scale; RA = rheumatoid arthritis; SF-12/36 = MOS Short Form 12/36; TUG = timed up & go test, KOS ADL = Knee Outcome Survey Activity of Daily Living scale.
4.4.4 Interventions

No two trials evaluated similar post-acute physiotherapy interventions following primary TKA with regards to timing, duration, dosage, setting and type of rehabilitation. The timing of the start of the intervention ranged from immediately after surgery (two days post-op) to four months following surgery. Most studies fell into the intermediate range delivering the intervention between two and eight weeks post-operatively. The treatment duration ranged from three weeks to 10 weeks. Overall dosage was difficult to calculate in two trials and ranged from two times a week for six weeks (12 sessions in total) to two times a week for 10 weeks (20 sessions in total). All trials were classified as 'higher dosage' according to our categories established a priori. The setting for physiotherapy included an inpatient rehabilitation hospital in one trial, outpatient departments/clinics in five trials and was not clear in one trial (69).

Adherence to the physiotherapy protocol or intervention was monitored in six trials and specific values were provided in four. One study included a subgroup analysis of high versus lower adherers with regards to treatment effects and reported no differences in outcomes for those patients who attended the prescribed nine outpatient sessions compared to those who completed eight or fewer (70).

4.4.5 Controls

Control or comparator situations were not consistent among trials and included standard or usual physiotherapy (n=3), home exercises with reduced physiotherapy supervision (n=1), home exercise with no further supervision (n=1), a different exercise type/setting (pool-based) (n=1), and different intervention (electrical muscle stimulation) (n=1). Baseline characteristics of the treatment and control groups were similar in all trials; however, minimal baseline information was provided in most studies.
4.4.6 Outcomes

More than 25 different outcome tools were used in the seven trials again making comparison across studies difficult. Post-operative pain (ICF level: body function) was evaluated in four trials. Physical functioning (ICF level: activity) was assessed in all seven studies and included performance measures (e.g. walking speed, stair climbing), self-report tools (e.g. WOMAC OA Index, Oxford Knee Score) and surgeon-rated tools (e.g. American Knee Society Score (KSS), Hospital for Special Surgery (HSS) scale). Four trials reported on HRQoL using generic tools (MOS Short Form 36 (SF-36) and MOS Short Form12 (SF-12)).

For the secondary outcomes of interest, knee ROM data were most frequently reported; however, methods for assessing and reporting ROM varied and included active range measured by electronic goniometry and passive range using different testing positions. Additional secondary outcomes included quadriceps and hamstrings strength using varied assessment methods, knee edema, and a physiologic cost index related to gait. Patient satisfaction with the physiotherapy intervention or outcomes was not assessed in any trials. We do not include any further discussion on secondary outcomes due to their inconsistent use and reporting methods.

The baseline assessment took place immediately prior to TKA surgery in three studies and post-operatively, prior to the intervention in four. The timing of subsequent assessments was similar for treatment and control groups in all trials. Four trials included a long-term follow-up assessment at one year post-op.

Adverse events during the intervention study period were adequately documented in four studies:

- Six cases of pain and/or swelling equally in both groups not requiring change in study protocol (71)
- Peri-operative complications experienced in 18 participants after discharge from acute care including thromboemboli, superficial and deep wound infection, hemarthrosis and one death not attributed to interventions (72)
- DVT, pulmonary emboli, superficial and deep wound infection and hematoma occurred equally in both groups and not attributed to intervention (70)
- One case of dizziness following neuromuscular stimulation (73)

Authors of three trials did not feel the adverse events were related to the treatment intervention while the other reported it was not clear (73). One study reported no adverse events (74), another provided incomplete information (75) and the remaining trial did not provide any information (69).

4.4.7 Risk of bias in included studies

All trials had design or methodological issues putting them at risk for bias. Allocation (selection) bias may have been present in the two studies that did not describe adequate randomization with concealed allocation. However, as noted earlier, correspondence with the author of one of these studies suggested appropriate randomization techniques had been used. Measurement bias is of concern in the one trial that did not report using a blinded outcome assessor. Performance bias is attributable to unblinded participants and treating therapists and may have been an issue in all of the trials. One study reported withholding detailed study information from the treating therapists (73). Attrition bias due to higher than anticipated dropouts was evident in one study (73) and unclear in another (75).

Another issue potentially contributing to performance bias is the lack of data on adherence to study protocols and exercise regimes. While six trials reported monitoring participants’ adherence to the intervention and/or comparator in a prospective fashion (e.g. attendances,
exercise logs), few provided specific adherence data. This makes it difficult to determine the true
effects of the intervention on the outcomes of interest or if there was a dose-response effect. That
is, were there greater treatment effects in the subgroup of participants that adhered to the
intervention compared to those who only partially completed the program? Similarly, the issue of
therapist adherence to the intervention protocol (procedural reliability) was only assessed in one
trial (73). While there is always the need for some individualization of therapeutic interventions
to address the needs and preferences of patients, deviating from the study protocol complicates
matters and introduces elements of co-intervention and even contamination that cannot be
controlled for in the analysis if not monitored.

Small sample sizes (less than the 50 participants per group standard) (59) in three of the trials
may have contributed to underpowered studies and the risk of false conclusions (Type II error)
about lack of treatment effect. Only three studies reported performing a power calculation using
the primary outcome of interest to determine an appropriate sample size a priori (70, 72, 74). A
fourth study stated a power calculation was undertaken to establish sample size; however, no
details were provided (73).

4.4.8 Effects of interventions
As noted earlier, we were unable to pool the data and perform a meta-analysis due to
methodological and clinical heterogeneity among trials. Therefore, we performed a qualitative
analysis and best evidence synthesis for the primary outcomes using the GRADE approach (57).
For trials with adequate data, WMDs and 95% CI for the primary outcomes and are summarized
below and sample forest plots are provided in Figures 4.2 to 4.7. Where appropriate, effect sizes
based on mean change scores are compared to those based on post-test values for select trials.
4.4.8.1 Pain
Four studies reported on post-operative pain following a variety of physiotherapy interventions with mixed results. Harmer et al. found no significant between group difference in WOMAC pain scores post-treatment (WMD 0.14, [-1.21, 0.93]) and six months post-op (WMD 0.82, [-0.59, 2.23]) after six weeks of supervised out-patient exercises compared to PT-led pool exercises both initiated two weeks post-op (72). Kramer and colleagues reported no long term difference (12 months post-op) in pain assessed with the WOMAC (WMD 1.00, [-2.09, 4.09]) and Knee Society (WMD -3.00, [-6.77, 0.77]) rating scales after a 10-week out-patient clinic-based physiotherapy program compared to a home-based exercise program with telephone support (75). There were no between group differences in function-related pain after six weeks of progressive strengthening compared to progressive strengthening plus neuromuscular electrical stimulation (NMES) in an out-patient setting at three (WMD 0.03 [-0.26, 0.32]) and 12 months (WMD -0.07 [-0.41, 0.27]) post-op (73). Significant short term (WMD -7.60 [-14.15, -1.05]) and intermediate term (WMD -7.10 [-13.68, -0.52]) reductions in pain were reported by Moffet et al. following an intensive functional exercise program (8 weeks) compared to standard rehabilitation at home. These between group differences were not maintained at twelve months post-op (8 month follow-up) based on both mean follow-up values (WMD -2.40 [-8.44, 3.64]); however, were significantly better using mean change scores (WMD 8.20 [2.45, 13.95] (74). (See Figures 4.2 and 4.3)

There is high quality evidence that:

- Intensive outpatient functional physiotherapy for six to eight weeks results in less short-term pain which is maintained at two months follow-up compared to a standard home program
- Six weeks of PT-led gym-based group exercises is no better than pool-based group exercises on short- and intermediate-term pain
There is moderate quality evidence that:

- Immediate outpatient physiotherapy of six weeks duration results in no differences in long-term pain at rest or with activity when compared to home-based exercise with telephone support.

- The addition of NMES to a six-week out-patient exercise program results in no differences in short- and long-term pain compared to out-patient exercises alone.

**Figure 4.2 Forest plot for WOMAC pain comparing mean 8-month follow-up values**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Mean</th>
<th>SD</th>
<th>Total</th>
<th>Control Mean</th>
<th>SD</th>
<th>Total</th>
<th>Weight</th>
<th>Mean Difference</th>
<th>IV, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moffett 2004</td>
<td>0.4</td>
<td>12.4</td>
<td>39</td>
<td>11.8</td>
<td>13</td>
<td>31</td>
<td>100.0%</td>
<td>-2.46</td>
<td>[-8.44, 3.52]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td></td>
<td>36</td>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td>100.0%</td>
<td>-2.40</td>
<td>[-8.44, 3.64]</td>
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<tr>
<td>Heterogeneity: Not applicable</td>
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<tr>
<td>Test for overall effect Z = 0.75 (P = 0.44)</td>
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</table>

**Figure 4.3 Forest plot for WOMAC pain comparing mean 8-month change scores**

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental Mean</th>
<th>SD</th>
<th>Total</th>
<th>Control Mean</th>
<th>SD</th>
<th>Total</th>
<th>Weight</th>
<th>Mean Difference</th>
<th>IV, Fixed, 95% CI</th>
</tr>
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<tbody>
<tr>
<td>Moffett 2004</td>
<td>10</td>
<td>13.6</td>
<td>38</td>
<td>10.8</td>
<td>16.75</td>
<td>31</td>
<td>100.0%</td>
<td>8.20</td>
<td>[2.45, 13.95]</td>
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<td>Total (95% CI)</td>
<td></td>
<td>38</td>
<td>31</td>
<td></td>
<td></td>
<td></td>
<td>100.0%</td>
<td>8.20</td>
<td>[2.45, 13.95]</td>
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<tr>
<td>Test for overall effect Z = 2.60 (P = 0.005)</td>
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</table>

**4.4.8.2 Function**

All seven trials included assessment of function using a self-report tool, surgeon-rated tool or performance-based measure alone or in combination for varied interventions and with mixed results.

Self-reported function

Five trials included self-report tools with the WOMAC OA Index being the most common.

Harmer *et al.* reported no significant improvements in function following a 6-week land-based physiotherapy program compared to a 6-week pool-based program immediately following...
treatment (WMD 3.34, [-1.02, 7.70]) and six months post-op (WMD -1.50, [-4.60, 1.60]) (72). There were no long-term differences in WOMAC function scores when a 10-week supervised out-patient physiotherapy program was compared to a home-based program with PT telephone support (WMD 4.00, [-3.86, 11.86]) (75). Six weeks of outpatient physiotherapy resulted in a significant short-term difference in the Oxford Knee Score (WMD -3.20, [-6.04, -0.36]) compared to unsupervised home exercises; however, this was not maintained at 12 months follow-up (WMD 1.20, [-1.96, 4.36]) (70). There was no significant difference in WOMAC function following intensive outpatient physiotherapy (WMD -5.30, [-12.68, 2.08]) nor at two (WMD -6.20, [-13.77, 1.37]) and eight months (WMD -3.80, [-11.58, 3.98]) follow-up compared to standard home exercises (74). Significant between-group differences favouring the intervention group were found at all measurement points when mean change scores were used (Figures 4.4 and 4.5) (74). Petterson et al. reported no significant differences in the Knee Outcome Survey – Activity of Daily Living Scale (KOS-ADLS) immediately following (WMD -0.01, [-0.05, 0.02]) and 12 months after (WMD -0.01, [-0.05, 0.03]) a 6-week progressive strengthening program plus NMES compared to a strengthening program alone (73).

There is consistent high level evidence that:

- Varied forms of outpatient physiotherapy including the use of NMES results in no long-term differences in self-reported function when compared to ‘standard’ care or pool-based exercises.

There is conflicting high quality evidence that:

- Short-term improvements in self-reported function can be achieved with supervised outpatient physiotherapy compared to ‘standard’ home-based care.
Surgeon-rated function

Three trials used a surgeon-rated tool to assess function after varied interventions. There was no significant difference in the Hospital for Special Surgery (HSS) Knee Score following six weeks of daily NMES at home plus conventional physiotherapy compared to physiotherapy alone immediately following and at 12-weeks follow-up; however, effect sizes could not be calculated due to incomplete data (69). Using the Knee Society Clinical Rating System, Kramer et al. found no differences 12 months post-operatively (WMD -7.00, [-16.29, 2.29]) when outpatient physiotherapy was compared to home-based therapy with PT telephone support (75). Effect sizes could not be calculated for the third trial as only post-test data were available (71).

There is low quality evidence that:

- Conventional physiotherapy plus daily NMES results in no short- and intermediate-term differences in surgeon-rated function compared to physiotherapy alone (effect sizes not calculated)
There is moderate quality evidence that:

- Supervised outpatient physiotherapy results in no long-term differences in surgeon-rated function when compared to home-based exercises with PT telephone support

Performance-based function
Five trials reported on function using five different performance-based tools and following varied interventions.

Walking speed
Walking speed was assessed in five studies. Avramidis et al. reported significant differences in 3-minute walk test (3-MWT) distances immediately following six weeks of daily NMES plus conventional physiotherapy and at 12-week follow-up compared to conventional physiotherapy alone; however, effect sizes could not be calculated due to incomplete data (69). There were no significant differences in walking speed as assessed by the 6-minute walk test (6-MWT) immediately following (WMD -12.20, [-54.76, 30.36]) and at six months (WMD -1.12, [-40.68, 38.44]) after a 6-week gym-based physiotherapy program compared to pool-based program (72). Supervised outpatient physiotherapy resulted in no differences in 6-MWT at 12 months (WMD -25.00, [-64.69, 14.49]) when compared to home-based exercises with PT telephone support (75).

There were no significant differences in 6-MWT immediately post-treatment (WMD 31.00, [-7.46, 69.46]), at two months (WMD 31.80, [-6.69, 70.29]) and eight months (WMD 30.00, [-11.14, 71.14]) following intensive outpatient physiotherapy when compared to standard home-based exercises (74). These differences remained non-significant using mean change scores while the authors reported significant between-group differences favouring the treatment group at post-test and 2-month follow-up using an analysis of covariance method to calculate effect sizes (74). Petterson et al. reported no short-term (WMD -5.00, [-40.36, 30.36]) or long-term
(WMD -9.00, [-47.60, 29.60]) differences in 6-MWT with the addition of NMES to a standard outpatient exercise program (73).

Timed stair climb
Timed stair climbing was used in two trials and no significant differences were found after supervised outpatient physiotherapy (WMD -4.00, [-9.57, 1.57]) compared to home-based exercises with PT telephone support (75) nor immediately following NMES as an adjunct to standard outpatient physiotherapy (WMD 1.50, [-0.07, 3.07])(73). There was a significant between-group difference favouring the exercise only group at 12-month follow-up (WMD 1.87, [0.21, 3.53]) (73). A variation on this test, stair climbing power, was used in a third trial and no significant differences were found immediately following (WMD -2.77, [-28.27, 22.73]) and at six months (WMD 17.17, [-9.81, 44.15]) after six weeks of gym-based group physiotherapy compared to pool-based group exercises (72).

Timed Up and Go (TUG)
The TUG test was used in one trial and no significant short-term (WMD 0.27, -0.31, 0.85]) and long-term (WMD 0.39, [-0.20, 0.98]) differences were found when comparing an outpatient progressive strength training program with and without NMES (73).

For performance-based function, there is moderate to high quality evidence that:

- Outpatient progressive strength training with and without NMES results in no differences in 6-MWT distances, short-term stair climbing speed or TUG scores

- Supervised outpatient physiotherapy does not result in longer 6-MWT distances or faster stair climbing speed compared to home-based exercises with PT telephone support

- An outpatient intensive functional exercise program does not result in longer 6-MWT distances compared to a standard home-based exercise program
• PT-led group pool- and gym-based exercise programs result in similar improvements in 6-MWT distances and stair climbing power

There is low quality evidence that:

• Daily NMES as an adjunct to conventional physiotherapy results in greater 3-MWT distances compared to conventional physiotherapy alone (effect sizes not calculated)

4.4.8.3 HRQoL
Four trials reported on HRQoL using the SF-36 or SF-12 generic tools. Kramer et al. reported no significant long-term differences in the SF-36 total score (WMD -1.00, [-6.66, 4.66]) with 10 weeks of outpatient physiotherapy compared to home-based exercises with telephone support (75). Significant between-group differences in the SF-36 MCS favouring the standard care group were found at 2-month follow-up (WMD -4.00, [-6.84, -1.16]) compared to the intensive functional rehabilitation program (74). This difference was no longer evident at the 8-month follow-up (WMD -3.40, [-7.44, 0.64]). No differences were noted in the SF-36 PCS at any measurement point (Figure 4.6, 2-month follow-up). Using mean change scores, significant group differences were found for the SF-36 PCS post-treatment (WMD 3.00, [0.35, 5.65]), and at two months (WMD 6.00, [3.26, 8.74]) (Figure 4.7) and eight months (WMD 4.40, [1.58, 7.22]) follow-up (74). Similarly, between group differences for SF-36 MCS were present at all measurement points using mean change scores. Again a difference in analytical approach to calculating effect size allowed the authors to conclude differently with significant between-group differences in favour of intensive functional rehabilitation only reported at 2-month follow-up for both the MCS and PCS of the SF-36 (74). Petterson et al. found no significant differences in the SF-36 PCS (WMD 0.19, [-2.63, 2.25]) and MCS (WMD 0.40, [-1.81, 2.61]) immediately following and in the PCS (WMD -0.69, [-3.72, 2.34] and MCS (WMD -0.53, [-2.54, 1.48]) 12
months after a progressive outpatient strengthening program with NMES compared to strength training alone (73). Using the SF-12, Mockford et al. reported no significant short-term differences in the PCS (WMD 2.30, [-0.98, 5.58]) and MCS (WMD 2.10, [-1.13, 5.33]) after standard outpatient physiotherapy compared to unsupervised home exercises (70). These differences remained non-significant at 12-month follow-up.

There is conflicting high quality evidence that:

- Intensive outpatient functional physiotherapy results in greater short- and long-term improvements in both the mental and physical components of HRQoL compared to standard home exercises (using mean change scores)

- Supervised outpatient physiotherapy of six and 10 weeks duration results in no short- and long-term differences in HRQoL compared to a home exercise program with no or reduced PT supervision

- Progressive strength training coupled with NMES does not result in better short- and long-term HRQoL when compared to strength training alone

**Figure 4.6 Forest plot for SF-36 PCS comparing mean 2-month follow-up values**
4.5 Discussion

4.5.1 Summary of main results

This review synthesized the research published between 1990 and May 2009 that examined the effects of post-acute physiotherapy after primary TKA on pain, function and HRQoL. There was limited evidence of low to high quality to support the use of various forms of post-acute physiotherapy for pain, function and HRQoL. We found favourable between-group results for: short- and intermediate-term pain and HRQoL following an intensive outpatient functional rehabilitation program compared to a standard home physiotherapy program; short-term self-reported function after supervised outpatient physiotherapy versus ‘standard’ home-based care; and walking speed after daily NMES as an adjunct to conventional physiotherapy. We determined there were no significant between-group differences for surgeon-rated function, TUG score and timed stair climb, and inconsistent differences for HRQoL based on mean post-test and follow-up values. However, in several cases, differences were evident when mean change scores were used to calculate effect size and in most cases, the findings favoured the experimental group.

Due to the heterogeneity among studies, it was not possible to perform a meta-analysis and draw conclusions across studies as to whether one form of physiotherapy was superior to another following TKA surgery. The limited between-group differences are largely explained by the fact that no trials compared a physiotherapy intervention to a 'no treatment' or placebo control group.
Clinically important within-group benefits were evident in most groups that received the targeted or experimental intervention (72, 73, 75), but one cannot draw conclusions about the magnitude of the added benefit of physiotherapy compared to the natural course of recovery after TKA. This lack of accumulated evidence is not evidence of a lack of effectiveness, but speaks to the need for high quality trials with carefully specified interventions and uniform outcome measures.

4.5.2 Quality of the evidence

The overall quality of trials included in this review was low to high with some trials being downgraded due to lack of concealed allocation and one for using unblinded assessors (57). As noted earlier, it is almost impossible to blind patients and providers due to the nature of the interventions. Three trials were likely under powered to detect meaningful between group differences.

Reporting issues were also evident in the included trials with few studies identifying their primary outcome and only three authors reporting they performed a power calculation using this outcome to determine necessary sample size. Participant demographics, particularly presence and severity of co-morbidities, were poorly described in most trials. A growing body of research demonstrates that co-existing health problems are prevalent in individuals undergoing TKA (76, 77) and influence the post-operative course of recovery and TKA outcomes (78). Therefore, co-morbidities should be reported and considered in the analyses of outcomes after TKA rehabilitation.

4.5.3 Strengths of this review

To our knowledge, this is the most comprehensive systematic review to date examining the varied forms of physiotherapy commonly delivered during the first year after TKA surgery. Our extensive search strategy resulted in a large body of published and unpublished studies and our
inclusion of non-English trials reduced the risk of language bias. We made every effort to contact authors for missing data and methodological clarification. Six different countries and respective health care systems are represented in our review. However, it is possible that some relevant trials are missing and those published since May 2009 are not included. There remain large gaps in the evidence and a paucity of high quality trials on physiotherapy interventions after TKA.

4.5.4 Weaknesses and potential biases of this review
Due to trial heterogeneity, we were unable to perform the planned meta-analysis and make definitive statements about the strength of the evidence and magnitude of treatment effects for physiotherapy interventions after TKA. Limiting our review to RCTs and CCTs precluded other study designs that may have contributed additional evidence on the topic of post-acute physiotherapy after TKA. We made every effort to avoid various forms of bias by pursuing unpublished reports in our search strategy, permitting non-English studies, using two authors to independently screen and review papers, and performing a rigorous and standardized quality assessment process. We did not create funnel plots to examine the possibility of publication bias due to the small number of included trials.

4.5.5 Agreements and disagreements with other studies or reviews
A recently published Cochrane review compared the effect of multidisciplinary rehabilitation interventions to single discipline care following primary and revision THA and TKA for OA and rheumatoid arthritis (RA) (50). This review, however, focused on the acute care phase of rehabilitation and included use of clinical pathways, formal patient education programs, post-operative pain management and dietary interventions in its range of outcomes. Studies examining physiotherapy interventions alone were excluded. Due to clinical heterogeneity and low study quality, a meta-analysis was not performed. The authors concluded that there was silver level (low to moderate) evidence to support early multidisciplinary rehabilitation in improving activity
and participation outcomes; however, optimal intensity, frequency and effects of rehabilitation warranted further study.

In order to support their development of evidence-based guidelines for ambulatory physiotherapy following TKA, the French Society of Physical and Rehabilitation Medicine (SOFMER) conducted a systematic review of French and English language articles from an unspecified time frame (79). A meta-analysis was not possible due to trial heterogeneity. Based on their analysis of 16 studies of mixed methodologies and inclusion criteria, the authors concluded that there were some advantages of ambulatory physiotherapy on muscle strength and function. From their limited economic analysis, no differences were found comparing home therapy to other approaches.

In 2005, two separate reviews were conducted to inform rehabilitation practice and education in Ontario, Canada. In a review by the Medical Advisory Secretariat of the Ministry of Health and Long-Term Care, it was concluded that there was limited high-quality evidence (from one published abstract) to support the use of home-based physiotherapy instead of inpatient treatment after THA and TKA (80). The English-only literature was reviewed up to 2004 to inform the Greater Toronto Area Rehabilitation Network's development of an online discussion forum to promote collaboration and education among patients and health professionals (81). Based on this review of experimental and observational studies spanning pre-operative, acute and post-operative care, rehabilitation was found to be an effective component in TJA management at various stages of recovery. Best practice recommendations were not clearly differentiated for hip versus knee replacement. Soever and MacKay also concluded that comparison of outpatient care to other rehabilitation processes warrants further study to determine the optimal processes of care following TJA (81).
In 2008, a systematic review on the effects of therapeutic exercise after discharge from hospital for primary TKA surgery was published (51). This review of trials up to April 2007 included interventions delivered beyond one year post-op and excluded those that involved inpatient rehabilitation and electrical modalities as a treatment adjunct. While there is obvious overlap in the trials included in this and our review, our review is more comprehensive in that it includes inpatient treatment, which is routine rehabilitation practice in many countries (26, 82). The authors performed a meta-analysis for function, walking speed, ROM and HRQoL outcomes despite clinical heterogeneity among the interventions. They found small to moderate pooled effects for short-term function, ROM and HRQoL. Pooled studies were of varied exercise interventions at different time frames, of mixed durations and used different outcome tools. Regardless, Minns Lowe et al. similarly concluded that trial availability, quality and diversity prevented definitive answers regarding effectiveness of post-discharge physiotherapy exercise for primary TKA and recommended further research on the topic (51).

4.6 Conclusions

4.6.1 Implications for practice

There is insufficient evidence from the studies included in this review, to suggest that any one type, setting or timing for post-acute physiotherapy for TKA is superior to another. The tremendous variety in the timing, duration, intensity and content of the interventions make developing clinical recommendations problematic. Additional high quality trials with sufficient power and standardized outcome assessment methods are needed to establish specific treatment recommendations for post-acute PT after TKA.

With the longstanding impairments, functional limitations and participation restrictions present in individuals awaiting primary TKA (47, 76, 83-87) and still evident as much as two years post-
op (37-40), it may be inappropriate and unethical to withhold post-operative physiotherapy all together. The physiotherapy setting may be less important than the type, quality, dosage and adherence to the intervention; however, dose-response calculations were not possible and limited adherence data were available in the trials selected, and further evidence is required to support this conclusion.

Despite the limitations in the availability and quality of evidence, there are a number of implications for clinical practice from the high quality trials:

- There is limited evidence from one high quality trial that a more intensive, functional exercise program results in better pain relief, self-reported function and HRQoL when compared to a standard home-based physiotherapy program (74)

- There is limited, high quality evidence to support the use of electrical muscle stimulation as an adjunct to progressive strengthening exercises in improving stair climbing ability 12 months after surgery (73)

- There is limited evidence from one high quality trial suggesting that similar improvements in pain and function can be achieved with a PT-led group pool-based exercise program as with a gym-based program (72)

- There is limited evidence from one high quality trial to support a 6-week supervised outpatient physiotherapy program for improving short-term self-reported function compared to unsupervised home exercises (70).
4.6.2 Implications for research

The heterogeneity among trials regarding the timing and types of interventions, control situations, outcomes and measures highlights the need for greater standardization in the conducting, evaluating and reporting of future research trials in TKA rehabilitation. Agreement on core outcomes and measures would facilitate comparison among different intervention approaches, settings, timing and costs. Additional suggestions for future research in this field include:

- Conduct trials with strong study designs, concealed allocation to groups, blinded assessors and large sample sizes to ensure adequate power
- Prospectively monitor participants' adherence to the study protocol (intervention) with subgroup analysis of treatment effects for high and low adherers (dose-response)
- Prospectively monitor providers' adherence to the study protocol
- Provide more detailed descriptions of the therapeutic interventions including timing, duration, frequency, intensity and progressions
- Determine what baseline and post-operative contextual factors (personal and environmental) are most strongly related to rehabilitation outcomes and patient satisfaction, and perform appropriate subgroup analyses
- Assess how patient preference for type, timing and/or setting for rehabilitation affects outcomes
- Identify a core set of outcome measures for each of the ICF domains to allow for consistent, standardized reporting of outcomes and comparison across interventions
• Include measures that capture participation, HRQoL and patient satisfaction

• Include a follow-up phase of at least 12 months and monitor and report on physical activity levels and use of health care services or rehabilitative therapies during this period

• Conduct multi-site trials to increase sample sizes and generalizability of findings

• Include an economic analysis including both direct and indirect costs, and patient out-of-pocket expenses during the intervention and follow-up phases
4.7 References


27. Troughton D, Pearce J. Total hip and knee replacement survey: Rehabilitation practices through the continuum of care. Rehabilitation Services, Vancouver Island Health Authority; 2007.


53. Westby MD, Backman CL. Patient and health professional views on rehabilitation practices and outcomes following total hip and knee arthroplasty: A focus group study. Submitted 2009 Sep 3.


Chapter 5: Developing consensus on best practice recommendations for total hip arthroplasty rehabilitation: A Delphi study

5.1 Background

The North American population is becoming older, more sedentary and more overweight. As a result, the number of individuals developing hip and knee osteoarthritis (OA) is on the rise (1-3) and elective total joint arthroplasty (TJA) surgery is in increasingly greater demand (4). More than 22,000 primary total hip arthroplasty (THA) surgeries were performed in Canada in 2006/07 (not including Quebec) (5) and 231,000 in the United States (US) in 2006 (6). By far the majority of THAs are carried out for end-stage OA when conservative treatments have failed (7).

While significant attention and resources have been directed toward managing TJA waiting times in Canada and optimizing surgical techniques, prosthetic materials and in-hospital care pathways, little attention has been directed at post-acute rehabilitation and its impact on long-term outcomes. Questions about appropriate rehabilitation interventions, settings, timing and dosage remain unanswered as evidenced by significant rehabilitation practice variation both locally (8) and internationally (9, 10), and by the lack of clinical practice guidelines (CPG) (10). An apparent lack of agreement on routine or standard THA rehabilitation against which new interventions are compared is also evident from the published trials of THA physiotherapy interventions (11). More than 15 years ago, the National Institutes of Health (NIH) in the US reported on the need for an “organized, in-depth study to determine optimum regimen, treatment duration, and expected outcomes as clinical data suggest that potential capabilities of THA

5 A version of this chapter will be submitted for publication. Westby MD, Brittain A, Liang M, Raglin Block M, Backman CL. Best practices for post-acute rehabilitation following primary total hip arthroplasty for osteoarthritis: A Delphi study.
patients are not being fully developed” (12)(p.8) and more recently acknowledged that “the use of rehabilitation services is perhaps the most understudied aspect of the peri-operative management of TKA patients” (13)(p.6). To date, little progress has been made towards this end for either type of surgery.

It is suggested that current rehabilitation approaches following THA are insufficient as evidenced by the numerous reports of prolonged physical impairment and activity limitations as much as two years post-op (14-17). Our Cochrane systematic review of post-acute physiotherapy interventions following primary THA revealed marked heterogeneity in rehabilitation practices and a lack of available evidence to suggest any one approach is clearly superior to another regarding pain, function and health related quality of life (HRQoL) (11).

5.1.1 Clinical practice guidelines

Clinical practice guidelines (CPG) are systematically developed evidence-based statements to assist practitioners and patients make decisions about appropriate health care for specific clinical circumstances (18). Guidelines aim to close the gap between evidence and practice, to reduce variation in clinical practice, and to improve the quality, efficiency and, effectiveness of health care by using the best available scientific evidence and expert opinion to make clinical recommendations (19, 20). Without sufficient high-quality and consistent evidence from rigorously conducted controlled studies, guidelines need to be based to some extent on the opinions of clinicians and others with experience in the field (21). Ideally, such expert opinion and consensus comes from a “…multidisciplinary panel of relevant stakeholders representing a wide range of interests and perspectives related to the topic area” (21)(p.1).
5.1.2 Rationale for Delphi survey

Historically, many clinical guidelines have been based on expert opinion with little scientific credibility, methodological transparency or formal process for achieving consensus (22). Three main consensus approaches are used in health care: the Delphi group process; the nominal group technique; and, the consensus development conference (21). The latter two approaches involve face-to-face meetings with structured interaction among participants. The Nominal group technique has participants share their ideas in a non-judgemental, round-robin, brainstorming format until all suggestions have been listed (21). This is followed by private voting on the options and statistical methods to derive a group decision. The consensus development conference was introduced by the NIH and as mentioned earlier, was used to examine various aspects of THA surgery (12). With this consensus method, a relatively small group of experts meets over the course of a few days in an open meeting format. Experts and representatives of various interest groups present evidence that is later used by the decision-making group to reach consensus (23). The conference is chaired by an individual who is responsible for controlling the proceedings and encouraging consensus.

The Delphi group process, which pre-dates these other approaches, is a formal and established survey method that makes best use of the available research evidence and the collective experiences and knowledge of the participants (24, 24). The method allows for the refinement of responses or opinions through a series of three or more questionnaires (rounds) using controlled feedback and analysis of group members’ responses (25). Although participants never interact directly, the method is useful to structure and organize group communication (26), especially with a large number of participants from different geographic locations (25). This group process was chosen for its relative ease, efficiency, ability to create a diverse panel and its lower costs when compared to a face-to-face Nominal group process (21, 23, 26, 27). As well, the
anonymous nature of the Delphi survey allows for equal and independent contributions from panel members without feeling pressured psychologically by more influential members (23, 27).

Delphi surveys have been used previously in guideline development (21, 23, 28) and more specifically in rheumatology (29, 30) and orthopaedics (31).

5.2 Purpose

The aim of this study was to incorporate health professional expertise and patient experience with the available research evidence to achieve consensus on best practice recommendations for rehabilitation following THA.

5.3 Methods

5.3.1 Participants

Purposive sampling was used to form a diverse expert panel with representation from across Canada and the US, both urban and more rural locations, and varied practice settings. Panelists were identified through word of mouth, letters of introduction sent to professional (Appendix F), consumer (Appendix G) and seniors organizations, internet searches of key rehabilitation institutions, and select members of Canadian and American arthritis health professional organizations.

Invited panelists included individuals who had undergone THA surgery (patient experts); orthopaedic surgeons and rehabilitation health care professionals (clinician experts); researchers in the field (research experts); and representatives from key rehabilitation and research institutions (clinician and research experts, decision makers). This diversity allowed for a wider variety of perspectives and creative alternatives and ensured areas of uncertainty and controversy would be fully explored (21, 23, 28).
Since no guidance exists on the ideal number of panel members for a Delphi survey, we strove for a balance between greater numbers (which would increase the reliability of group judgment) and logistics, costs, and human resources (21, 32). Recent Delphi surveys in the area of health care have reported between 18 and 44 participants (29-31).

We followed-up invitations with phone calls or e-mails for those individuals who did not respond within two weeks. One of the two investigators (MW, AB) confirmed their eligibility and ability to complete all Delphi rounds. This process continued until we had a panel of 40 individuals with the desired diversity of experience and professional representation.

5.3.2 The Delphi questionnaires (rounds)

While traditionally round one is used to generate ideas in a brainstorming fashion, Keeney et al. suggest there is support for a revised approach in which pre-existing information is provided for rating thereby reducing the number of rounds to reach consensus (32). Prior to starting the Delphi survey, panelists were sent a glossary of terms and an overview of our systematic reviews to help focus their attention on the task, bring them to a similar level of knowledge, and underscore that the exercise was based on research, not opinion alone (22, 23, 28, 33, 34).

The first round questionnaire was organized in 10 sections, each addressing a component of THA rehabilitation (Appendix H). Each section had one or more key statements on which panelists were asked to rate their level of agreement on a five-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral/no opinion, 4=agree, 5=strongly agree) and provide comments and/or justification for their responses. Related to each key statement were a number of questions (items) regarding specific rehabilitation parameters and contextual factors. The personal and external (environmental) factors were derived from our earlier focus group study (35), systematic review (11) and related literature (36-39). Where possible, wording of personal and external
factors followed the World Health Organization’s (WHO) International Classification of Functioning, Disability and Health (ICF) terminology for consistency with the published literature (40). Panelists were invited to suggest additional items and these were included in the subsequent round, where appropriate. As a result of this process, one additional section was added to rounds two and three. (Refer to Appendix I for example of the round three questionnaire.) We pilot tested the first questionnaire with three patients and 13 health professionals for feedback on its organization, time needed to complete, and clarity (27, 41, 42), which led to minor revisions for implementation of round one.

After rounds one and two, panelists were provided with descriptive statistics (mean, standard deviation, range) for group responses, their individual ratings, and anonymous comments reflecting the range of views (25, 33, 34). Panelists were asked to review and reflect on this controlled feedback before responding to the subsequent round. This reflective element encourages panelists to reconsider their views in light of new or more relevant information, an important element in moving towards consensus (23, 25, 26, 32, 34). In order to avoid ‘response exhaustion’ among busy, time-pressed participants, we decided a priori to stop the survey after three rounds. The Delphi process took six months to complete and is consistent with other reported Delphi studies requiring three to six months to complete (32).

5.3.3 Procedures

The questionnaires were developed and administered using the Arthritis Research Centre of Canada’s Research Survey System (©2008) (https://dq.arthritisresearch.ca) which enabled panelists to log-on and complete the questionnaires in one or more sittings. Panelists were given a choice in method of survey completion (paper or online version); all chose the online format.
To maximize response rates through three rounds, e-mail and/or telephone reminders were sent at weekly intervals over a maximum of six, five and four weeks in rounds one, two and three respectively (32). Personalized thank you cards were mailed to panelists after each round and a $100 honorarium (gift card or donation to registered charity of panelist’s choice) upon completion of round three.

5.3.4 Ethics approval

We received ethical approval to conduct this study from the University of British Columbia Behavioural Research Ethics Board (Appendix C) and the Vancouver Coastal Health Research Institute. An informed consent letter was sent to all panelists and completing the first questionnaire was confirmation of their consent. Participants were assured anonymity during the Delphi rounds and only those who gave permission will be acknowledged by name in publications (Appendix J).

5.3.5 Data collection and analysis

As there are a variety of ways to define and determine consensus (21, 26), we asked the panelists to determine a priori the level of agreement that would lead them to believe that the panel has reached consensus and was confident about a given recommendation. Of the 49 panelists who agreed to participate on either the THA and/or TKA panel, 43 (88%) responded and the mean value was 79.4% (mode 80%, range = 60% - 95%); thus 80% was assigned as the level needed to reach consensus for each key statement and individual item. This is consistent with the published literature (27). The cut off point for items to go forward to subsequent rounds was ≥ 50%; however, if a majority of patient panelists felt an item was important despite less than 50% of the full panel agreeing, the item was flagged and included in the subsequent round for further consideration. This novel ‘patient veto’ approach was used to ensure that professionals remained
patient-centered in their deliberations. Panelists were advised of these procedures prior to the first round.

After each round, descriptive statistics (mean, standard deviation (SD), range) and level of consensus (percentage of respondents who selected “agree” or “strongly agree” for a given statement) were calculated for rated items (continuous data) and percentage in agreement for check list items (dichotomous data) consistent with previous Delphi studies (29, 30, 41). The mean represents group agreement while the SD represents the amount of disagreement within the group (42). In round three, panelists were asked to further rate the items on rehabilitation interventions, outcomes and measuring outcomes according to their perceived importance or clinical feasibility (Table 5.1).
### Table 5.1 Sample controlled feedback

#### Example

1. Indicate your level of agreement with the following statement:
   Post-acute rehabilitation should include….

   ![Agreement level in text box](image)

   **Range**
   - Strongly Disagree
   - Disagree
   - Neutral
   - Agree
   - Strongly Agree

#### New questions for Round 2 - Stage of Rehabilitation

1. Indicate your level of agreement with the following statement:
   When developing best practice recommendations for post-acute rehabilitation after primary THR for OA, it is important to specify or distinguish between an early and a late phase.

   ![Agreement = 80.5%](image)

   **Mean = 3.9 (±1.4)**

   **Arrow points to the Mean (±SD in brackets)**

   ![Mean = 3.9 (±1.4)](image)

   - The early phase or the only phase should have patients walking with confidence.
     Designing another phase could be helpful but optional.
   - Need to specify what underlying concept you are working from in terms of definition of early and late (e.g. related to soft tissue healing?)

---

Topics on which consensus was not reached, had the greatest range and SDs, or generated the greatest divergence in comments (outlier views) were further explored through subgroup analyses. Three sets of subgroups were identified *a priori* based on earlier research suggesting...
unique perspectives (35): 1) Panelist type (PT, surgeon or patient); 2) Professional or primary role (clinician/surgeon or researcher/academic); and 3) Country (Canada or US). It is well documented that panelists tend to advocate treatments consistent with their specialty or procedures they perform (23) and we were interested in exploring this phenomenon. Group mean scores were compared using one-way ANOVA (SPSS Version 17, SPSS Inc., Chicago, IL). Categorical data were analyzed descriptively by the various subgroup variables.

A qualitative analysis of panelists’ comments was performed after each round and the number of new topics/items recorded (41). Two of the authors (MDW, AB) independently reviewed the narrative data and assigned codes to recurring or important topics and grouped these into categories and key themes (33, 41). Positive (supportive), negative and outlier comments related to each questionnaire topic and theme were provided to panelists (23, 34) along with their individual and pooled ratings approximately 10 days prior to rounds two and three. Panelists were instructed to review and refer to this controlled feedback while completing the next round.

5.4 Results

5.4.1 Panelist demographics

Panelists represented a broad range of stakeholders in post-acute rehabilitation after THA in Canada and the US (Table 5.2). All panelists indicated English was their first language. Two of the three patient panelists had post-graduate degrees, all were retired and all had participated in some form of structured rehabilitation for an average of 22 (SD=9) weeks following their THA. The professionals included PTs (n=17), other allied health professionals (n=4), surgeons (n=10), and other physicians (n=4) including rheumatology, physiatry and family practice. The greater proportion of PTs is in line with their major role reported by patients in the focus group study and this thesis’ focus on physical rehabilitation. Just under half of professionals reported between
five and 14 years of experience in THA care, another 17% had 15 to 24 years and 32% had 25 or more years of experience. Roughly one-quarter of professionals saw between one to 99 THA patients each year, just under half saw 100 to 199 and the remainder saw ≥200 patients each year.

Table 5.2 THA panelists’ demographics

<table>
<thead>
<tr>
<th></th>
<th>Clinicians/ Surgeons (n=22)</th>
<th>Academics/ Researchers (n=10)</th>
<th>Other* (n=3)</th>
<th>Patients (n=3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD), years</td>
<td>48 (8)</td>
<td>47 (7)</td>
<td>52 (10)</td>
<td>68 (4)</td>
</tr>
<tr>
<td>Gender (% female)</td>
<td>55%</td>
<td>40%</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>Canadian residents (%)</td>
<td>68%</td>
<td>60%</td>
<td>33%</td>
<td>67%</td>
</tr>
</tbody>
</table>

* Manager (n=2) and educator (n=1)

5.4.2 Response rates

Fifty-seven professionals and three patients (n=60) were invited to participate on the THA and/or TKA panel; of these, 40 (67%) agreed to serve on the THA panel and were sent the pre-reading package. One patient panelist dropped out prior to the start of round one for health reasons and was replaced. One physician requested to be removed from the panel prior to the start of round one due to other work commitments. Response rates ranged from 94% to 97% in each round (Table 5.3). Main reasons for not completing a round were time constraints and travel during the study period. Only panelists who completed the previous round were included in the subsequent round.
Table 5.3 THA panelists’ response rates by rounds

<table>
<thead>
<tr>
<th></th>
<th>Round 1</th>
<th>Round 2</th>
<th>Round 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invited to participate</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agreed to participate</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dropped out before start of round</td>
<td>2*</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sent questionnaire</td>
<td>39</td>
<td>38</td>
<td>36</td>
</tr>
<tr>
<td>Completed questionnaire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• By deadline (10 days)</td>
<td>22 (56%)</td>
<td>14 (37%)</td>
<td>20 (56%)</td>
</tr>
<tr>
<td>• After 1 reminder</td>
<td>10 (26%)</td>
<td>11 (29%)</td>
<td>11 (30%)</td>
</tr>
<tr>
<td>• After 2 or more reminders</td>
<td>6 (15%)</td>
<td>11 (29%)</td>
<td>3 (8%)</td>
</tr>
<tr>
<td>Total completed round</td>
<td>38 (97%)</td>
<td>36 (95%)</td>
<td>34 (94%)</td>
</tr>
</tbody>
</table>

*Patient who dropped out was replaced

5.4.3 Response times

Panelists were given 10 days to complete each round; however, only 37% to 56% met this deadline (Table 5.3). In total, it took six, five and four weeks to complete rounds one, two and three respectively. On average, it took panelists 49 to 59 minutes to complete the THA questionnaire in each round.

5.4.4 Round one results

Consensus was achieved for 17 of 28 key statements (Table 5.4). Consensus was not reached in statements pertaining to preoperative screening, levels of professional supervision, setting, evaluation of outcomes not captured within the ICF and need for long-term follow-up (FU). These were also the areas in which there were the greatest number of comments and new items/options suggested. Of the 89 items that did not reach the 50% cut off point, 21 were
selected by two or more patient panelists and therefore brought forward to round two. Seventy-five new items were suggested in round one.
<table>
<thead>
<tr>
<th>Section/Statement</th>
<th>Round 1 (n=38)</th>
<th>Round 2 (n=36)</th>
<th>Round 3 (n=34)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent</td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td></td>
<td>agreementa</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>New. Important to recognize an early &amp; late phase</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to recognize a maintenance phase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual approach</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>A. Patients should be offered structured rehab</strong></td>
<td>82%</td>
<td>4.2 (1.2)</td>
<td>1-5</td>
</tr>
<tr>
<td>Importance of screening pre-operatively to assess need for rehab</td>
<td>68%</td>
<td>3.8 (1.2)</td>
<td>1-5</td>
</tr>
<tr>
<td>Influence of personal factors on need</td>
<td>87%</td>
<td>4.2 (1.0)</td>
<td>1-5</td>
</tr>
<tr>
<td>Influence of external factors on need</td>
<td>69%</td>
<td>3.7 (0.9)</td>
<td>1-5</td>
</tr>
<tr>
<td><strong>B. Rehab should be provided by trained professionals with THA knowledge &amp; experience</strong></td>
<td>92%</td>
<td>4.5 (0.9)</td>
<td>1-5</td>
</tr>
<tr>
<td>Standardized training on THA rehabilitation should be available for health professionalsb</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>C. Need for direct supervision by health professional</strong></td>
<td>71%</td>
<td>3.8 (1.1)</td>
<td>2-5</td>
</tr>
<tr>
<td>Indirect/reduced supervision by health professional is appropriate</td>
<td>61%</td>
<td>3.3 (1.1)</td>
<td>1-5</td>
</tr>
<tr>
<td>Self-directed (no supervision) is appropriate</td>
<td>16%</td>
<td>2.1 (1.1)</td>
<td>1-4</td>
</tr>
</tbody>
</table>

**Table 5.4 Level of agreement by Delphi round**

- **a** Percent agreement based on sum of ‘agree’ and ‘strongly agree’ responses
- **b** New themes/topics added in Round 2 or 3

*Note: Bolded numbers indicate consensus ≥80% reached*
Table 5.4 Level of agreement by Delphi round (continued)

<table>
<thead>
<tr>
<th>Section/Statement</th>
<th>Round 1</th>
<th>Round 2</th>
<th>Round 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent agreement</td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td><strong>D. Timing of rehab is important for outcomes</strong></td>
<td>82%</td>
<td>4.1 (1.0)</td>
<td>1-5</td>
</tr>
<tr>
<td>Influence of personal factors on timing</td>
<td>50%</td>
<td>3.2 (1.0)</td>
<td>1-5</td>
</tr>
<tr>
<td>Influence of external factors on timing</td>
<td>47%</td>
<td>3.0 (1.1)</td>
<td>1-4</td>
</tr>
<tr>
<td><strong>E. Setting for rehab is important for outcomes</strong></td>
<td>53%</td>
<td>3.3 (1.0)</td>
<td>1-5</td>
</tr>
<tr>
<td>Influence of personal factors on setting</td>
<td>84%</td>
<td>3.9 (0.8)</td>
<td>1-5</td>
</tr>
<tr>
<td>Influence of external factors on setting</td>
<td>87%</td>
<td>3.9 (0.8)</td>
<td>2-5</td>
</tr>
<tr>
<td><strong>F. Appropriate rehab interventions are important for outcomes</strong></td>
<td>84%</td>
<td>4.3 (0.9)</td>
<td>2-5</td>
</tr>
<tr>
<td>G. Dosage of rehab is important for outcomes</td>
<td>Not asked (technical error)</td>
<td>77%</td>
<td>3.9 (0.8)</td>
</tr>
<tr>
<td>Influence of personal factors on dosage</td>
<td>90%</td>
<td>4.1 (0.9)</td>
<td>1-5</td>
</tr>
<tr>
<td>Influence of external factors on dosage</td>
<td>84%</td>
<td>3.8 (0.9)</td>
<td>1-5</td>
</tr>
</tbody>
</table>
Table 5.4 Level of agreement by Delphi round (continued)

<table>
<thead>
<tr>
<th>Section/Statement</th>
<th>( \text{Round 1} )</th>
<th>( \text{Round 2} )</th>
<th>( \text{Round 3} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent agreement</td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td><strong>H. Routinely assessing body structure/function outcomes is important</strong></td>
<td>89% 4.3 (0.7) 2-5</td>
<td>94% 4.3 (0.8) 1-5</td>
<td>94% 4.3 (0.6) 3-5</td>
</tr>
<tr>
<td>Routinely assessing activity/participation outcomes is important</td>
<td>90% 4.2 (0.7) 2-5</td>
<td>92% 4.2 (0.8) 1-5</td>
<td>94% 4.2 (0.6) 2-5</td>
</tr>
<tr>
<td>Routinely assessing non-ICF outcomes is important</td>
<td>34% 3.3 (0.8) 2-5</td>
<td>47% 3.4 (1.0) 1-5</td>
<td>53% 3.6 (0.8) 2-5</td>
</tr>
<tr>
<td>Influence of personal factors on outcomes</td>
<td>92% 4.2 (0.6) 3-5</td>
<td>95% 4.3 (0.8) 1-5</td>
<td>94% 4.3 (0.7) 2-5</td>
</tr>
<tr>
<td>Influence of external factors on outcomes</td>
<td>87% 4.1 (0.7) 2-5</td>
<td>97% 4.3 (0.5) 1-5</td>
<td>94% 4.1 (0.6) 2-5</td>
</tr>
<tr>
<td><strong>I. Using appropriate tools to measure body structure/function outcomes is important</strong></td>
<td>90% 4.2 (0.6) 3-5</td>
<td>89% 4.2 (0.8) 2-5</td>
<td>97% 4.3 (0.6) 2-5</td>
</tr>
<tr>
<td>Using appropriate tools to measure activity/participation outcomes is important</td>
<td>92% 4.2 (0.7) 2-5</td>
<td>94% 4.3 (0.7) 2-5</td>
<td>94% 4.2 (0.6) 2-5</td>
</tr>
<tr>
<td>Using appropriate tools to measure non-ICF outcomes is important</td>
<td>61% 3.6 (0.8) 2-5</td>
<td>56% 3.6 (0.8) 2-5</td>
<td>62% 3.6 (1.2) 1-5</td>
</tr>
<tr>
<td><strong>J. Short-term patient follow-up is important</strong></td>
<td>82% 4.0 (1.0) 2-5</td>
<td>92% 4.3 (0.8) 1-5</td>
<td>88% 4.3 (0.8) 2-5</td>
</tr>
<tr>
<td>Long-term patient follow-up is important</td>
<td>66% 3.6 (1.2) 1-5</td>
<td>67% 3.9 (1.0) 2-5</td>
<td>79% 4.0 (0.9) 2-5</td>
</tr>
<tr>
<td>Access to appropriate follow-up services is important</td>
<td>89% 4.4 (0.8) 2-5</td>
<td>89% 4.4 (1.3) 2-5</td>
<td>94% 4.4 (1.3) 1-5</td>
</tr>
</tbody>
</table>
5.4.5 Round two results

Consensus was achieved for 19 of 31 key statements – the total of 31 reflects three new key statements that were not included in round one (Table 5.4). The same items noted in round one still did not reach consensus while two of the three new topics related to phases of post-acute rehabilitation reached agreement. Twenty-seven new items/options were suggested in this round. Of the 52 items below the 50% cut off point, 21 were selected by a majority of patient panelists and included in the final round. There were 20% fewer comments in this round compared to round one.

5.4.6 Round 3 results

Consensus was achieved on a further three key statements for a total of 22 of 33 key statements – the total of 33 reflects two new statements not included in previous rounds (Table 5.4). One statement approached consensus to recommend against in that more than 79% of panelists disagreed or strongly disagreed that ‘unsupervised’ rehabilitation (ie. no direct contact with a rehabilitation provider) was appropriate after THA. Consensus was not reached on the importance of format, setting, and dosage on patient outcomes; outcomes and outcome measures not captured by the ICF; and the importance of long-term follow-up. As well, the influence of personal factors on the timing of post-acute rehabilitation did not achieve consensus. These topics continued to have the greatest range in scores, largest standard deviations and greatest number of comments. Personal and external factors were felt to influence several components of rehabilitation and outcomes (Table 5.5).
Table 5.5 Influence of personal and external factors by section

<table>
<thead>
<tr>
<th>Personal factors</th>
<th>Need for rehab</th>
<th>Timing</th>
<th>Setting</th>
<th>Dosage</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>General health</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Body weight</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other symptomatic joints</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Fitness level</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Pain status</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Healing/wound status</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Post-op complications</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Functional status</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Psychological status</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Mental/cognitive status</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Patient expectations</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
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<tr>
<td>Patient goals</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Patient attitude</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Patient engagement</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
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</tr>
<tr>
<td>Patient motivation</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Physical response to rehabilitation*</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External factors</th>
<th>Need for rehab</th>
<th>Timing</th>
<th>Setting</th>
<th>Dosage</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support of spouse/family</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Attitude of physician</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Access/availability of rehab professionals</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Access to rehab programs</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Access to transportation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Health insurance</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health professional skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Surgeon skills</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
</tr>
</tbody>
</table>

Contextual factors achieving ≥80% agreement in round 3
5.4.7 Results by survey sections

5.4.7.1 Rehabilitation phases
This section was added after round one in response to panelist comments. While panelists strongly agreed (94%) that it was important to differentiate between an early and late phase of post-acute rehabilitation, there was no consensus on the duration of each phase. Suggestions ranged from three to 16 weeks with six weeks being selected most often. Late phase suggestions ranged from 12 weeks to eight months with 16 weeks receiving the most frequent endorsement. The need for a maintenance phase did not reach consensus. Panelists strongly agreed (94%) that an individualized approach was needed for post-acute rehabilitation after THA. Subgroup analysis revealed that there was no significant between-group differences for patients, PTs and surgeons regarding the need to recognize an early and late phase (p=.63) and maintenance phase (p=.73).

5.4.7.2 Need for post-acute rehabilitation
There was strong support for the need for post-acute rehab (91%) and recognition that personal and external factors influenced this need (Table 5.5). Surgeons rated the need lower than did PTs and patients; however, this difference did not reach statistical significance (p=.10). Pre-operative screening to identify patients in need of post-acute rehabilitation also reached consensus (82%) with no significant differences in responses by panelist type, primary role or country.

5.4.7.3 Rehabilitation providers
Panelists strongly agreed (97%) that there was a need for trained health professionals to provide post-acute rehabilitation after THA and this did not differ by primary role of professionals. Physical therapists (94%) and occupational therapists (OTs) (85%) were the two health care professionals viewed as appropriate to provide post-acute rehabilitation. Rehabilitation or PT assistants approached agreement (77%) after three rounds while there remained marked
uncertainty amongst panelists regarding the appropriateness of community nurses, kinesiologists, fitness professionals and general practitioners as providers of rehabilitation. Subgroup analysis revealed that there was similar levels of support from PTs, surgeons and patients regarding the appropriateness of PTs, OTs and rehabilitation assistants. No patients or surgeons felt community nurses or family practitioners were appropriate and no PTs or patients felt kinesiologists were appropriate providers of post-acute rehabilitation. Fitness professionals were not selected by any subgroup; however, 35% of panelists remained unsure after three rounds. Panelists agreed (88%) that there was a need for standardized, evidence-based training for health professionals to ensure the knowledge and skills necessary to provide safe and effective THA rehabilitation care; an additional statement that was added to round two based on panelist comments.

5.4.7.4 Rehabilitation format
Panelists did not reach consensus (76%) on the need for direct supervision by a trained professional for post-acute rehabilitation after THA. Panelists agreed (87%) that 1:1 patient supervision was appropriate but did not reach consensus on the appropriateness of group treatment with all THA patients (77%) or a mixed format (individual and group treatment) (77%). There was no consensus on the appropriateness of reduced or indirect supervision. Of the 23 panelists who responded favorably to this form of supervision, there was strong support for the use of a rehabilitation or PT assistant (100%) and slightly less support for a trained fitness professional (87%), both under the supervision of a PT. Also rated as appropriate were self-directed rehabilitation/exercise programs with health professional support on request (83%), with a PT consulting during scheduled surgical post-operative visits (96%) and with scheduled periodic checks by a PT (87%). Self-directed rehabilitation with no professional supervision approached negative consensus with 79% of panelists disagreeing with this option. Of the seven
who responded favorably, there was unanimous support for self-directed rehabilitation using an illustrated exercise sheet provided by the hospital and equal agreement (86%) on the appropriateness of coaching from a family member who received exercise instruction from the inpatient PT, web-based exercise illustrations or videos, and use of an exercise video at home along with a contact number should questions arise.

Subgroup analysis revealed no differences on the appropriateness of various levels of professional supervision when comparing responses of Canadian and American panelists. As well, a similar proportion of American (82%) and Canadian (75%) panelists felt group treatment (all THA patients) was appropriate; although agreement fell on either side of the consensus value of 80%. A majority of panelists (87%) indicated that small groups (1 provider to 3-4 patients) were most appropriate. Panelists agreed (85%) that structured post-acute rehabilitation using a multi-phased approach based on stages of tissue healing and recovery of muscle function was appropriate, regardless of setting and available supervision.

5.4.7.5 Timing of post-acute rehabilitation
Consensus was reached (88%) on the importance of timing of post-acute rehabilitation following THA. There were varied levels of agreement on the influence of different personal and external factors on such timing (Table 5.5). Panelists did not reach consensus on the optimal start time for rehabilitation with 61% suggesting less than one week and a further 27% and 12% selecting one to three weeks and three to six weeks respectively. Subgroup analysis identified a significant between group difference (p=.01) with patients rating the importance of timing highest followed by PTs, then surgeons. A similar trend was found for optimal start time with all patients suggesting within one week of surgery compared to 59% of PTs and 43% of surgeons. After collapsing response options, 88% of PTs and 86% of surgeons agreed post-acute rehabilitation should start within three weeks of surgery. Additional subgroup analysis revealed that more
Canadians than Americans agreed that external factors influenced the timing of rehabilitation; however, the difference was not statistically significant (p=.07).

**5.4.7.6 Rehabilitation setting**
Consensus was not achieved regarding the importance of rehabilitation setting on optimal outcomes after THA. More than one third (38%) of panelists remained undecided or neutral after three rounds of questions and feedback. Only an outpatient setting was selected as being appropriate with both physical therapy outpatient departments (100%) and private clinics (97%) reaching consensus. Inpatient settings including inpatient departments within the acute care hospital (55%), inpatient rehabilitation facilities (IRFs) (65%) and skilled nursing facilities (SNFs) (55%) did not reach consensus. Home-based rehabilitation approached consensus (77%).

A number of personal and external factors were felt to have strong influences on the selection of rehabilitation setting Table 5.5.

Subgroup analyses revealed that more patients than PTs and surgeons (p=.09) and more clinicians than researchers (p=.06) rated setting as being important for optimal outcomes after THA however, these differences did not reach statistical significance. There was no difference in ratings when Canadian panelists were compared to Americans. An equal percentage of Canadians and US panelists felt that ‘health care systems and policies’ influenced where post-acute rehabilitation was carried out and 20% more Americans agreed that ‘health insurance policies and coverage’ affected choice of settings.

**5.4.7.7 Rehabilitation interventions**
Panelists agreed (88%) that appropriate rehabilitation interventions were important for optimal outcomes after THA. Consensus was reached on a number of specific interventions and those
selected as either ‘appropriate and somewhat important’ or ‘appropriate and very important’ by 80% or more of panelists in round three are shown in Table 5.6.

**Table 5.6 Appropriate and important post-acute rehabilitation interventions after THA**

<table>
<thead>
<tr>
<th>Therapeutic and functional exercises</th>
<th>Electrical/thermal modalities</th>
<th>Manual therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Active ROM</td>
<td>• None reached consensus</td>
<td>• None reached consensus</td>
</tr>
<tr>
<td>• Strength training</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Stretching</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Postural training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Core stability training</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Home exercises</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Static balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Dynamic balance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Stair climbing</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rising/lowering to chair</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Rising/lowering to floor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Getting in/out of car</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Getting in/out of bathtub</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Getting on/off toilet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Dressing</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gait training</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Correct use/progression of walking aids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Correction of altered gait pattern</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Ensuring proper weight bearing status on operated limb</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cardiovascular training</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• None reached consensus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Bolding indicates ≥80% of panelists rated item as “appropriate and very important”

Several interventions were rated as ‘appropriate but not important’ including low to moderate intensity cardiovascular (CV) training, use of CV machines (e.g. stationary bike), pool based exercises, cryotherapy, massage for swelling and scar mobility, passive stretching and proprioceptive neuromuscular facilitation techniques.
Subgroup analysis revealed that patients rated the overall importance of appropriate interventions higher than PTs and surgeons (p<.01) and a greater proportion of patients selected low to moderate intensity CV training as being very important (67%) compared to surgeons (43%) and PTs (35%). There was no difference in ratings on the importance of appropriate interventions for optimal patient outcomes when comparing Canadian and American panelists’ responses (p=.65).

5.4.7.8 Dosage of rehabilitation
Consensus was not reached regarding the importance of the overall dosage of post-acute rehabilitation for optimal patient outcomes and there were no differences in ratings by primary role or country. A number of personal and external factors were felt to influence dosage (Table 5.5)

With further examination of the details of rehabilitation dosage, there was clearly no agreement within or across types of panelists regarding optimal duration with 41% of PTs selecting four to eight weeks (range <4 weeks to 20 – 24 weeks), a majority of surgeons (57%) selecting four to eight weeks (range 4 – 8 weeks to 12 – 16 weeks) and an equal proportion of patients selecting eight to twelve weeks, 12 to 16 weeks and ‘other’ (variable based on individual patient). The total number of treatment sessions was similarly diverse with a majority of PTs (59%) responding that this should be individualized (range 5 – 9 sessions to 36 sessions), an equal number of surgeons selecting five to nine and 10 to 14 sessions (range <5 sessions to 15-19 sessions) and one surgeon suggesting that an individualized prescription was most appropriate. All patients indicated that the number of treatment sessions should be based on individual needs. The preferred frequency of rehabilitation sessions was more consistent with 47% of PTs selecting an individualized approach followed next by two to three times per week (24%). Surgeons felt two to three times per week was most appropriate (43%) and the rest were equally
supportive of the other options. Two of three patients agreed two to three times per week was appropriate.

5.4.7.9 Rehabilitation outcomes
There was strong agreement on the importance of routinely assessing outcomes conceptualized within the ICF including body structure and function (97%) and activity and participation (94%); however, panelists did not reach consensus (62%) on the need to evaluate outcomes not captured by the ICF (e.g., patient satisfaction). Outcomes that were selected by at least 80% of panelists as being both appropriate and important after THA are shown in Table 5.7. Panelists strongly agreed (94%) that both personal and external factors influenced outcomes after THA (Table 5.5).
Table 5.7 Important outcomes to routinely assess and/or monitor after THA

<table>
<thead>
<tr>
<th>Body structure and function outcomes</th>
<th>Activity and participation outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Pain (at rest)</td>
<td>• Static balance</td>
</tr>
<tr>
<td>• Pain (with activity)</td>
<td>• Dynamic balance</td>
</tr>
<tr>
<td>• Pain coping</td>
<td>• Walking speed</td>
</tr>
<tr>
<td>• Sleep functions</td>
<td>• Walking distance</td>
</tr>
<tr>
<td>• ROM (operated joint)</td>
<td>• Stair ascent/descent</td>
</tr>
<tr>
<td>• ROM (other lower limb joints)</td>
<td>• Carrying/lifting</td>
</tr>
<tr>
<td>• Leg length discrepancy (LLD)</td>
<td>• Ability to use public transportation</td>
</tr>
<tr>
<td>• Posture and alignment</td>
<td>• Ability to drive a vehicle</td>
</tr>
<tr>
<td>• Gait (pattern, use of aids)</td>
<td>• Run errands/shop</td>
</tr>
<tr>
<td>• Joint proprioception (position sense)</td>
<td>• Ability to do self care (dressing)</td>
</tr>
<tr>
<td>• Muscle strength (operated limb)</td>
<td>• Ability to attend participate in religious activities (pray, kneel)</td>
</tr>
<tr>
<td>• Muscle strength (non-operated limb)</td>
<td>• Ability to do light household activities (cooking, dusting)</td>
</tr>
<tr>
<td>• Muscle strength (upper limbs)</td>
<td>• Ability to participate in sexual activity</td>
</tr>
<tr>
<td>• Muscle recruitment/voluntary activation</td>
<td>• Ability to perform care giving activities (to child or spouse)</td>
</tr>
<tr>
<td>• Muscle atrophy</td>
<td>• Ability to participate in low-moderate intensity leisure/sporting activities</td>
</tr>
<tr>
<td>• Core stability (trunk/pelvic deep muscle control)</td>
<td>• Ability to participate in paid employment</td>
</tr>
<tr>
<td>• Soft tissue flexibility (contractures)</td>
<td></td>
</tr>
<tr>
<td>• Wound/tissue healing</td>
<td></td>
</tr>
<tr>
<td>• Energy and vigor</td>
<td></td>
</tr>
<tr>
<td>Other outcomes</td>
<td>Outcomes with a combined rating of “somewhat” or “very important” reaching ≥80% agreement</td>
</tr>
<tr>
<td>• Health related quality of life</td>
<td>Bolding indicates that ≥80% of panelists rated item as “very important”</td>
</tr>
<tr>
<td>• Self-efficacy for exercise</td>
<td></td>
</tr>
<tr>
<td>• Self-efficacy for rehabilitation</td>
<td></td>
</tr>
<tr>
<td>• Patient satisfaction with rehabilitation outcomes/process</td>
<td></td>
</tr>
<tr>
<td>• Patient knowledge (e.g. post-operative complications, precautions)</td>
<td></td>
</tr>
<tr>
<td>• Patient global assessment (self rating of how he/she is doing)</td>
<td></td>
</tr>
<tr>
<td>• Health professional/surgeon global assessment (of how patient is doing)</td>
<td></td>
</tr>
</tbody>
</table>

Subgroup analysis was conducted to further examine the lack of consensus on the importance of outcomes not captured by the ICF and revealed non-significant differences by panelist type (p=.11) and primary role (p=.79). More patients (100%) and PTs (88%) felt access to
rehabilitation services influenced patient outcomes than did surgeons (57%) and a similar trend was seen regarding access to health professionals. A similar proportion of Canadian (91%) and American (83%) panelists agreed that access to rehabilitation services influenced outcomes while a much greater number of Canadian panelists (91%) felt access to health professionals was an issue compared to Americans (67%). More Canadian panelists (81%) also felt that a patient’s financial situation affected outcomes than did Americans (67%) and a similar percentage from both countries saw ‘health insurance coverage and policies’ and ‘health care systems and policies’ having an influence.

5.4.7.10 Rehabilitation outcome measurement
Panelists strongly agreed on the importance of using appropriate tools or methods to evaluate body structure and function (97%) and activity and participation (94%) outcomes after primary THA. Consensus was not reached on the importance of such tools to evaluate outcomes not captured by the ICF. Those outcome methods and tools selected as being both important and clinically feasible by 80% or more of the panelists are shown in Table 5.8. Subgroup analysis showed that ratings on the importance of measuring outcomes outside of the ICF in a standardized fashion using appropriate tools differed by provider type (p<.01) with PTs rating this statement higher than patients and surgeons. Clinicians and researchers did not differ in their ratings for this statement.
Table 5.8 Measures and tools considered feasible and important for routine clinical outcome evaluation and/or monitoring after primary THA

<table>
<thead>
<tr>
<th>Body structure and function measures</th>
<th>Activity and participation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Pain visual analogue scale (VAS)</td>
<td>• Timed walk</td>
</tr>
<tr>
<td>• <strong>Numeric pain rating scale (NPRS)</strong></td>
<td>• Timed Up and Go (TUG)</td>
</tr>
<tr>
<td>• Standard goniometer to assess passive ROM</td>
<td>• Single leg static balance test</td>
</tr>
<tr>
<td>• Standard goniometer to assess active ROM</td>
<td>• Repeated stands test (sit-to-stand)</td>
</tr>
<tr>
<td>• Visual observation to assess passive ROM</td>
<td>• Timed stair ascent/descent</td>
</tr>
<tr>
<td>• Visual observation to assess active ROM</td>
<td>• <strong>WOMAC OA Index</strong></td>
</tr>
<tr>
<td>• Tape measure to assess leg lengths</td>
<td>Other measures</td>
</tr>
<tr>
<td>• Visual observation to assess leg lengths</td>
<td>• Numeric rating of patient’s satisfaction with functional outcome</td>
</tr>
<tr>
<td>• Visual observation to assess lower limb alignment</td>
<td></td>
</tr>
<tr>
<td>• Standard goniometer to assess lower limb alignment</td>
<td></td>
</tr>
<tr>
<td>• Visual observation of gait</td>
<td></td>
</tr>
<tr>
<td>• Trendelenburg test</td>
<td></td>
</tr>
<tr>
<td>• Patient’s ability to reproduce target angle (joint position sense)</td>
<td></td>
</tr>
<tr>
<td>• Skin sensation over operated limb</td>
<td></td>
</tr>
<tr>
<td>• Manual muscle testing (e.g. Grades 0–5)</td>
<td></td>
</tr>
<tr>
<td>• Palpation/observation to assess voluntary activation/muscle recruitment</td>
<td></td>
</tr>
<tr>
<td>• Standardized test positions to assess flexibility/muscle lengths (e.g. Thomas Test for hip flexor length)</td>
<td></td>
</tr>
</tbody>
</table>

Bolding indicates ≥80% of panelists rated item as “very important”

5.4.7.11 Follow-up care

Panelists agreed that it was important to monitor patients on a short-term follow-up (FU) basis (88%) after primary THA and neared consensus regarding long-term FU (79%). There was strong support (94%) for the importance of patients having access to appropriate FU services.
within the first two years following THA. However, there was less agreement on who should provide this FU care with only surgeons being identified (91%) as being appropriate to routinely provide FU services in the short-term. The only other providers receiving more than 50% support were PTs (65%) and advanced practice PTs (62%). Results differed by subgroups with 94% of PTs and 67% of patients agreeing surgeons were appropriate, 12% of PTs, 57% of surgeons and no patients suggesting physician assistants were appropriate and 65% of PTs, 29% of surgeons and all patients agreeing PTs were appropriate to provide short-term FU services. Advanced practice PTs were viewed as appropriate FU providers by PTs (82%) but received less support from surgeons (29%) and patients (33%). Roughly one-third of patients, PTs and surgeons felt family practitioners were appropriate to provide short-term FU services. Views on appropriate FU providers also differed by country with more Canadian than American panelists selecting surgeons (96% versus 83%) and advanced practice PTs (77% versus 33%). More Americans felt physician assistants (33% versus 23%) were appropriate and similar proportions of roughly two-thirds for PTs and one-third for family practitioners agreed these provider types were appropriate for routine FU care.

Consensus was not reached on the appropriate schedule of short-term FU visits which ranged from once at six months to ‘6 weeks, 3 months, 6 months, 1 and 2 years’. The schedule selected by the largest number of panelists (21%) was ‘6 weeks, 3 months, 1 and 2 years’. There was a similar lack of agreement on the duration of long-term FU which ranged from one year to ‘life time every 3 years’. The greatest support (32%) was for ‘indeinitely’.

One form of short-term FU care and services achieved 80% support: scheduled FU clinic visit (88%). The only other FU services that reached 50% were telephone support from a health professional as needed (74%) and community-based THA exercise programs (50%). Subgroup analysis by type of provider revealed differing levels of agreement on forms of FU care.
5.4.8 Thematic analysis of comments

Based on the panelists’ comments in round one, two themes emerged. Panelists emphasized the need to distinguish between an early and later phase of post-acute rehabilitation and commented that their selection of various response options was influenced by this overarching theme. (See Table 5.9 for sample comments.) The second theme speaks to the need for an individualized approach regarding several aspects of post-acute rehabilitation. Panelists commented that rehabilitation providers should remain client-centred and focus on each patient’s specific needs, goals and response to treatment (Table 5.9). These themes were integrated into the process by creating three new statements for round two. Two misconceptions were evident from round one. Several panelists confused post-acute care with inpatient care and others needed clarification around provision of rehabilitation versus health monitoring. These issues were addressed through Delphi moderator’s comments in the controlled feedback after round one and the instructions at the beginning of round two.

Two additional themes emerged from round two comments. Panelists felt strongly that professionals required standardized training and clinical experience to provide safe and effective rehabilitation services after THA surgery (Table 5.9). Many queried whether any post-entry level training programs in THA assessment and rehabilitation existed in Canada or the US. This theme was addressed through an additional question in round three. The other theme related to the need to acknowledge different subgroups of patients undergoing THA surgery such as the frail elderly and the young active patient (Table 5.9). Panelists were encouraged to comment on such subgroups further in round three. Comments were invited in the final round; however, new items were not specifically requested as there were no further rounds planned.
### Table 5.9 Sample comments from thematic analysis

<table>
<thead>
<tr>
<th>Theme 1: Need to consider different phases of post-acute rehabilitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Different interventions are appropriate for different stages of recovery as muscles gain strength.”</td>
</tr>
<tr>
<td>“Cardiovascular training should be initiated in the late phase…”</td>
</tr>
<tr>
<td>“In reality a late phase could last through one’s lifetime. Patients should be educated on the importance of exercise after focused rehabilitation.”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Theme 2: Need to individualize treatment approaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>“In a sense, all treatment should be individualized but the general practice guidelines need to be constructed based on the generalized patient needs.”</td>
</tr>
<tr>
<td>“The amount of supervision varies with individuals – hence the need for an individualized approach.”</td>
</tr>
<tr>
<td>“[Rehabilitation duration] is entirely patient specific, could be less than four weeks right through to 6 months.”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Theme 3: Need for standardized rehabilitation provider training</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Knowledge translation and dissemination of latest research findings to the clinicians involved in front line care should be a priority.”</td>
</tr>
<tr>
<td>“A background in rehabilitation knowledge and skills for THA patients is essential for providing the best quality of care.”</td>
</tr>
<tr>
<td>“…some sort of standard accreditation or designation would raise the standard on quality of care by clinicians.”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Theme 4: Recognizing different subgroups of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>“In order for a patient to be a good candidate for ‘indirect or reduced supervision’, the patient must be ideal for this type of rehab… there are a number of low needs, highly motivated, educated patients who would fit this model very well.”</td>
</tr>
<tr>
<td>“Some people are never going to be able to cross country ski nor run marathons and they should not be used as a standard optimum goal. Younger people with less joint damage will likely out perform older, more damaged patients.”</td>
</tr>
</tbody>
</table>

### 5.5 Discussion

This study is the first to assemble a diverse panel of Canadian and American health professionals, researchers and patients and employ the Delphi method to identify best practices
for post-acute rehabilitation following primary THA for OA. Further, it couched the recommendations within the ‘real world’ by identifying personal and environmental contextual factors (including institutional and systems-level factors) that can’t be ignored. Such factors may serve to either facilitate or hinder the ability to apply rehabilitation best practices in this rapidly growing population and in two very different health care systems.

Consensus was reached in 22 of 33 potential statements, yet a number of key areas of rehabilitation planning, delivery and outcome evaluation remained uncertain after three rounds of discussion. The trend of growing convergence in opinion and greater number of statements reaching consensus over the three rounds is evidence of the Delphi process at work (34, 41, 42). Critics of the Delphi argue this phenomenon is nothing more than the natural tendency of panelists to conform to the majority view (34, 41, 42), while proponents of this method suggest that the quantitative and qualitative feedback works in a constructive way to help panelists who are out of line with the group opinion to refine their judgments (42).

Several THA rehabilitation topics did not achieve consensus nor was a trend towards greater agreement evident after three rounds. Whether additional rounds would have led to consensus on these statements is not known; however, examination of their mean ratings and SDs suggested this was unlikely. Disparate opinions regarding rehabilitation format, setting, dosage and specific treatment interventions are strongly entrenched in local practices/customs and widely reported (9, 10, 35, 43).

Subgroup analyses revealed significant between group differences when comparing the ratings of PTs, patients and surgeons in regard to appropriateness of differing levels of supervised rehabilitation and the importance of timing, appropriate interventions, dosage and outcomes not captured by the ICF. No significant differences were found comparing clinicians’ and
researchers’ and Canadian and American panelists’ ratings on the key statements. Descriptive analysis of individual items, however, revealed some marked differences by provider type, primary role and country. For example, more Canadian (77%) than American panelists (33%) indicated advanced practice PTs were appropriate to provide short-term FU care. This difference may be partially explained by our differing health care systems, and designations of health professionals as the ‘advanced practice’ designation in physical therapy is not formally recognized in the US (A. Guccione, US Department of Veterans Affairs, Health Services Research and Development Service, January 7, 2010).

Outcome measurement is another area of THA rehabilitation for which there remained marked uncertainty and dissenting views within the Delphi panel. Further, as much as 36% of panelists were unfamiliar with some of the most commonly reported tools, including the Harris Hip Score and Short Form-12 health status instrument. Riddle et al. suggest that the inconsistency in use of outcome measures makes clinical interpretation of treatment effects problematic (44) and are undertaking a consensus process to identify a core set of outcome measures for use in research trials (45). Our Delphi process has provided a baseline for a similar initiative for use of outcome measures in clinical practice.

Our study clearly shows the importance of identifying and acknowledging the large and varied number of personal and external factors that play significant roles in the delivery and outcomes of THA rehabilitation. While several panelists commented that health provider attitudes and health care policies and funding should not influence one’s need for post-acute rehabilitation, more than three quarters acknowledged these and other contextual factors did indeed influence whether a patient was offered structured rehabilitation. Preoperative screening received mixed support yet was suggested as being useful in identifying those personal and provider-level factors that can be modified or addressed.
While a number of therapeutic interventions including ROM exercises, strength and gait training were recommended following THA, treatment details such as key muscle groups to address and specifics of exercise prescription and progression, were not captured by this study. There remains a paucity of high quality research supporting any one form of treatment and optimal treatment dosage in this population (11) thus leaving the clinician to rely more heavily on clinical judgment and individual patient results to guide treatment. While clinician experience and patient values and preferences are important elements of evidence-based practice, there remains a need for increased research on effectiveness of rehabilitation interventions and greater dissemination of already published information on the value of specific approaches.

5.5.1 Strengths and limitations

There is no “gold standard” for achieving consensus and developing practice guidelines in the absence of a large body of research evidence (21). Therefore, we used a rigorous method to ensure validity, objectivity and transparency while remaining feasible with regard to overall expense and burden on study participants. Every effort was made to ensure representation from different patients, health care disciplines, practice settings and geographical locations to ensure diverse views and expertise. The decision to include consumer experts is somewhat controversial and the dilemma is likely rooted in the varied definitions of the term ‘expert’. While recent Delphi processes in the area of rheumatology have not included patients or consumers in their ‘expert panels’ (29-31), we felt it was critical to recognize the lived experience of undergoing a THA as a form of expertise. Consumer involvement in all stages of guideline development is an important element that is often overlooked (46). Further, our novel approach of giving patients ‘veto power’ over items that would otherwise be omitted from subsequent rounds ensured that patient-centred care was given utmost priority and resulted in 21 retained items through round three. We are not aware of other published reports using this approach.
For the Delphi method to be successful and its results to be both credible and applicable, the participants must complete all rounds of the survey. Our response rates (94% - 95%) in each of the three rounds exceed (47, 48) or are similar to (49) other Delphi studies in related fields. While response rates of 100% are very rare in Delphi surveys (50), the controlled feedback provided after rounds one and two encourages panel members to become involved and to stay motivated. Active involvement of stakeholders early in the process of guideline development helps participants realize and feel that they are partners in the study, whose judgments will ultimately influence the clinical recommendations and best practice statements for THA rehabilitation. This also leads to the perception of ownership by panel members and greater acceptance of the findings. By providing clear controlled feedback after rounds one and two, along with frequent reminders, thank-you cards, timely technical support and an honorarium, we believe we encouraged panelist engagement and motivation.

A number of limitations are also worth noting. The higher number of surgeon drop outs (4 of 5) than other professionals may have led to non-response bias in which those who did not complete all three rounds systematically differed in their views on the various components of post-acute rehabilitation from those who completed the survey. A delay in starting the Delphi survey due to recruitment difficulties and subsequent change to the original time frame may have contributed to panelist drop out. As well, with the majority of panelists serving on both the THA and TKA panel, respondent burn out may have led to some panelists leaving before completing the final round.

With the researchers’ extensive professional affiliations and collaborations, there exists the possibility of response bias in that panelists may have answered questions in the way they thought the researchers wanted them to answer rather than according to their true beliefs. To
address this potential form of bias, we pilot tested the first questionnaire to check for leading questions and were careful to provide a range of views through the controlled feedback.

Using time stamps, we were able to calculate the length of time panelists took to complete each questionnaire (round) and discovered that three panelists took less than 20 minutes (outside the standard deviation) in each of the three rounds. This threatens the validity of the Delphi results and suggests that a thorough review of questionnaire instructions, reference to the controlled feedback and reflection on one’s previous ratings likely did not occur. Snap judgments undermine the Delphi method and lead to conformist pressure in succeeding rounds (34).

To maintain a manageable size for the Delphi survey, we limited the number of panelists in each stakeholder group while ensuring broad representation. One could argue that involving only three patient experts would not likely reflect the range of rehabilitation experiences and outcomes typical following THA surgery. However, we feel giving patients ‘veto power’ over items to that would otherwise be dropped helped to ensure that their views remained at the forefront. It is unlikely that the subgroup analyses had sufficient power to detect statistically significant differences between groups; however, in several cases, such differences were observed and suggest real and important differences in opinion regarding some aspects of post-acute rehabilitation.

There were a number of challenges to identification and recruitment of panelists from all parts of Canada and the US, which may bring into question the representativeness of the panel (see Appendix K). With differences across provinces and states in the organization and delivery of health care services, it is likely that some important contextual and practice issues were not taken into account. It is suggested that the only way to test the validity of the recommendations
developed by a given panel of experts is to replicate the process to confirm the findings with a different sample of similarly experienced panelists (34, 51).

5.6 Conclusion

After a three-round Delphi survey, expert panelists reached consensus on 22 statements related to post-acute rehabilitation after primary THA. Panelists agreed on the need for structured rehabilitation, importance of preoperative screening, use of trained health professionals to provide rehabilitation, importance of timing, appropriate interventions and FU services, and routine use of outcome measurement. The importance of setting and specifics of treatment dosage, format and timing did not reach consensus and continued to generate new ideas and comments through the three rounds. A number of personal and external factors were felt to influence various aspects of the delivery and outcomes of care.

Subgroup analysis revealed statistically significant differences in several aspects of rehabilitation delivery and outcome assessment when comparing by panelist type, professional role and country. This supports the importance of multidisciplinary input when creating guideline recommendations.

5.6.1 Clinical implications

Our findings suggest that:

- Early intervention by trained health professionals following THA is important for optimal outcomes. The need for ‘trained’ health professionals means that education to develop, maintain and upgrade skills of practicing health professionals is important. The recommendation (88% agreement) for standardized training on THA rehabilitation may prompt universities and colleges across Canada and the US to standardize the relevant entry level curriculum for medical and allied health professional students. This may also
encourage health regions and major rehabilitation providers to standardize treatment approaches within and between their facilities and organizations. Timing of post-acute rehabilitation is important and panelists recommended it be started within three weeks of THA surgery. This information needs to be conveyed to administrators and policy makers to ensure adequate service delivery post-op (e.g., increased funding to acute care hospitals for more THA surgeries needs to translate into ‘downstream’ increases in resources allocated for post-acute rehabilitation).

- The panel recommends a multi-phased approach to post-acute rehabilitation (based on stages of tissue healing and recovery of muscle function) regardless of the setting or format (e.g., level of supervision, group versus 1 to 1 care). Both health professionals and patients need to understand this important concept as failure to do so may lead to the prescription of inappropriate exercises at the wrong time and less favorable outcomes.

- The panel strongly recommends inclusion of the following components in the routine assessment of patients following THA:
  - Numeric pain rating scale to assess pain at rest and with activity
  - Manual muscle testing to assess muscle strength
  - Visual observation of gait
  - Dynamic balance (technique not specified)
  - Ability to manage stairs
  - Ability to perform self-care

- And the following therapeutic interventions:
  - Dynamic balance training
  - Stair climbing
  - Rising/lowering to chair
- Gait training including use/progression of walking aids, correction of altered gait pattern and ensuring proper weight bearing on operated leg
- Patient education (e.g., how to monitor for post-op complications, position/movement restrictions, return to driving)
- Home exercises

- Although consensus was not achieved with respect to the optimum dosage and format for rehabilitation, the panel agreed that type of intervention (88%) and neared agreement (77%) that overall dosage affect outcome after THA.

Finally, the panel unanimously agreed that both personal and external factors influence patient outcomes and that health professionals cannot forget the need to consider individual patient needs and preferences when designing and implementing post-acute THA rehabilitation.

### 5.6.2 Implications for future research

A number of questions arise from this study that could be addressed through future research.

Most obviously, the specifics on rehabilitation dosage (duration, frequency, number of treatments) warrant investigation through well designed controlled trials in which one or more of these dosage parameters are altered. Calculating a dose-response relationship would provide clinicians and decision makers with important information on the optimal amount of rehabilitation care following THA and contribute to the establishment of standardized care.

Another Delphi survey or smaller face-to-face consensus meeting of highly experienced rehabilitation providers is needed to identify the details of the key therapeutic interventions such as strength, gait and balance training. Additionally, more high quality trials need to be undertaken to determine which interventions have the greatest effects on both the rate of recovery and short- and long-term outcomes after THA coupled with the fewest adverse events. A staged approach to post-acute rehabilitation is suggested yet further work will need to be done.
to identify the key features of each stage and the most appropriate providers, settings, interventions and outcome measures.

The influence of patient expectations, attitudes and engagement in the rehabilitation process on the delivery and outcomes of care would benefit from further exploration so that rehabilitation programs and interventions can be tailored to individual preferences and circumstances. Allowing for greater patient choice in rehabilitation format, level of supervision, setting and follow-up care poses methodological challenges in RCTs; however, better adherence to therapeutic regimes and post-operative outcomes may be achieved.

Pre-operative screening to identify those individuals with the greatest need for structured rehabilitation, at risk for poor outcomes or likelihood of delayed recovery is an area for more research. Development of a screening tool and decision-making algorithm may help to ensure the appropriate provider, setting, format and types of rehabilitation and follow-up care are available to those patients demonstrating the greatest need. Further, such a tool would help to identify other subgroups of patients who may respond more or less favourably to certain rehabilitation approaches as suggested in our findings.

Finally, future research should assess the final practice guideline recommendations using standardized assessment methods and tools as identified in this study and related research (45) to permit the evaluation and comparison of current and emerging rehabilitation practices on patient outcomes and costs in varied health care settings and contexts in Canada and the US.

This study used a rigorous consensus method to develop recommendations on important and clinically feasible multidisciplinary rehabilitation practices and patient outcomes after THA. Ultimately, this work will lead to better service delivery and begin to develop a standard for
rehabilitation care for the hundreds of thousands of Canadians and Americans undergoing THA surgery each year.
5.7 References


8. Troughton D, Pearce J. Total hip and knee replacement survey: Rehabilitation practices through the continuum of care. Rehabilitation Services, Vancouver Island Health Authority; 2007.


35. Westby MD, Backman CL. Patient and health professional views on rehabilitation practices and outcomes following total hip and knee arthroplasty: A focus group study. Submitted 2009 Sep 3.


Chapter 6: Developing consensus on best practice recommendations for total knee arthroplasty rehabilitation: A Delphi study

6.1 Background

The North American population is becoming older, more sedentary and more overweight. As a result, the number of individuals developing hip and knee osteoarthritis (OA) is on the rise (1, 2) and elective total joint arthroplasty (TJA) surgery is in increasingly greater demand (3). More than 35,300 primary total knee arthroplasty (TKA) surgeries were performed in Canada in 2006/07 (not including Quebec) (4) and 0.6 million in the United States (US) in 2007 (5). By far the majority of joint replacements are carried out for end-stage OA when conservative treatments have failed. It is estimated that costs for TKA surgery and the six month-period following average $14,700 per patient thus costing the Canadian health care system more than $557 million per year (4, 6). This figure is disproportionately higher in the US at more than $17.65 billion annually (based on 2005 data) (7).

While significant attention and resources have been directed toward managing TJA waiting times in Canada and optimizing surgical techniques, prosthetic materials and in-hospital care pathways, little attention has been directed at post-acute rehabilitation and its impact on long-term outcomes. Questions about optimal rehabilitation interventions, settings, timing and dosage remain unanswered as evidenced by significant rehabilitation practice variation both locally (8, 9) and internationally, (10-12) as well as by the lack of clinical practice guidelines (CPG) (10, 12). An apparent lack of agreement on routine or standard TKA rehabilitation against which new

6 A version of this chapter will be submitted for publication. Westby MD, Brittain A, Liang M, Raglin Block M, Backman CL. Best practices for post-acute rehabilitation following primary total knee arthroplasty for osteoarthritis: A Delphi study.
interventions are compared is also evident from the published trials of TKA physiotherapy interventions (13). A 2003 NIH consensus conference acknowledged that the use of rehabilitation services is perhaps the most understudied aspect of the peri-operative management of TKA patients (14). To date, little progress has been made towards this end.

It is suggested that current rehabilitation approaches following TKA are insufficient as evidenced by the numerous reports of prolonged physical impairment and activity limitations as much as two years post-surgery (15-19). Our Cochrane systematic reviews of post-acute physiotherapy interventions following primary TKA revealed marked heterogeneity in rehabilitation practices and a lack of available evidence to suggest any one approach is clearly superior to another regarding pain, function and health related quality of life (HRQoL) (13).

6.1.1 Clinical practice guidelines and the Delphi method

Clinical practice guidelines are based on the best available scientific evidence and expert opinion and inform clinical decision-making in areas of health care for which there are noticeable gaps between evidence and practice and unexplained practice variation (20, 21). With the aforementioned limitations in the evidence base for post-acute physiotherapy after TKA, guidelines will need to be based to some extent on expert opinion and consensus from a diverse panel of relevant stakeholders (22).

The Delphi group process is a formal and established survey method that makes best use of the available research evidence and the collective experiences and knowledge of the participants (23) and has been used previously for guideline development (22, 24) in the fields of rheumatology (25, 26) and orthopaedics (27).

As described in chapter 5.1.2, the Delphi method involves a series of three or more questionnaires (rounds) and uses quantitative and qualitative feedback to help panelists refine
responses and move towards consensus on key discussion points (28). Panelists and their responses remain anonymous through all rounds of the Delphi survey thus encouraging equal contributions and minimizing pressure to conform to the views of more influential members (22, 29). To date, no formal consensus process has not been undertaken to establish guidelines for post-acute TKA rehabilitation.

6.2 Purpose
The aim of this study was to incorporate health professional expertise and patient experience with the available research evidence to achieve consensus on best practice recommendations for rehabilitation following TKA.

6.3 Methods
6.3.1 Participants
Invited panelists included individuals who had undergone TKA surgery (patient experts); orthopaedic surgeons and rehabilitation health care professionals from a variety of disciplines (clinician experts); leading researchers in the field (research experts); and representatives from key rehabilitation and research institutions (clinician and research experts, decision makers). Group diversity was again important to ensure a wide range of perspectives was incorporated (22).

6.3.2 Sampling, recruitment and panel composition
Using the purposive sampling and panelist recruitment methods described in chapter 5.3.2 and 5.3.3, we assembled a diverse panel of approximately 40 experts from across Canada and the US. As stated previously, only those individuals who intended to complete all Delphi rounds were selected to participate.
6.3.3 The Delphi questionnaires (rounds)

The identical methods described in chapter 5.3.2 were undertaken to prepare the panelists prior to the first round and reinforce the evidence-based nature of the Delphi exercise (22, 30-32). The first questionnaire was pilot tested with the same group of patients and health professionals and any concerns related to clarity and leading questions were addressed (29, 33, 34).

Each of the 10 sections of the first questionnaire addressed different components of TKA rehabilitation (Appendix H). Panelists rated their level of agreement on individual statements using a five-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral/no opinion, 4=agree, 5=strongly agree) and were instructed to provide comments and/or justification for their responses at the end of each section. Specific rehabilitation parameters and contextual factors derived from our earlier research (13, 35) and the related literature (36-39) were included in several sections. One additional section was added to round two based on panelist comments. (See Appendix I for example of round three questionnaire).

Descriptive group statistics (mean, standard deviation, range), individual responses and comments were fed back to panelists after rounds one and two (28, 40). Panelists were asked to review and reflect on this controlled feedback before responding to the subsequent round (28, 41, 42). As with the THA survey, this iterative process was completed over the same six-month period and discontinued after three rounds to avoid ‘response exhaustion’ among participants.

The questionnaires were created and administered using The Arthritis Research Centre of Canada’s Research Survey System (©2008) (https://dq.arthritisresearch.ca) which enabled panelists to log-on and access both the TKA and THA questionnaires at any time (24/7). The online format was selected by all panelists.
As described earlier, efforts were made to maximize response rates through three rounds including use of regular reminders, personalized thank you cards and a $100 honorarium (42).

6.3.4 Ethics
The University of British Columbia Behavioural Research Ethics Board (Appendix C) and the Vancouver Coastal Health Research Institute provided approval for panelists to participate in one or both Delphi surveys as appropriate. Completion of the first round questionnaire was confirmation of panelists’ consent. Participants were assured anonymity during the Delphi rounds and only those who gave permission will be acknowledged by name in publications (Appendix L).

6.3.5 Data collection and analysis
The details of the data collection, criteria for retaining or eliminating Delphi items for subsequent rounds and the novel ‘patient veto’ approach are described in chapter 5.3.5 (24, 41). As per the THA Delphi study, 80% was set as the needed level of agreement to achieve consensus on key statements and individual items. Panelists were advised of these procedures prior to the first round.

After each round, the mean, standard deviation (SD), range and level of consensus (percentage of respondents who selected “agree” or “strongly agree” for a given statement) were calculated for rated items (interval data). Percentage of panelists who selected “yes” (e.g., percentage of respondents who selected an item as being important) was determined for dichotomous items (33). The mean represents group agreement while the SD represents the amount of disagreement within the group (34). In round three, panelists were asked to further rate items related to rehabilitation interventions, outcomes and outcome measurement according to their perceived importance or clinical feasibility (Appendix I).
We applied the same rationale and approach described in Chapter 5.3.5 to analyze select findings by subgroups established \textit{a priori}: 1) Panelist type (PT, surgeon or patient); 2) Professional or primary role (clinician/surgeon or researcher/academic); and 3) Country (Canada or US). Group mean scores were compared using one-way ANOVA (SPSS Version 17, SPSS Inc., Chicago, IL). Categorical data were analyzed descriptively by the various subgroup variables.

Panelists’ comments and suggestions for new items were carefully reviewed after each round and the number of new topics/items recorded (33). A thematic analysis was performed to identify recurring and important topics and group them into key themes (40). Positive (supportive), negative (unsupportive) and outlier comments along with the key themes were fed back to panelists approximately 10 days before the next round (22, 32). Panelists were instructed to review and refer to this controlled feedback while completing the next round. New items were added to rounds two and three based on panelists’ suggestions in the previous round.

\section*{6.4 Results}

\subsection*{6.4.1 Panelist demographics}

Panelists represented a broad range of stakeholders in post-acute rehabilitation after TKA in Canada and the US (Table 6.1). All panelists reported English was their first language, they had completed undergraduate degrees or higher and were retired. Patients had all participated in some form of structured rehabilitation, including individual and group treatment, for an average of eight (SD=0) weeks following their TKA. The professionals included PTs (n=21), other allied health professionals (AHPs) (n=4), surgeons (n=9), and other physicians (n=5). As with the THA panel, the greater proportion of PTs was planned. Just over half of professional panelists reported 5 – 14 years of experience in TKA care, another 13% had 15 - 24 years and 28% had 25 or more...
years of experience. Roughly one third of professionals’ saw between 1 - 100, 100 – 199, and ≥200 patients each year.

Table 6.1 TKA panelists’ demographics

<table>
<thead>
<tr>
<th></th>
<th>Clinicians/ Surgeons (n=22)</th>
<th>Academics/ Researchers (n=14)</th>
<th>Other* (n=3)</th>
<th>Patients (n=3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD)</td>
<td>47 (9)</td>
<td>46 (8)</td>
<td>52 (10)</td>
<td>71 (8)</td>
</tr>
<tr>
<td>Gender (% female)</td>
<td>55%</td>
<td>50%</td>
<td>33%</td>
<td>33%</td>
</tr>
<tr>
<td>Canadian residents (%)</td>
<td>68%</td>
<td>43%</td>
<td>33%</td>
<td>33%</td>
</tr>
</tbody>
</table>

Manager (n=2) and educator (n=1)

6.4.2 Response rates

Fifty-seven professionals and three patients (n=60) were invited to participate on the TKA and/or THA panel; of these, 47 (78%) agreed to serve on the TKA panel and were sent the pre-reading package. Thirty four of the professionals participated on both panels. One patient was removed from the panel after admitting he did not meet the specific inclusion criteria and was replaced. Two physicians requested to be removed from the panel prior to the start of round one due to other commitments. The response rates ranged from 93% to 95% in each round (Table 6.2). Main reasons for not completing a round were time constraints and travel during the study period. Only panelists who completed the previous round were included in the subsequent round.
Table 6.2 TKA panelists’ response rates by rounds

<table>
<thead>
<tr>
<th></th>
<th>Round 1</th>
<th>Round 2</th>
<th>Round 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invited to participate</td>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agreed to participate</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dropped out before start of round</td>
<td>2*</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sent questionnaire</td>
<td>45</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>Completed questionnaire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• By deadline (10 days)</td>
<td>21 (47%)</td>
<td>17 (40%)</td>
<td>16 (40%)</td>
</tr>
<tr>
<td>• After 1 reminder</td>
<td>12 (27%)</td>
<td>12 (29%)</td>
<td>17 (43%)</td>
</tr>
<tr>
<td>• After 2 or more reminders</td>
<td>9 (20%)</td>
<td>11 (26%)</td>
<td>5 (12%)</td>
</tr>
<tr>
<td>Total completed round</td>
<td>42 (93%)</td>
<td>40 (95%)</td>
<td>38 (95%)</td>
</tr>
</tbody>
</table>

*Patient who dropped out was replaced

6.4.3 Response times

Panelists were given 10 days to complete each round; however, less than half met this deadline in each of the rounds (Table 6.2). In total, it took six, five and four weeks to complete rounds one, two and three respectively. On average, it took 50 to 54 minutes to complete the TKA questionnaire in each round.

6.4.4 Round one results

Consensus was achieved for 19 of 28 key statements (Table 6.3). Consensus was not reached in statements pertaining to indirect and reduced professional supervision, rehabilitation setting, long-term patient follow-up, and assessment and tools related to outcomes not captured within the ICF framework. These were also the areas in which there were the greatest number of comments and new items/options suggested. Of the 94 items that did not reach the 50% cut off
point, 22 were selected by two or more patient panelists and therefore brought forward to round two. Fifty-seven new options were suggested in round one.

6.4.5 Round two results

Consensus was achieved for 22 of 32 key statements – this total of 32 reflects four new key statements that were not included in round one (Table 6.3). The same items noted in round one, as well as topics related to pre-operative screening and a rehabilitation maintenance phase still did not reach consensus in round two. Forty-three new options were suggested in this round and 38 were below the 50% cut off point. The patient veto process resulted in 17 items being carried forward to the final round. There were 32% fewer comments in this round compared to round one.
Table 6.3 Level of agreement by Delphi round

<table>
<thead>
<tr>
<th>Section/Statement</th>
<th>Round 1 (n=42)</th>
<th>Round 2 (n=40)</th>
<th>Round 3 (n=38)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent</td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td><strong>New</strong></td>
<td>agreement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to recognize an early &amp; late phase b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important to recognize a maintenance phase b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Need to acknowledge individual needs b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Patients should be offered structured rehabilitation</td>
<td><strong>95%</strong></td>
<td>4.6 (0.9)</td>
<td>1-5</td>
</tr>
<tr>
<td>Importance of screening pre-operatively to assess need for rehabilitation</td>
<td><strong>81%</strong></td>
<td>4.1 (1.0)</td>
<td>2-5</td>
</tr>
<tr>
<td>Influence of personal factors on need</td>
<td><strong>88%</strong></td>
<td>4.3 (0.9)</td>
<td>2-5</td>
</tr>
<tr>
<td>Influence of external factors on need</td>
<td><strong>83%</strong></td>
<td>4.0 (0.9)</td>
<td>2-5</td>
</tr>
<tr>
<td>B. Rehabilitation should be provided by professionals with TKA knowledge &amp; experience</td>
<td><strong>100%</strong></td>
<td>4.7 (0.5)</td>
<td>4-5</td>
</tr>
<tr>
<td>Standardized training on TKA rehabilitation should be available for health professionals b</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a Percent agreement based on combined number of ‘agree’ and ‘strongly agree’ responses

b New theme/topic added in Round 2 or 3

Note: Bolded numbers indicate 80% consensus reached
Table 6.3 Level of agreement by Delphi round (continued)

<table>
<thead>
<tr>
<th>Section/Statement</th>
<th>Round 1</th>
<th>Round 2</th>
<th>Round 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent agreement</td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td><strong>C. Need for direct supervision by health professional</strong></td>
<td>86%</td>
<td>4.3 (0.9)</td>
<td>2-5</td>
</tr>
<tr>
<td>Indirect/reduced supervision by health professional is appropriate</td>
<td>43%</td>
<td>2.9 (1.2)</td>
<td>1-5</td>
</tr>
<tr>
<td>Self-directed (no supervision) is appropriate</td>
<td>10%</td>
<td>1.7 (1.0)</td>
<td>1-5</td>
</tr>
<tr>
<td><strong>D. Timing of rehabilitation is important for outcomes</strong></td>
<td>100%</td>
<td>4.7 (0.5)</td>
<td>4-5</td>
</tr>
<tr>
<td>Influence of personal factors on timing</td>
<td>52%</td>
<td>3.4 (1.3)</td>
<td>1-5</td>
</tr>
<tr>
<td>Influence of external factors on timing</td>
<td>64%</td>
<td>3.4 (1.2)</td>
<td>1-5</td>
</tr>
<tr>
<td><strong>E. Setting for rehabilitation is important for outcomes</strong></td>
<td>69%</td>
<td>3.8 (1.1)</td>
<td>2-5</td>
</tr>
<tr>
<td>Influence of personal factors on setting</td>
<td>81%</td>
<td>4.0 (0.7)</td>
<td>2-5</td>
</tr>
<tr>
<td>Influence of external factors on setting</td>
<td>86%</td>
<td>4.0 (0.9)</td>
<td>1-5</td>
</tr>
<tr>
<td><strong>F. Appropriate rehabilitation interventions are important for outcomes</strong></td>
<td>95%</td>
<td>4.7 (0.6)</td>
<td>2-5</td>
</tr>
<tr>
<td><strong>G. Dosage of rehabilitation is important for outcomes</strong></td>
<td>Not asked (technical error)</td>
<td>88%</td>
<td>4.2 (0.7)</td>
</tr>
<tr>
<td>Influence of personal factors on dosage</td>
<td>95%</td>
<td>4.3 (0.6)</td>
<td>2-5</td>
</tr>
<tr>
<td>Influence of external factors on dosage</td>
<td>79%</td>
<td>3.9 (0.9)</td>
<td>2-5</td>
</tr>
</tbody>
</table>
Table 6.3 Level of agreement by Delphi round continued

<table>
<thead>
<tr>
<th>Section/Statement</th>
<th>Round 1</th>
<th></th>
<th>Round 2</th>
<th></th>
<th>Round 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent agreement</td>
<td>Mean (SD)</td>
<td>Range</td>
<td>Percent agreement</td>
<td>Mean (SD)</td>
<td>Range</td>
</tr>
<tr>
<td>H. Routinely assessing body structure/function outcomes is important</td>
<td>98%</td>
<td>4.5 (0.6)</td>
<td>3-5</td>
<td>100%</td>
<td>4.4 (0.5)</td>
<td>4-5</td>
</tr>
<tr>
<td>Routinely assessing activity/participation outcomes is important</td>
<td>98%</td>
<td>4.5 (0.6)</td>
<td>3-5</td>
<td>98%</td>
<td>4.3 (0.5)</td>
<td>3-5</td>
</tr>
<tr>
<td>Routinely assessing other outcomes is important</td>
<td>62%</td>
<td>3.7 (0.9)</td>
<td>1-5</td>
<td>60%</td>
<td>3.6 (0.8)</td>
<td>2-5</td>
</tr>
<tr>
<td>Influence of personal factors on outcomes</td>
<td>95%</td>
<td>4.3 (0.6)</td>
<td>3-5</td>
<td>100%</td>
<td>4.4 (0.5)</td>
<td>4-5</td>
</tr>
<tr>
<td>Influence of external factors on outcomes</td>
<td>86%</td>
<td>4.0 (0.9)</td>
<td>1-5</td>
<td>98%</td>
<td>4.1 (0.5)</td>
<td>2-5</td>
</tr>
<tr>
<td>I. Using appropriate tools to measure body structure/function outcomes is important</td>
<td>98%</td>
<td>4.4 (0.6)</td>
<td>2-5</td>
<td>100%</td>
<td>4.4 (0.5)</td>
<td>4-5</td>
</tr>
<tr>
<td>Using appropriate tools to measure activity/participation outcomes is important</td>
<td>98%</td>
<td>4.3 (0.6)</td>
<td>2-5</td>
<td>98%</td>
<td>4.3 (0.6)</td>
<td>2-5</td>
</tr>
<tr>
<td>Using appropriate tools to measure other outcomes is important</td>
<td>57%</td>
<td>3.7 (0.8)</td>
<td>2-5</td>
<td>68%</td>
<td>3.8 (0.7)</td>
<td>2-5</td>
</tr>
<tr>
<td>J. Short-term patient follow-up is important</td>
<td>93%</td>
<td>4.4 (0.7)</td>
<td>2-5</td>
<td>90%</td>
<td>4.3 (0.8)</td>
<td>1-5</td>
</tr>
<tr>
<td>Long-term patient follow-up is important</td>
<td>71%</td>
<td>3.9 (1.1)</td>
<td>2-5</td>
<td>78%</td>
<td>3.9 (0.9)</td>
<td>2-5</td>
</tr>
<tr>
<td>Access to appropriate follow-up services is important</td>
<td>95%</td>
<td>4.4 (0.7)</td>
<td>2-5</td>
<td>95%</td>
<td>4.3 (0.7)</td>
<td>2-5</td>
</tr>
</tbody>
</table>
6.4.6 Round three results

Consensus was reached on a further two statements for a total of 24 key statements – the total of 33 reflects one new statement not included in previous rounds (Table 6.3). One item reached ‘negative consensus’ in that more than 80% of panelists disagreed or strongly disagreed that ‘unsupervised’ rehabilitation (i.e. no direct contact with a rehabilitation provider) was appropriate after TKA. Consensus was not reached on the importance of setting on patient outcomes, the specifics of dosage (frequency, duration, number of visits), format (including level of supervision) and optimal timing (start of rehabilitation). Additionally, there was no agreement on the importance of outcomes and outcome measurement not captured within the ICF framework. Personal and external factors were felt to influence several components of rehabilitation and outcomes (Table 6.4). Statements not reaching consensus continued to have the greatest range of scores, largest standard deviations and greatest numbers of comments.
### Table 6.4 Influence of personal and external factors by section

<table>
<thead>
<tr>
<th>Personal factors</th>
<th>Need for rehab</th>
<th>Timing</th>
<th>Setting</th>
<th>Dosage</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>General health</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Other symptomatic joints</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain status</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Healing/wound status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-op complications</td>
<td></td>
<td></td>
<td></td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Functional status</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Fitness/physical activity level</td>
<td>●</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Psychological status</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Mental/cognitive status</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Patient expectations</td>
<td>●</td>
<td></td>
<td></td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Patient attitude</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>Patient engagement</td>
<td></td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical response to rehabilitation</td>
<td></td>
<td></td>
<td></td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>Patient adherence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External factors</th>
<th>Need for rehab</th>
<th>Timing</th>
<th>Setting</th>
<th>Dosage</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support of spouse/family</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Access to rehabilitation professionals</td>
<td></td>
<td></td>
<td></td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Waiting list for rehabilitation services</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to rehabilitation programs</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Access to transportation</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Health insurance policies/coverage</td>
<td></td>
<td>●</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health care system/policies</td>
<td></td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health professional skills</td>
<td></td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgeon skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>●</td>
</tr>
</tbody>
</table>

Contextual factors achieving ≥80% agreement in round 3
6.4.7 Results by sections

6.4.7.1 Rehabilitation phases
This section was added after round one in response to panelists’ comments. While panelists strongly agreed (97%) that it was important to differentiate between an early and late phase of post-acute rehabilitation, there was no consensus on the duration of each phase. Suggestions for early phase ranged from three to 16 weeks with six weeks being selected most often. Late phase suggestions ranged from 12 weeks to 12 months with both extremes of range receiving the most frequent endorsement. Subgroup analysis revealed that patients, PTs and surgeons provided similar ratings on the need to acknowledge early and late phases. There was no consensus on the need for a maintenance phase with surgeons rating this lower than that of patients and PTs (p=.07). Panelists strongly agreed (97%) on the need for an individualized approach to post-acute rehabilitation.

6.4.7.2 Need for post-acute rehabilitation
There was strong support for the need for post-acute rehabilitation (95%) and this was consistent with subgroup analysis by panelist type and country. Pre-operative screening to identify patients in need of post-acute rehabilitation was viewed as important; however, it did not reach consensus (76%) and did not differ significantly by panelist type, primary role or country. Panelists recognized that personal and external factors influenced the need for rehabilitation (Table 6.4).

6.4.7.3 Rehabilitation providers
There was strong support (97%) for trained health professionals providing post-acute rehabilitation after TKA; however, this differed by subgroup with more clinicians than researchers supporting this recommendation (p=.04). Physical therapists were the only health professionals identified as being appropriate to provide post-acute rehabilitation. Advanced practice PTs (70%), rehabilitation or PT assistants (70%), and occupational therapists (OTs)
(65%) were the other providers achieving more than 50% support. After three rounds, there remained marked uncertainty amongst panelists regarding the appropriateness of nurse practitioners, kinesiologists and advanced practice OTs as providers of rehabilitation. Panelists agreed (95%) that there was a need for standardized, evidence-based training for health professionals to ensure the knowledge and skills necessary to provide safe and effective TKA rehabilitation care; an additional statement that was added to round two based on panelist comments.

Subgroup analysis by panelist type revealed variable support for different types of rehabilitation providers with all surgeons and patients agreeing advanced practice PTs were appropriate more so than PTs themselves (67%); this trend held true for OTs and advanced practice OTs. Fewer patients (33%) and PTs (24%) felt nurse practitioners were appropriate providers of rehabilitation than did surgeons (60%). All patients (n=3) agreed that rehabilitation assistants or PT assistants were appropriate rehabilitation providers compared to 67% of PTs and 60% of surgeons. Similarly, all patients felt family physicians were appropriate to provide TKA rehabilitation compared to 14% of PTs and 20% of surgeons. There were no subgroup differences for kinesiologists with one patient, two PTs and one surgeon agreeing these exercise professionals were appropriate to provide post-acute TKA rehabilitation.

6.4.7.4 Rehabilitation format
Panelists agreed (87%) on the importance of supervised rehabilitation after TKA; however, support for specific forms of supervision and formats for rehabilitation was inconsistent. Panelists agreed (87%) that 1:1 patient supervision was an appropriate format for rehabilitation care; however, failed to reach consensus on whether group treatment with all TKA patients (70%) or a mixed format (individual and group treatment) (70%) was appropriate. There was no consensus on the appropriateness of reduced or indirect supervision. Of those panelists who
responded favourably, use of trained fitness professionals under PT supervision (83%) and self-directed home exercises with periodic clinic-based checks with a PT (100%) were felt to be appropriate. Self-directed rehabilitation with no professional supervision achieved negative consensus with 82% of panelists agreeing this was not appropriate. Of the seven panelists who responded favourably, self-directed exercise with internet-based video instruction (86%) and use of an iPod with downloaded exercises (86%) were suggested.

Surgeons rated the need for supervised rehabilitation as slightly less important and reduced supervision as more appropriate for optimal patient outcomes than did patients and PTs; however, differences were not statistically significant (p=.33, p=.14). Subgroup analysis further revealed a similar number of Canadian (71%) and American (65%) panelists felt group treatment (all TKA) was appropriate. Group size was also discussed and a majority of panelists (70%) indicated that small groups (1 provider to 3-4 patients) were most appropriate. Panelists agreed (90%) that structured post-acute rehabilitation using a multi-phased approach based on stages of tissue healing and recovery of muscle function was appropriate, regardless of setting and available supervision.

6.4.7.5 Timing of rehabilitation
There was strong agreement (97%) on the importance of timing of post-acute rehabilitation following TKA. Consensus was not reached for the overall influence of personal and external factors on the timing of rehabilitation yet a number of specific factors were identified as being important (Table 6.4). Half of PTs (48%) and surgeons (50%) and two-thirds of patients felt post-acute rehabilitation should start within 72 hours of acute hospital discharge. By far the majority of PTs (95%) and all patients agreed treatment should be initiated within 1 week compared to 67% of surgeons. Ratings did not differ by country.
6.4.7.6 Rehabilitation setting
The importance of setting on optimal outcomes after TKA approached consensus (79%) after three rounds with 16% of panelists remaining undecided or neutral regarding this matter. There was unanimous agreement on the appropriateness of hospital outpatient clinics or departments for TKA rehabilitation and slightly less support for private physical therapy clinics (94%) and outpatient orthopaedic centers (89%). Rehabilitation in inpatient settings including inpatient departments within the acute care hospital (61%), inpatient rehabilitation facilities (IRFs) (67%) and skilled nursing facilities (SNFs) (53%) did not reach consensus. Home-based rehabilitation approached consensus (78%). Personal and external factors were felt to have strong influences on the selection of rehabilitation setting (Table 6.4).

Subgroup analyses revealed that more patients than PTs and surgeons (p=.03) rated setting as being important for optimal outcomes after TKA. More clinicians than researchers felt the rehabilitation setting was important; however, the difference was not statistically significant (p=.11). There was no difference in ratings when Canadian panelists were compared to Americans.

6.4.7.7 Rehabilitation interventions
Panelists strongly agreed (92%) that appropriate rehabilitation interventions were important for optimal outcomes after TKA and further consensus was reached on a number of specific interventions. Those selected as either ‘appropriate and somewhat important’ or ‘appropriate and very important’ by 80% or more of panelists in the final round are shown in Table 6.5.
Table 6.5 Appropriate and important post-acute rehabilitation interventions after TKA

<table>
<thead>
<tr>
<th>Therapeutic and functional exercises</th>
<th>Electrical/thermal modalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Active ROM</td>
<td>• Ice</td>
</tr>
<tr>
<td>• Active assisted ROM</td>
<td></td>
</tr>
<tr>
<td>• Passive ROM</td>
<td></td>
</tr>
<tr>
<td>• Strength training</td>
<td>• Massage for swelling</td>
</tr>
<tr>
<td>• Stretching</td>
<td>• Massage for scar mobility</td>
</tr>
<tr>
<td>• Postural training</td>
<td>• Passive stretching techniques</td>
</tr>
<tr>
<td>• Home exercises</td>
<td>• Proprioceptive neuromuscular facilitation (PNF)</td>
</tr>
<tr>
<td>• Neuromuscular re-education</td>
<td>• Joint mobilizations (e.g. glides)</td>
</tr>
<tr>
<td>• Static balance</td>
<td></td>
</tr>
<tr>
<td>• Dynamic balance</td>
<td></td>
</tr>
<tr>
<td>• Stair climbing</td>
<td></td>
</tr>
<tr>
<td>• Rising/lowering to chair</td>
<td></td>
</tr>
<tr>
<td>• Rising/lowering to floor</td>
<td></td>
</tr>
<tr>
<td>• Transfers</td>
<td></td>
</tr>
</tbody>
</table>

Gait training

• Correct use/progression of walking aids
• Correction of altered gait pattern
• Indoor/outdoor training
• Variable surface training

Cardiovascular training

• Low-moderate intensity training
• Use of appropriate CV machines (e.g. stationary bike, treadmill)

Interventions with a combined rating of “somewhat” or “very important” reaching ≥80% agreement; bolding indicates ≥80% of panelists rated item as “very important”

Subgroup analyses revealed that patients rated the overall importance of appropriate rehabilitation interventions on TKA outcomes lower than did PTs and surgeons (p=.02). There was no difference in ratings when comparing Canadian and American panelists’ responses (p=.19). One physical therapy intervention of interest and controversy was the use of neuromuscular electrical stimulation (NMES) after TKA. A comparison of response frequencies showed that 76% of PTs compared to only 33% of surgeons and 50% of patients agreed that
NMES was somewhat or very important after TKA while there was little difference in this rating when clinicians (64%) were compared to researchers (60%).

6.4.7.8 Dosage of rehabilitation
Panelists agreed (84%) that the overall dosage of rehabilitation following TKA was important in achieving optimal outcomes; however, there was strong concordance that both personal and environmental factors influenced the amount of rehabilitation care patients receive. Specific contextual factors are shown in Table 6.4. After three rounds, there was no consensus on the optimal duration (greatest support for 4-8 weeks (40%) and 8-12 weeks (40%), range <4 weeks to 20-24 weeks), frequency (greatest support for 2-3 times/week (42%)) or number of treatment sessions (greatest support for 15-19 sessions (29%), range 5-9 to 24-36 sessions) and no apparent trend towards agreement was emerging.

Surgeons rated the importance of rehabilitation dosage lower than patients and PTs (p=.02) while there was no statistically significant difference when Canadian and American ratings were compared. By examining the details of rehabilitation dosage, it was evident that there was no agreement within each subgroup regarding duration with 48% of PTs selecting four to eight weeks (range <4 weeks to 20-24 weeks), an equal number of surgeons (33%) selecting four to eight weeks and eight to 12 weeks (range 4-8 weeks to 12-16 weeks) and most patients (67%) indicating eight to 12 weeks (range 4-8 weeks to 8-12 weeks) as the optimal length of a post-acute rehabilitation program. The overall number of treatment sessions was equally diverse with one quarter of PTs selecting 15 to 19 sessions (range 5-9 sessions to 24-36 sessions), half of surgeons selecting 10 to 14 sessions (range 10-14 sessions to 15-19 sessions) and two thirds of the patients choosing 15 to 19 sessions. Frequency of rehabilitation sessions was more consistent among groups with 43% of PTs, 67% of surgeons and 67% of patients indicating two to three times a week as optimal for TKA rehabilitation. Several panelists within each subgroup felt that
the elements that comprise the overall dosage of rehabilitation (e.g., frequency, duration) should be variable or individualized taking into account each patient’s specific needs and goals. For this reason, one third of PTs did not specify an optimal duration, number or frequency of rehabilitation sessions.

6.4.7.9 Rehabilitation outcomes
There was strong agreement on the importance of routinely assessing outcomes conceptualized within the ICF including body structure and function (95%) and activity and participation (97%) domains; however, panelists were just shy of consensus (79%) for outcomes not captured by the ICF such as health related quality of life (HRQoL) and patient satisfaction. Outcomes that were selected by at least 80% of panelists as being both appropriate and important after TKA are shown in Table 6.6. The panel unanimously agreed that personal factors influence patient outcomes and was of a similar view (97%) for external factors. Specific contextual factors are shown in Table 6.4.
<table>
<thead>
<tr>
<th>Body structure and function outcomes</th>
<th>Activity and participation outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Pain (at rest)</td>
<td>• Static balance</td>
</tr>
<tr>
<td>• Pain (with activity)</td>
<td>• Dynamic balance</td>
</tr>
<tr>
<td>• Pain coping</td>
<td>• Walking speed</td>
</tr>
<tr>
<td>• Knee effusion</td>
<td>• Walking distance</td>
</tr>
<tr>
<td>• Lower limb edema</td>
<td>• Stair ascent/descent</td>
</tr>
<tr>
<td>• Sleep functions</td>
<td>• Carrying/lifting</td>
</tr>
<tr>
<td>• ROM (operated joint)</td>
<td>• Ability to use public transportation</td>
</tr>
<tr>
<td>• ROM (other lower limb joints)</td>
<td>• Ability to drive a vehicle</td>
</tr>
<tr>
<td>• Posture and alignment</td>
<td>• Run errands/shop</td>
</tr>
<tr>
<td>• Gait (pattern, use of aids)</td>
<td>• Ability to do self care (dressing)</td>
</tr>
<tr>
<td>• Joint (ligamentous) stability</td>
<td>• Ability to attend social functions</td>
</tr>
<tr>
<td>• Joint proprioception (position sense)</td>
<td>• Ability to attend participate in religious activities (pray, kneel)</td>
</tr>
<tr>
<td>• Coordination</td>
<td>• Ability to travel (air travel, bus tour)</td>
</tr>
<tr>
<td>• Muscle strength (operated limb)</td>
<td>• Ability to do light household activities (cooking, dusting)</td>
</tr>
<tr>
<td>• Muscle strength (non-operated limb)</td>
<td>• Ability to do moderate/heavy household activities (laundry, vacuuming)</td>
</tr>
<tr>
<td>• Muscle strength (upper limbs)</td>
<td>• Ability to do light outdoor work</td>
</tr>
<tr>
<td>• Muscle recruitment/voluntary activation</td>
<td>• Ability to do moderate/heavy outdoor work (rake leaves, shovel snow)</td>
</tr>
<tr>
<td>• Muscle atrophy</td>
<td>• Ability to participate in sexual activity</td>
</tr>
<tr>
<td>• Core stability (trunk/pelvic deep muscle control)</td>
<td>• Ability to perform care giving activities (to child or spouse)</td>
</tr>
<tr>
<td>• Soft tissue flexibility (contractures)</td>
<td>• Ability to participate in low-moderate intensity leisure/sporting activities</td>
</tr>
<tr>
<td>• Wound/tissue healing</td>
<td>• Ability to participate in paid employment</td>
</tr>
<tr>
<td>• Energy and vigor</td>
<td>• Ability to participate in unpaid/volunteer employment</td>
</tr>
<tr>
<td>• Emotional functioning (stress, coping)</td>
<td></td>
</tr>
</tbody>
</table>

Other outcomes

- Self-efficacy for exercise
- Self-efficacy for rehabilitation
- Patient satisfaction with rehabilitation outcomes/process
- Patient knowledge (e.g. post-operative complications, precautions)
- Patient global assessment (self rating of how he/she is doing)
- Health professional/surgeon global assessment (of how patient is doing)

Outcomes with a combined rating of “somewhat” or “very important” reaching ≥80% agreement; bolding indicates ≥80% of panelists rated item as “very important”
Subgroup analysis was conducted to further examine the lack of concordance on outcomes not captured within the ICF framework and revealed a significant difference (p=.02) among provider types with patients rating this category of outcomes highest and surgeons the lowest. Health related quality of life, for example, was rated ‘very important’ by 48% of PTs, 33% of patients and no surgeons. Clinicians and researchers were in agreement on the importance of evaluating outcomes not captured by the ICF and similar percentages (27% versus 30%) rated HRQoL as being ‘very important’.

Further analyses demonstrated between group differences regarding the influence of external factors on outcomes with more Canadian than American panelists selecting access to health professionals (95% versus 77%), and access to rehabilitation services (95% versus 88%) as issues. Although not reaching consensus, patients’ financial situation was selected by more American panelists (77% versus 65%) while health insurance and health policy were similarly rated.

6.4.7.10 Rehabilitation outcome measurement
Panelists reached consensus on the importance of using appropriate tools in a consistent manner to evaluate or monitor body structure and function (97%) and activity and participation (97%) outcomes; however, again did not achieve consensus on ‘other’ tools (74%). Those outcome methods and tools selected as being both important and clinically feasible by 80% or more of the panelists are shown in Table 6.7. Subgroup analysis showed that ratings on the importance of measuring outcomes outside of the ICF in a standardized fashion did not differ by provider type or primary role.
Table 6.7 Measures and tools considered feasible and important for routine clinical outcome evaluation and/or monitoring after primary TKA

<table>
<thead>
<tr>
<th>Body structure and function measures</th>
<th>Activity and participation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Pain visual analogue scale (VAS)</td>
<td>• Timed walk</td>
</tr>
<tr>
<td>• Numeric pain rating scale (NPRS)</td>
<td>• Timed Up and Go (TUG)</td>
</tr>
<tr>
<td>• Standard goniometer to assess passive ROM</td>
<td>• Single leg static balance test</td>
</tr>
<tr>
<td>• Visual observation to assess lower limb alignment</td>
<td>• Functional Reach Test for balance</td>
</tr>
<tr>
<td>• Standard goniometer to assess active ROM</td>
<td>• Repeated stands test (sit-to-stand)</td>
</tr>
<tr>
<td>• Ligamentous stress testing (for joint stability)</td>
<td>• Timed stair climbing</td>
</tr>
<tr>
<td>• Patient’s ability to reproduce target angle (joint position sense)</td>
<td>• 6-minute walk test</td>
</tr>
<tr>
<td>• Skin sensation over operated limb</td>
<td>• WOMAC OA Index</td>
</tr>
<tr>
<td>• Visual observation of gait</td>
<td>• Lower Extremity Functional Scale (LEFS)</td>
</tr>
<tr>
<td>• Trendelenburg test</td>
<td>• Performance battery (e.g. timed walk, stair climb and TUG)</td>
</tr>
<tr>
<td>• Manual muscle testing (e.g. Grades 0–5)</td>
<td>Other measures</td>
</tr>
<tr>
<td>• Palpation/observation to assess voluntary activation/muscle recruitment</td>
<td>• Numeric rating of patient’s satisfaction with functional outcome</td>
</tr>
<tr>
<td>• Standardized test positions to assess flexibility/muscle lengths (e.g. Thomas Test for hip flexor length)</td>
<td>• Numeric rating of patient’s satisfaction with rehabilitation process</td>
</tr>
<tr>
<td>• Visual observation of patellar alignment and tracking</td>
<td>• Self-efficacy for self-management</td>
</tr>
</tbody>
</table>

Bolding indicates ≥80% of panelists rated item as “very important”

6.4.7.11 Follow-up care
Panelists agreed strongly that it was important to monitor patients on both a short-term (95%) and to a lesser extent, long-term (84%) follow-up (FU) basis after primary TKA. Further, there was strong support (97%) for the importance of patients having access to appropriate follow-up services to address their needs in the initial two year-period after TKA; however, marked differences in opinion surfaced when panelists were asked to suggest who should provide such
care. Orthopaedic surgeons were the only health professionals reaching consensus (92%) with all surgeons and patients in support and 91% of PTs. Physician assistants (PAs), nurse practitioners, PTs, advanced practice PTs and dieticians were under consideration in round three but did not reach consensus when considering the total panel’s views. Subgroup analysis showed that surgeons rated PAs and nurse practitioners higher than did PTs and patients. Conversely, PTs rated their fellow PTs and advanced practice PTs higher than did surgeons and both designations had 100% support from patients on the panel.

Views on appropriate providers of short-term FU care differed by country with more American panelists selecting PAs (59% versus 38%) and nurse practitioners (47% versus 24%) as appropriate than Canadians. Slightly fewer American panelists felt surgeons (88% versus 95%) and markedly less agreed advanced practice PTs (53% versus 91%) were appropriate to provide FU care. Support for PT follow-up care did not differ by country with approximately two-thirds of both subgroups selecting this provider.

Consensus was not reached on the appropriate schedule of short-term FU visits which ranged from FU at ‘2 months and 1 year post-op’ to ‘6 weeks, 6 months, 1 year and 2 years post-op’. The schedule selected by the largest number of panelists (51%) was ‘6 weeks, 3 months, 1 year and 2 years post-op’. Similarly, when asked to select the appropriate time frame and schedule for long-term FU there was no agreement and the greatest support (27%) was given to ‘indefinitely’.

Forms of short-term FU care and services that reached consensus were telephone support from a health professional as needed (87%) and scheduled FU clinic visit with the surgeon (82%). Support for the different forms of FU care differed by panelist type with more PTs (95%) than surgeons (50%) and patients (67%) agreeing telephone support from a health professional was appropriate. Scheduled FU clinic visit with surgeon and exercise booster sessions with a PT
received more support from patients and PTs than from surgeons. Surgeons unanimously agreed with scheduled FU clinic visits with radiographic evaluation compared to two-thirds of PTs and patients. Community-based TKA exercise programs were deemed appropriate by 57%, 50% and 33% of PTs, surgeons and patients respectively.

6.4.8 Thematic analysis of comments

Based on panelists’ comments in round one, two themes emerged. The need to differentiate stages of post-acute rehabilitation was emphasized across panelist groups and influenced how they responded to items in several sections of the questionnaire. (See Table 6.8 for sample comments.) A second theme reinforces the need for an individualized approach to some aspects of post-acute rehabilitation. Panelists felt it was important to remember that ‘best practice’ guidelines are not a substitute for clinical judgment and individual patient needs and preferences (Table 6.8). These themes were integrated in the process by creating new statements for rating in round two. A recurring topic related to several panelists’ misconceptions on delivery of post-acute rehabilitation care (e.g., post-acute rehabilitation meant inpatient care) and was addressed by providing clarification in the controlled feedback after round one and the instructions at the beginning of round two.

We identified one additional theme from round two comments. Need for standardized rehabilitation provider training captures panelists’ views that all professionals providing rehabilitation services after TKA surgery should have appropriate training and clinical experience (Table 6.8). It was acknowledged that no standardized, post-entry level training program currently exists in Canada and the US. This theme was addressed by the adding a related statement to the third questionnaire. Comments were invited in round three; however, new items were not specifically requested as there were no further rounds planned. Thematic analysis revealed no new concepts.
Table 6.8 Sample comments from thematic analysis

**Theme 1: Need to consider different phases of post-acute rehabilitation**

“Early and late phases should be defined by milestones relating to body and function outcomes, not time related.”

“Maintenance to me indicates no further improvement or gains, which in my experience with TKA patients rarely occurs within the first year post op.”

While I think that maintenance and health/wellness are important, I don’t believe that long-term outcome of a TKR will be affected by a maintenance program.”

“Clearly data support the continued need for and ability to achieve improvement 12 months and beyond.”

“Setting will vary depending on early and late post-acute rehab.”

**Theme 2: Need to individualize treatment approaches**

“Dosage should be individualized based on patient status, progress and outcomes.”

“Best [practice] guidelines apply to the majority of patients but individual needs must always be considered and may indicate intensity, duration, timing etc. of rehab interventions.”

“Having a choice of how to structure rehab may allow therapists to allocate less resources to those patients who don’t need it and give more resources to those who do. This is more complex and less ‘one size fits all’ and requires good judgment from the therapist.”

**Theme 3: Need for standardized rehabilitation provider training**

Re: Follow-up care: “Need special training in evaluation and management of joint replacement patients”

“…quality training experiences are rare.”

“[Providers] should have clinical experience that is comprehensive with sound knowledge of ortho-biomechanics, gait abnormalities, looking beyond the knee to factors that may contribute to potential aberrant problems that may affect the short and long-term effects following TKA.”

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6.5 Discussion

This study is the first to assemble a diverse panel of Canadian and American health professionals, researchers and patients and employ the Delphi method to identify best practices for post-acute rehabilitation following primary TKA for OA. Further, it couched the
recommendations within the ‘real world’ by identifying personal and environmental contextual factors (including institutional and systems-level factors) that can’t be ignored. Such factors may serve to either facilitate or hinder the ability to apply rehabilitation best practices in this rapidly growing population and in two very different health care systems. While panelists were not instructed to differentiate whether these factors were facilitators or barriers to optimal patient outcomes, most are intuitive such as access to rehabilitation professionals, rehabilitation programs and transportation.

Consensus was reached in 24 of 33 potential statements; however, similar to our THA Delphi findings, a number of key areas of rehabilitation planning, delivery and outcome evaluation remained uncertain after three rounds of discussion. Subgroup analyses revealed significant between group differences when comparing the ratings of PTs, patients and surgeons in regard to appropriateness of unsupervised rehabilitation and the importance of setting, rehabilitation and FU provider-type, specific interventions, treatment dosage, and outcomes not captured by the ICF. Further differences were found in the perceived need for trained professionals in providing TKA rehabilitation when clinicians’ views were compared to researchers’, and in the appropriateness of reduced or indirect health professional supervision comparing Canadian and American responses. Some of these latter differences again may be explained by our differing health care systems, and designations of health professionals. For example, only 38% of Canadian panelists felt that PAs were appropriate to provide FU care compared to 59% of American panelists. In Canada, there is one accredited PA training program compared to 149 such programs in the US (I. Jones, Canadian Association of Physician Assistants, December 23, 2009).

Similar to the THA study, we saw a trend towards convergence in opinion and a greater number of statements reaching consensus over the three rounds - evidence of the Delphi process at work.
As mentioned in the previous chapter, however, the Delphi method is not without its critics (32).

Several TKA rehabilitation topics including rehabilitation setting, dosage and specific treatment interventions did not achieve consensus and may have benefited from further discussion through another Delphi round. Yet evidence of similar lack of agreement and resultant inconsistencies in rehabilitation practices is widely reported (11, 12, 35, 43) and unlikely to change without significant efforts at all levels of health care.

Again, similar to our THA Delphi findings, outcome measurement in TKA rehabilitation remains problematic. No activity and participation measures were identified as ‘feasible and should do’ and only numeric ratings of patient satisfaction and self-efficacy were selected as appropriate and feasible despite several outcomes not captured within the ICF recognized as being important across stakeholders. Inconsistent and underuse of outcome measures eliminates valuable clinical information that would assist in clinical decision making. To address the inconsistent use of outcome tools in research (44), Riddle et al. are undertaking a consensus process to identify a core set of outcome measures for TKA trials (45).

The importance of identifying and acknowledging the numerous personal and external factors that play significant roles in the delivery and outcomes of TKA rehabilitation was evident from our findings. As suggested earlier, preoperative screening would be valuable for identifying personal and provider-level factors that could be modified or addressed to better prepare the patient for TKA surgery and flag those individuals at risk for delayed or incomplete recovery.

A number of therapeutic interventions including active ROM, strength training and dynamic were strongly recommended following TKA, but treatment specifics were not part of this study and still need to be teased out. With the limitations in the current evidence and no one form of
physical therapy and treatment dosage clearly superior to another (13), it poses a challenge to the clinician wanting to provide evidence-based care. Instead greater emphasis must be placed on clinical judgment and individual patient preferences to guide treatment. While the latter are important elements of evidence-based practice, further research needs to be done on the effects of rehabilitation interventions and greater efforts made to disseminate and integrate available evidence on specific approaches. For example, there is a growing body of research supporting the use of NMES after TKA yet less than 60% of panelists rated it as appropriate and two-thirds of surgeons felt it was neither appropriate nor important.

6.5.1 Strengths and limitations of research

Strengths and weakness of the Delphi approach and its application to this study are discussed in chapter 5.5.1. Our rigorous methodology and efforts to ensure anonymous and broad representation from key stakeholders strengthens the overall validity and generalizability of our findings. Inclusion of patient experts in the design and implementation of this study helped to ensure it remained client centred (46). In addition, our novel ‘patient veto’ approach resulted in 17 items being retained for further discussion in the final round – a technique that we have not found described elsewhere.

Response rates of 93% to 95% per round are considered excellent and exceed those of other Delphi studies in related health care fields (42, 47, 48). Varied strategies to engage and retain panelists were successful and through these efforts, may have led to their appreciation that they were partners in the study, whose judgments will ultimately influence the clinical recommendations and best practice statements for TKA rehabilitation.

A number of limitations are worth noting and have been addressed in chapter 5.5.1. The higher number of surgeon drop outs (four of seven drop outs) than other professionals may have led to
non-response bias in which those who did not complete all three rounds systematically differed in their views on the various components of post-acute rehabilitation from those who completed the survey. The delayed Delphi start date and possible response exhaustion for those professionals serving on both panels may have contributed to this drop out.

As noted earlier, the authors’ extensive professional affiliations increased the risk of response bias and therefore we pilot tested the first questionnaire to check for leading questions and provided a range of perspectives in the controlled feedback. Three panelists took less than 20 minutes to complete each questionnaire (outside the standard deviation) suggesting snap judgements and threatening the validity of the results (32).

It was a challenge to form a diverse and representative panel of experts while maintaining a manageable size. While we were only able to include three patient experts, we feel their ‘veto power’ over items not otherwise carried forward helped to ensure that their views remained at the forefront. An additional challenge to forming a representative panel was identifying and recruiting experts from all parts of Canada and the US (see Appendix K). Some important health care delivery issues may not have been taken into account as a result of not having panelists from all regions of Canada and the US. Again, the validity of the expert panels’ recommendations can only be confirmed by replicating the process with a new yet similarly experienced panel (32, 49).

6.6 Conclusion

After a three-round Delphi survey, expert panelists reached consensus on 24 statements related to post-acute rehabilitation after primary TKA. There was strong agreement on the need for structured rehabilitation, use of trained health professionals to provide rehabilitation, importance of timing, appropriate interventions and follow-up services, and routine use of outcome measurement.
The importance of setting and specifics of treatment dosage, format and timing did not reach consensus and continued to generate new ideas and comments through the three rounds. A number of personal and external factors were felt to influence various aspects of the delivery and outcomes of care.

Subgroup analysis revealed statistically significant differences in several aspects of rehabilitation delivery and outcome assessment when comparing panelist type, professional role and country. This supports the importance of multidisciplinary input when creating guideline recommendations.

6.6.1 Clinical implications

Our findings suggest that:

- Early intervention by trained health professionals following TKA is important for optimal outcomes. The need for ‘trained’ health professionals means that education to develop, maintain and upgrade skills of practicing health professionals is important. The recommendation (95% agreement) for standardized training on TKA rehabilitation may prompt universities and colleges across Canada and the US to standardize the relevant entry level curriculum for medical and allied health professional students. There was strong agreement (97%) on the importance of early intervention (within 1 week) following TKA. This information needs to be conveyed to administrators and policy makers to ensure adequate service delivery post-op (e.g., increased funding to acute care hospitals for more TKA surgeries needs to translate into increased resources allocated for post-acute rehabilitation).

- The panel recommends that a multi-phased approach (based on stages of tissue healing and recovery of muscle function) be adopted when providing intervention, regardless of
the setting or format (e.g., level of supervision) to avoid inappropriate exercise prescription and less favorable outcomes.

- The panel strongly recommends inclusion of the following components in the routine assessment of patients following TKA:
  - Numeric pain rating scale to assess pain at rest and with activity
  - Goniometry to measure active and passive ROM
  - Manual muscle testing to assess muscle strength
  - Soft tissue flexibility (technique not specified)
  - Visual observation of gait
  - Dynamic balance (technique not specified)
  - Ability to manage stairs
  - Ability to perform self-care

- And the following therapeutic interventions:
  - Active ROM
  - Strengthening exercises
  - Dynamic balance training
  - Stair climbing
  - Rising/lowering to chair
  - Gait training including use/progression of walking aids, correction of altered gait
  - Patient education (e.g., how to monitor for post-op complications)
  - Home exercises

- Although consensus was not achieved with respect to the optimum dosage and format for rehabilitation, the panel agreed that dosage (84%) and type of intervention (92%) affect outcome after TKA.
Finally, the panel unanimously agreed that both personal and external factors influence patient outcomes and individual patient needs and preferences need to take precedence in the planning and delivery of post-acute rehabilitation.

6.6.2 Implications for future research

Recommendations for future research are similar to those outlined in chapter 5.6.3. Specifics of rehabilitation including timing, dosage, format and interventions require further investigation before consensus is reached on these key elements of rehabilitation after TKA. Another Delphi survey or smaller face-to-face consensus meeting is needed to identify details of the key therapeutic interventions such as strength, gait and balance training. Additionally, more high quality trials are warranted to determine which interventions have the greatest effects on both the rate of recovery and short- and long-term outcomes after TKA. Identification of essential elements of key treatment parameters will advance the field of TKA rehabilitation research and contribute to improved and more consistent standards of care. Empirical data will need to be coupled with our findings and related literature that shows the substantial influence of patient expectations, attitudes and engagement in the rehabilitation process on the delivery and outcomes of care. As noted previously, attention to these factors may lead to better adherence to therapeutic regimes and more favourable outcomes. Research on pre-operative screening and use of decision-making tools may further our understanding of risk factors contributing to delayed recovery or poor outcomes after TKA.

Lastly, the final practice guideline recommendations will need to be rigorously evaluated in varied rehabilitation settings and using standardized assessment tools identified in this study and related research (45) to enable comparison of their effects and costs against current and emerging rehabilitation practices in Canada and the US.
6.7 References


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Chapter 7: Conclusions and implications for future research

7.1 Summary of thesis objectives

The overall aim of this thesis was to integrate stakeholder views, the scientific evidence and expert opinion to inform the development of clinical practice guidelines for post-acute rehabilitation after primary total hip and knee arthroplasty. In Chapter 2, we explored patient and health professional experiences and attitudes on current rehabilitation practices and outcomes following primary THA and TKA. Chapters 3 and 4 examined the evidence for physiotherapy interventions on pain, function and HRQoL following THA and TKA. In Chapters 5 and 6, Delphi surveys were conducted with two multidisciplinary panels to develop best practice recommendations for key aspects of THA and TKA rehabilitation and outcome evaluation. The multiple phases being undertaken to develop clinical practice guidelines are outlined in Figure 7.1 - the phases specific to this thesis are highlighted.

When I embarked on this doctoral research, I had a number of clinical questions stemming from more than 15 years of physiotherapy practice that I hoped to answer. These included:

- Is there a need for post-acute rehabilitation? Which patients would most benefit from post-acute rehabilitation?

- Who should provide post-acute rehabilitation? What knowledge and skills do clinicians need to provide safe and effective rehabilitation care?

- What (if any) level of health professional supervision is needed for optimal outcomes? What forms of indirect or self-directed rehabilitation are appropriate?

- What are appropriate formats and protocols for rehabilitation programs? Is group care more or less effective than individual care?
• What is the optimal timing for rehabilitation? (e.g. immediate vs. delayed)

• What are appropriate settings in which to carry out rehabilitation? Is inpatient rehabilitation more or less effective than outpatient or home-based care?

• What types of rehabilitation services and therapeutic interventions are most effective?

• What is the optimal dosage (duration, frequency, number of sessions) of rehabilitation?

• What outcomes are of importance to patients? To health professionals?

• What tools or measures are appropriate to assess patient outcomes in a clinical setting?

• Is follow-up care necessary after completion of rehabilitation? Who should provide follow-up services? For how long? How often? In what format?

• How do personal (patient-related) and external (environmental) contextual factors influence rehabilitation care and outcomes?

The extent to which this thesis addresses these questions is discussed next.
Figure 7.1 Phases of clinical guideline development for THA and TKA rehabilitation

**Phase 1**
Focus Groups
- Conduct focus groups with stakeholders in Canada & US
- Thematic analysis & interpretation of findings
- Prepare manuscript

**Phase 2**
Systematic Reviews
- Reviewers trained in Cochrane review methodology
- Literature search, data abstraction & best evidence synthesis (PT interventions)
- Prepare manuscripts for Cochrane Library

**Phase 3**
Delphi Group Process
- Assemble experts for THA & TKA panels
- Conduct online Delphi survey & draft best practice statements
- Prepare manuscripts & working document for Phase 4

**Phase 4**
Consensus Conference
- Obtain funding & invite stakeholders & experts
- Conduct consensus conference & draft practice guidelines for review
- Refine guidelines & submit for publication

**Phase 5**
Guideline Implementation & Evaluation
- Develop KT plan for guideline dissemination & evaluation
- Evaluate KT strategies & guideline implementation (economic evaluation)
- Revise/update guidelines based on evaluation & new evidence
7.2 Summary of study findings

The focus group findings (Chapter 2) and Delphi consensus process (Chapters 5 and 6) provided an answer to the first question: Individuals who undergo a primary THA or TKA for OA need supervised rehabilitation in the post-acute stage to optimize outcomes. It was less clear as to which types of patients would most benefit from specific forms of post-acute rehabilitation and a lack of subgroup analysis within the synthesized literature, provided no additional information.

In Chapter 2, we sought to gain a greater understanding of the variety of health care providers and services that patients utilized after TJA. While the systematic reviews (Chapters 3 and 4) focused on one provider type, physiotherapists, and the Delphi process confirmed this profession’s predominant role in provision of post-acute rehabilitation services, other views were sought and will contribute to the long term goal of multidisciplinary guidelines. Providers need knowledge and clinical experience in TJA surgery and rehabilitation to provide safe and effective treatment for these patients (Chapter 5 and 6); however, the specifics of these core competencies were not addressed. Similarly, Delphi panelists agreed that direct supervision, whether it be 1 to 1 or group treatment, was important for optimal patient outcomes and that no health professional supervision was inappropriate. The question as to whether reduced or indirect supervision, such as a patient self-directed exercise program with periodic consultations with a PT or through tele-rehabilitation for individuals in more remote settings, could lead to optimal outcomes remained nebulous. It may be that a majority of the research participants were not practicing in settings that warranted use or exploration of these alternative forms of health professional supervision and the few who suggested and supported these options, were dealing with limited resources or less access to rehabilitation services necessitating creative approaches to providing the best care possible to their clients.
Individual’s varied rehabilitation experiences identified in Chapter 2, confirmed the marked practice variation evident in the literature and provided the basis for posing the question on most appropriate formats and protocols for post-acute rehabilitation care. A staged approach (early and late) to rehabilitation interventions was viewed as appropriate as were both individual and small group programs. The systematic reviews (Chapter 3 and 4) did not have sufficient evidence to recommend individual (1 to 1) over group approaches and in Chapters 5 and 6, research participants acknowledged both formats had their place over the course of recovery.

Timing of post-acute rehabilitation is important but the optimal timing remains somewhat vague. Only by collapsing the mixed responses to this question in the Delphi study, did the recommendations emerge for initiating post-TKA rehabilitation within one week of hospital discharge and within three weeks following THA surgery. Conversely, the literature review found cases of individuals still benefitting from a course of structured exercise therapy nearly a year out after surgery. This question requires additional discussion and research before it can be answered with confidence.

Outpatient settings, such as an outpatient department of a hospital or private physiotherapy clinic, are viewed as the most appropriate setting for post-acute rehabilitation after THA and TKA. Different care settings served as comparators in several trials synthesized in this research; however, in most cases, groups did not perform identical exercise routines with similar levels of supervision so one cannot draw conclusions as to whether ‘setting’ was the deciding factor. Inpatient rehabilitation was identified as being appropriate only under specific patient circumstances such as significant co-morbidities, post-operative complications and poor cognitive status.
A number of post-acute rehabilitation interventions and patient education topics were rated as important following THA and TKA surgery yet the question as to which specific interventions are most effective remains unanswered. In general, active exercise programs that are customized to patient needs, progressed beyond the early acute care phase, of higher intensity and functionally-based appear to be most appropriate and are well-tolerated by patients (Chapters 3 and 4). Practice details such as optimal dosage (duration, frequency, number of sessions) remain unclear. The addition of NMES to address muscle weakness and activation deficits may be of benefit to some individuals but requires further study before broadly recommending. From the perspective of someone who has considerable clinical experience with clients with TJA, I found the rehabilitation interventions that achieved consensus and will form the basis of practice recommendations to be somewhat conservative in nature. It could be that my experience working in a publicly-funded outpatient clinic with adequate resources (e.g., personnel, equipment, educational tools, training) allows me to think outside of the traditional rehabilitation toolbox and consider therapeutic approaches that are simply not feasible in settings with lower volumes of TJA patients, limited resources or reimbursement methods based on meeting a minimal set of performance indicators or caps on number of rehabilitation sessions. This speaks to the value of including diverse input into developing practice guidelines that are meant to inform care across varied practice environments, health care providers and health care systems.

A core set of outcomes are proposed that were deemed important by group consensus (Chapters 5 and 6) thus addressing one of the initial questions. Outcomes spanned all four domains of the ICF classification (1) with similar numbers identified as important in the levels of ‘body structure and function’ and ‘activity and participation’. There is considerable overlap with important TJA outcomes reported in the literature (2).
Several tools or measures are recommended to assess patient outcomes in a clinical setting; however, they predominantly fell under the ‘body structure and function’ domain. No measures of participation achieved consensus suggesting either limited awareness of appropriate tools or a lack of their perceived value or feasibility in the clinical context.

Short-term follow-up care is necessary after completion of rehabilitation while long-term follow-up was viewed as slightly less important (Chapters 5 and 6). Orthopaedic surgeons are most appropriate to provide follow-up services; however, views were inconsistent among provider types and patients. There is no consensus on the duration and ideal format for follow-up care.

The final question as to how personal and external (environmental) factors influence rehabilitation care and outcomes was partially answered. While not asked to state how these contextual factors affected the delivery and outcomes of care, several were identified as having a strong influence on the process of care and outcomes of TJA rehabilitation and should be considered when designing and implementing rehabilitation programs, and analyzing study results.

As evident from this summary, a majority of the original clinical questions were answered through this research. Unanswered or partially addressed questions are reflected in the marked practice variation noted previously and create a gap in the clinical practice guidelines. How best to fill these gaps in knowledge and address additional questions raised through this research are discussed in sections 7.4 and 7.7.

7.3 Implications for clinical practice

The primary aim of this research was to inform clinical practice and help patients and health professionals make informed decisions on effective rehabilitation interventions following primary THA and TKA for OA (3, 4). Clinical practice guidelines are viewed as effective tools
to promote best practice (5), facilitate continuity and consistency of care (6), and improve communication with both patients and other health care providers across practice settings (7).

There was confusion among Delphi panelists that required moderator clarification regarding the difference between ‘best practice’ and ‘standard of care’. Best practice integrates the best current research evidence with clinical expertise, client values, and available resources to achieve optimum results across broad spectrums of patients. Standard of care, on the other hand, has its origins in law related to medical malpractice and in a descriptive sense, refers to the prevailing or routine practice patterns among a given group of health care providers (8). Confusing the matter further was the apparent view among some experts that standard of care equates to the minimal, acceptable level of care while best practices suggests optimal or ideal treatment.

The need for better and more open channels of communication was stressed in focus group findings (Chapter 2) and together with appropriate forms of support and information, will lead to realistic and shared expectations and enhanced patient satisfaction and outcomes (9, 10). Clinicians are encouraged to engage patients’ family members in these communication efforts, and rehabilitation planning and delivery.

While results of the systematic reviews do not clearly show any one form of physiotherapy as being superior on post-operative pain, function and HRQoL after THA and TKA, the synthesized evidence may guide practitioners and patients on appropriate treatment options. Appropriate interventions were further delineated through the Delphi survey thus demonstrating the value in following a systematic review with a formal consensus process when the evidence is too weak or limited to make sound recommendations. Certain patient subgroups may benefit from different forms of rehabilitation and levels of professional supervision at different stages of recovery, yet the evidence doesn’t yet indicate who needs what and when.
As noted earlier, the recommendations summarized above are, in my opinion, not terribly original or progressive in nature. Nevertheless, the recommendations were generated from synthesizing the available evidence and encompass a broad range of experiences and practice environments. In keeping with the principles of evidence-based practice, clinicians are encouraged to integrate these recommendations with clinical expertise and patient values (11). Evidence alone is not patient-specific and study participant characteristics and group findings may not be relevant to the individual patient in a given clinical context. Clinical judgement and judicious application of the evidence is necessary for best practice. In light of the evidence and reported practice variation, PTs and other rehabilitation providers are encouraged to examine their treatment approaches and outcome evaluation methods to reflect best practice.

Study participants cited several challenges to routinely evaluating outcomes: lack of time, limited knowledge of available tools, and low or uncertain value in the clinical setting. Yet routine use of valid, reliable and responsive measures in clinical practice would inform clinical decision making by identifying which patients respond more of less favourably to each intervention (12). Documenting outcomes is important not only to individual practitioners and patients, but the routine documentation of key outcomes would enable chart reviews and program evaluation to occur, further enhancing clinical decisions by identifying trends across patients, settings and time.

7.4 Implications for future research
A number of important research questions should be addressed in TJA rehabilitation. These include identifying those individuals who would most benefit from structured post-acute rehabilitation and specific approaches. The amount of health professional supervision necessary for optimal outcomes has not been established and warrants further study because this has implications for both patient safety and resource allocation. While the timing of post-acute
rehabilitation was considered important by THA and TKA expert panelists in our Delphi studies (Chapters 5 and 6), specific recommendations did not arise, nor did the literature (Chapters 3 and 4) shed much light. The quasi-randomized controlled trial of a standardized rehabilitation intervention done at different points along the rehabilitation process by Scherak et al. (13) is an example of work that would help answer this question. The component of TJA rehabilitation that requires most attention is dosage – that is, the frequency, duration and number of treatment sessions. While two-thirds of Delphi panelists felt these should be based on the patient’s needs, decision- and policy-makers continue to allocate resources based on these treatment parameters.

Randomized trials are needed to test: (1) the essential components of an active rehabilitation protocol following TJA that should be promoted as the standard of care to optimize patient outcomes; (2) the value of alternative rehabilitation interventions (i.e. treatment adjunct) in addition to the standard of care; (3) head-to-head comparisons to identify which interventions are superior under what circumstances; and (4) economic analyses to determine the short- and long-term costs and outcomes (effects) of different rehabilitation approaches. Establishment of a consistent standard of care across providers and treatment settings would reduce the problems faced by individuals undergoing TJA, their health care providers and researchers trying to compare alternative or new and innovative rehabilitation interventions against a common baseline. A RCT with treatment arms differing only by frequency, duration, number of rehabilitation sessions or exercise intensity would help to determine the fundamental components for a best practice protocol. Finally, RCTs are not always achievable for rehabilitation interventions and individualized patient care. Well designed controlled clinical trials (CCTs) that match interventions to patient choice, motivation and other personal characteristics would increase our understanding on the extent to which these factors influence rehabilitation outcomes.
7.5 Implications for health care policy

Making clinical practice recommendations that challenge beliefs, current practices, available resources and funding allocation for rehabilitation care after TJA, has policy implications at many levels. At the individual patient level, a standard of care for post-acute rehabilitation is established in most settings throughout Canada and the US and deviating from this may be viewed as unacceptable. On the other hand, some patients may be aware that this standard differs greatly from one health care setting to another which leads to frustration, dissatisfaction and the seeking out of alternative surgeons and hospitals for their TJA surgery and rehabilitation (7).

From a health care facility or organization perspective, this thesis presents managers and other decision makers with evidence on which to base programming, staffing and other resource allocation decisions. Departmental and facility managers should recognize the need for protocols that ensure seamless transfers of care along the rehabilitation continuum and across health care settings and jurisdictions. Decision makers should take from this research, experts’ recommendation that all individuals need some form of supervised rehabilitation after discharge from the acute care setting starting within one week for TKA and within three weeks for THA. Further, it is critical to understand that the lack of accumulated evidence is not evidence of a lack of effectiveness, but speaks to the need for high quality trials of specific interventions and consistent use of standardized outcome measures. There is a concern that recommendations from this work might be used to limit or restrict rehabilitation care for this rapidly growing and vulnerable patient population. Rather, the identified gaps in the research should push policy makers and funding agencies to invest more resources into examining this important phase of TJA surgery – a recommendation of the NIH more than 15 years ago (14). With the limited available research and omission of any economic evaluation in this thesis, it is inappropriate to conclude that any one form or dosage of post-acute rehabilitation is superior or more cost-
effective than another. Certainly cost of care studies are warranted before such decisions are made, to avoid any negative impact on the rate and extent of recovery following TJA and result in further long-term impairment, activity limitations and participation restrictions already evident in the literature. The sequence of studies presented in this thesis indicates that many forms of post-acute rehabilitation designed and delivered by health professionals enhance physical recovery and other meaningful patient outcomes. To withhold or limit post-acute physiotherapy after THA and TKA would be unacceptable both ethically and clinically in that it would compromise minimal standards of care, ignore individual patient needs, and potentially lead to poorer outcomes and an overall increase in direct and indirect costs (15). It is apparent from the literature that the rehabilitation provided does not enable many individuals to achieve their recovery potential following these elective procedures (16-21) thus reinforcing the need for more research to identify the most effective interventions.

The sheer number of THA and TKA surgeries performed each year in Canada and the US, and associated hospital and post-discharge costs, have implications at a health care system level (22). The projected growth in these procedures exceeds that of the aging of the population and thus governments and other payers need to carefully consider how they will fund future rehabilitation services to ensure equitable access to quality rehabilitation care and optimal patient outcomes and safety. The long-term implications of persistent disability as a result of incomplete recovery or insufficient rehabilitation on patients’ future health care utilization (e.g., need for revision surgery), mobility, functional limitations (e.g. risk of falls and injury) (14, 18, 23, 24) and secondary health problems associated with reduced activity levels (25, 26), are not known and may prove to be enormous.
7.6 Strengths and limitations

A strength of this thesis is its use of mixed methods, specifically, rigorous qualitative, systematic review and consensus generating methodologies to address the clinical questions (27). There are numerous reports of appropriate methods to develop evidence-based clinical practice guidelines (28) yet many fail to incorporate all potential stakeholders (29, 30) and most importantly, capture the views of patients or consumers from the outset (31). Our novel “patient veto” approach in the Delphi study ensured that the patient perspective was valued throughout the process. Using a qualitative approach to explore the topic of TJA rehabilitation and gain greater understanding of the issues facing stakeholders in Canada and the US, ensured subsequent phases were relevant and comprehensive in their scope. Rigorous systematic review methods are critical to producing quality evidence-based guidelines yet are often hampered, as was the case with our topic, by the limited number and/or poor quality of the primary studies. The Cochrane systematic review methodology provided a valuable framework with which to structure the reviews and the freely available online tools (32) and meta-analysis software (RevMan 5.0.2) enabled relatively straightforward analyses and reporting. A drawback of the Cochrane method was its emphasis on RCTs at the time our reviews were being planned; thus restricting the types of studies available to inform our guidelines and resulting in inconclusive findings as so many Cochrane reviews do.

The need for a formal consensus process was apparent from the beginning of this research and the Delphi group technique was well suited to address the study objectives and support the overall aim of ensuring diverse stakeholder involvement through all stages. Whether different panel composition or size, or an additional round would have led to greater consensus is unknown. It was apparent from panelists’ feedback that time needed to complete three questionnaires and the required reading prior to the first round and between rounds was significant and this would lead to a redesign of the Delphi approach in future research initiatives.
Overall, the approaches used to inform the next stages of practice guideline development were appropriate and methodologically sound.

As noted above and unlike other recent guideline initiatives (29, 33), we involved individuals with TJA and arthritis consumer organizations to include their needs, values and preferences in the guidelines (34) and to enhance the acceptability of the research. Creation of a multidisciplinary, international advisory group to provide direction to the research project ensured timely and valuable guidance from varied experts in TJA surgery and rehabilitation. Involvement of fellow researchers and study participants from Canada and the US as well as inclusion of trials from outside of North America, afforded greater understanding and appreciation of other health care systems and the challenges facing each. The number of researchers prepared to collaborate on different phases and the varied professional organizations in Canada and the US eager to contribute to the Delphi study through nominating panelists or offering to review and/or disseminate the findings was indicative of the importance and timeliness of this topic (Appendix M).

There are several limitations. The goal is to develop practice guidelines that will be applicable and feasible in both Canadian and American health care settings, so it was disappointing that despite the research plan, focus groups were limited to one American city. Important and different US patient experiences and rehabilitation practices may have been missed and therefore not considered in subsequent phases of the research. However, American panelists were successfully recruited for the Delphi surveys and important issues in the American context may have been captured at that stage. But since panel members were drawn from a limited number of US states and Canadian provinces (Appendix K) there remains a possibility that some relevant patient and practitioner experiences and expert views were missed, that could influence the uptake of North American guidelines. Future research will need to investigate whether the
practice recommendations are applicable and adoptable in both countries, given different health care systems.

Although the Cochrane methodology is considered the ‘gold standard’ for conducting and reporting systematic reviews, it favors narrow healthcare questions that can be answered by multiple, large RCTs with sufficient clinical and methodological homogeneity to allow for pooling of results (32). Limiting the two systematic reviews to controlled trials of physiotherapy interventions prevented consideration of other study designs that may have contributed important information in the development of clinical practice guidelines. Observational studies and other designs were identified through our comprehensive search strategies and will need to be examined for their potential to inform guideline recommendations, implementation and evaluation (35). Further, the reviews addressed a single aspect of post-acute rehabilitation, physiotherapy, and therefore, additional syntheses of the evidence are needed for other forms of rehabilitation.

7.7 Next steps
While important groundwork has been completed, we are not yet ready for clinical practice guidelines. There remain several unanswered questions and additional steps to complete the guideline development cycle and successfully implement the recommendations.

As noted earlier, additional systematic reviews are warranted for yet to be examined areas of TJA rehabilitation and consensus exercises needed to establish specific and detailed intervention recommendations. Most obviously, the best practice recommendations generated through this thesis research and future steps will need to be refined and subjected to critical review by stakeholders. As previously mentioned, a number of professional and consumer organizations expressed interest in reviewing drafts of the practice guidelines, an important step in guideline
development (6, 28, 36). Future work will involve developing and evaluating a multi-faceted knowledge transfer (KT) plan that will lead to changes in clinician behaviours and support at organization and policy levels to promote the adoption and maintenance of guideline recommendations (36-39). Individuals undergoing TJA surgery will play key roles in promoting the uptake of guideline recommendations and championing equitable and timely access to quality post-acute rehabilitation.

While the approach outlined by Davis et al. (36) was useful for initially conceptualizing the cyclic nature of guideline development and implementation, more contemporary KT models and theories have since been proposed that address complex innovations, (e.g. clinical practice guidelines) that may require significant practice or organizational change (40). One such model, the Ottawa Model of Research Use (OMRU) (Figure 7.2) is a good fit for this guideline initiative in that two of its primary assumptions are that “patients/clients play a key role in all aspects of the process” and “…both the societal and health-care external environments will affect all aspects of the process and must be considered” (40)(p.93). Some of the initial work depicted in the left side of the OMRU figure (highlighted in blue) has been addressed through this thesis. Potential adopters of the guidelines and their attitudes and current rehabilitation practices were explored through the focus groups. The Delphi process and focus groups helped to identify the varied personal (patient), social, structural and economic issues that may support or negatively impact adoption of the guidelines. This and/or other planned action approaches will facilitate the uptake of the clinical practice guidelines and ensure appropriate KT evaluation methods are used.
Figure 7.2 The Revised Ottawa Model of Research Use

The Revised Ottawa Model of Research Use

Assess barriers and supports

Monitor interventions and degree of use

Evaluate outcomes

Evidence-based innovation
- development process
- innovation attributes

Potential adopters
- awareness
- attitudes
- knowledge/skill
- concerns
- current practice

Practice environment
- patients
- culture/social
- structural
- economic
- uncontrolled events

Implementation intervention strategies
- barrier management
- transfer
- follow-up

Adoption
- intention
- use

Outcomes
- patient
- practitioner
- system
7.8 Thesis contribution

This research makes important contributions to clinical practice, health care policy and the research literature in TJA rehabilitation. We addressed a long overdue need for a comprehensive approach to determine optimum interventions, dosage and expected outcomes after THA and TKA (14). As a result of this thesis and publication of its chapters, it is expected that greater attention will be directed towards the rehabilitation phase of the TJA continuum and more high quality research will be conducted on the topic. The results of our research underline the value of a mixed methods approach and use of qualitative data to explore and fully appreciate the diverse needs and attitudes of stakeholders who will be impacted by the ensuing guidelines.

This thesis has taken an important first step in identifying appropriate rehabilitation interventions and health care resources to optimize individuals’ activity, participation and HRQoL. It is now possible to proceed with the next steps in developing guidelines and their eventual testing in well-designed clinical trials. Until that time, the evidence gathered here will inform practice decisions for post-acute rehabilitation following primary THA and TKA in adults with OA.
7.9 References


Appendices
Appendix A: Multidisciplinary advisory group

(in alphabetical order)

Catherine Backman, PhD, OT(C), FCAOT
Department of Occupational Science and Occupational Therapy, University of British Columbia (UBC), Vancouver, BC

Mary Bell, PT, MSc, MD, FRCP(C)
Sunnybrook and Women’s College, University of Toronto, ON

Victoria Brander, MD
Northwestern Arthritis Institute, Chicago, IL

(Former Senator) Pat Carney, Consumer representative
Member of Consumer Advisory Board, Arthritis Research Centre of Canada, Vancouver, BC

Susan Carr, Dip PT
Mary Pack Arthritis Program, Vancouver, BC

J. Mark FitzGerald, MD, FRCP(C), PhD
Division of Respiratory Medicine, UBC & Vancouver General Hospital, Vancouver, BC

Nelson Greidanus, MD, FRCS(C), MPH
Department of Orthopaedics UBC

Dina Jones, PhD, PT
Department of Orthopaedics, West Virginia University, Morgantown, WV

Deborah Kennedy, BSc.PT, MSc.
Sunnybrook Holland Orthopaedic & Arthritic Centre, Toronto, ON

Matthew Liang, MD, FRCP, MPH
Brigham and Women’s Hospital, Boston, MA

Nizar Mahomed, MD, FRCS(C), ScD
Toronto Western Hospital, Toronto, ON
### Appendix B: Focus group key questions

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<tr>
<th>Guide Item</th>
<th>Patient/Consumer Format</th>
<th>Physician Format</th>
<th>AHP Format</th>
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| Transitional question | What rehabilitation or health services did you use after hip or knee surgery?  
Probes: physiotherapy, occupational therapy, nursing, exercises, home care, aids and devices from Red Cross or medical supply stores…. | What rehabilitation services do you recommend for your patients having THA and TKA surgery?  
Probes: PT, OT, SW; public or private services; transportation, meals or home-help services | What rehabilitation services are you involved in providing for patients having THA and TKA surgery?  
Probes: pre-op, acute care, post-op; treatment, counseling, education, planning |
| Key question #1 | Think back to that period after you were discharged from hospital. What parts of your rehabilitation or health services were most helpful? What parts would you change? | In your opinion, which rehabilitation services or interventions are most helpful to your patients? What aspects of current rehabilitation services are working well? What gets in the way of providing best care to these clients? | In your opinion, which rehabilitation services or interventions are most helpful to patients after these surgeries? What aspects of current rehabilitation are working well? Not well? What gets in the way of providing best care? |
| Key question #2 | We are now going to shift from talking about rehabilitation issues and look at the outcomes or results of surgery and rehabilitation. What results are most important to you following your hip or knee surgery?  
Probes: short term & long term; ability to walk, play, work; managing pain; doing things you used to do before surgery | We are now going to shift from talking about rehabilitation issues and look at the outcomes surgery and rehabilitation. In your opinion, what outcomes are most important following THA and TKA surgery?  
Probes: short term & long term; outcomes related to function, activity, participation, QOL | We are now going to shift from talking about rehabilitation issues and look at the outcomes of surgery and rehabilitation. In your opinion, what outcomes are most important following THA and TKA surgery?  
Probes: short term & long term; outcomes related to function, activity, participation, QOL |
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<th>Physician Format</th>
<th>AHP Format</th>
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<td>Key question #3</td>
<td>How should these results outcomes be measured? That is, how will you know the surgery was successful? Probes: patient questionnaire, assessment by health professional</td>
<td>How should these outcomes be measured? Probes: How often? By whom?</td>
<td>How should these outcomes be measured? Probes: How often? By whom?</td>
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<tr>
<td>Key question #4</td>
<td>When this project is finished, and we have guidelines for rehabilitation after hip and knee surgery, what’s the best way to inform patients about these guidelines? Probes: arthritis consumer networks, newsletters, internet, through doctor or surgeon</td>
<td>When this project is finished, and we have guidelines for rehabilitation after THA and TKA, what’s the best way to inform surgeons/physicians about these guidelines? What would it take for you to implement the recommendations into your practice? What might get in the way of you implementing the guidelines?</td>
<td>When this project is finished, and we have guidelines for rehabilitation after THA and TKA, what’s the best way to inform rehab professionals about these guidelines? What would it take for you to implement the recommendations into your practice? What might get in the way of you implementing the guidelines?</td>
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Appendix C: UBC Ethics certificates of approval

The University of British Columbia
Office of Research Services
Behavioural Research Ethics Board
Suite 102, 6199 Agronomy Road, Vancouver, B.C. V6T 1Z3

CERTIFICATE OF APPROVAL - MINIMAL RISK RENEWAL

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<tr>
<td>Catherine L. Backman</td>
<td>UBC/Medicine, Faculty of/Rehabilitation Sciences</td>
<td>H05-3C021</td>
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<td>Vancouver General Hospital</td>
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<td>Marie Wesby</td>
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<tr>
<td>Nelson Greidanus</td>
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<tr>
<td>Susan Carr</td>
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<td>Multidisciplinary Clinical Practice Guidelines for Total Hip and Knee Arthroplasty Rehabilitation: Phase 1 Focus Groups</td>
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EXPIRY DATE OF THIS APPROVAL: March 10, 2008

APPROVAL DATE: March 10, 2007

The Annual Renewal for Study have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.

Approval is issued on behalf of the Behavioural Research Ethics Board and signed electronically by one of the following:

Dr. Peter Suedfeld, Chair
Dr. Jim Rupert, Associate Chair
Dr. Aminse Kazanjian, Associate Chair
Dr. M. Judith Lynam, Associate Chair
CERTIFICATE OF APPROVAL - MINIMAL RISK

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<tr>
<td>Marie Westby</td>
<td>UBC/Medicine, Faculty of/Physical Therapy</td>
<td>H07-02272</td>
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**INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT:**

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<td>Vancouver (excludes UBC Hospital)</td>
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<tr>
<td>Vancouver Coastal Health (VCHRI/VCHA)</td>
<td>Mary Pack Arthritis Centre</td>
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Other locations where the research will be conducted:
On-line or paper version of surveys will be completed at participant’s home or place of work.

**CO-INVESTIGATOR(S):**
Asako Brittain
Catherine L. Backman
Matthew H. Liang

**SPONSORING AGENCIES:**
British Columbia Medical Services Foundation

**PROJECT TITLE:**
Developing consensus on best practice for hip and knee replacement rehabilitation.

**CERTIFICATE EXPIRY DATE:** February 20, 2009

**DATE APPROVED:** February 20, 2008

**DOCUMENTS INCLUDED IN THIS APPROVAL:**

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<td>Letter of Initial Contact:</td>
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<td>January 17, 2008</td>
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The application for ethical review and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.

*Approval is issued on behalf of the Behavioural Research Ethics Board*
and signed electronically by one of the following:

Dr. M. Judith Lynam, Chair
Dr. Ken Craig, Chair
Dr. Jim Rupert, Associate Chair
Dr. Laurie Ford, Associate Chair
Dr. Daniel Salhani, Associate Chair
Dr. Anita Ho, Associate Chair
Appendix D: Sample search strategy for THA

MEDLINE (OVID) Search Strategy using the EBM Filter for Therapy (Phase 3 Study)
1. arthroplasty, replacement, hip/
2. hip prosthesis/
3. joint prosthesis/
4. (hip adj5 (arthroplast$ or replac$ or prosth$)).mp.
5. or/1-4
6. physical therapy techniques/ or cryotherapy/ or electric stimulation therapy/ or transcutaneous
electric nerve stimulation/ or hydrotherapy/
7. exercise movement techniques/ or exercise/ or exercise therapy/ or walking/
8. rehabilitation/ or "activities of daily living"/ or early ambulation/
9. Postoperative Care/
10. Ambulatory Care/
11. (physiotherap$ or physio therap$ or pt).mp.
12. therap$.mp.
13. rehab$.mp.
14. or/6-13
15. "Recovery of Function"/
16. "Quality of Life"/
17. Health Status/
18. "outcome and process assessment (health care)"/ or "outcome assessment (health care)"/ or
treatment outcome/ or treatment failure/ or "process assessment (health care)"/
19. (outcome$ adj3 (assess$ or measur$)).mp.
20. pain$.mp.
21. (function$ adj5 (mobili$ or outcome$)).mp.
22. (quality adj3 life).mp.
23. (QOL or HRQOL).mp.
24. ambulat$.mp.
25. gait.mp.
26. (walk adj5 (speed or distance$)).mp.
27. or/15-26
28. Randomized Controlled Trial.pt.
29. controlled clinical trial.pt.
30. randomized controlled trials.sh.
31. random allocation.sh.
32. double blind method.sh.
33. single blind method.sh.
34. or/28-33
35. (animals not human).sh.
36. 34 not 35
37. Clinical Trial.pt.
38. exp Clinical Trials/
40. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or maks$)).ti,ab.
41. placebos.sh.
42. placebo$.ti,ab.
43. random$.ti,ab.
44. research design.sh.
45. or/37-44
46. 45 not 35
47. comparative study.sh.
48. exp evaluation studies/
49. follow up studies.sh.
50. prospective studies.sh.
51. (control$ or prospectiv$ or volunteer$).ti,ab.
52. or/47-51
53. 52 not 35
54. or/36,46,53
55. 5 and 14
56. 5 and 14 and 27
57. 5 and 14 and 27 and 54
58. limit 57 to yr="1990 - 2008"
Appendix E: Sample search strategy for TKA

MEDLINE (OVID) Search Strategy using the EBM Filter for Therapy (Phase 3 Study)

1. Arthroplasty, Replacement, Knee/
2. Knee Prosthesis/
3. ((knee or knees) adj5 (arthroplast$ or replac$ or prosth$)).mp.
4. joint prosthesis/ and (knee or knees).mp.
5. or/1-4
6. physical therapy techniques/ or cryotherapy/ or electric stimulation therapy/ or transcutaneous
electric nerve stimulation/ or hydrotherapy/
7. exercise movement techniques/ or exercise/ or exercise therapy/ or walking/
8. rehabilitation/ or "activities of daily living"/ or early ambulation/
9. Postoperative Care/
10. Clinical Protocols/
11. Ambulatory Care/
12. Rehabilitation Centers/
13. Home Care Services/
14. (physiotherap$ or physio therap$ or pt).mp.
15. therap$.mp.
16. rehab$.mp.
17. or/6-16
18. Pain, Postoperative.pc [Prevention & Control]
19. "Recovery of Function"/
20. "Quality of Life"/
21. Health Status/
22. "outcome and process assessment (health care)"/ or "outcome assessment (health care)"/ or
treatment outcome/ or treatment failure/ or "process assessment (health care)"/
23. (outcome$ adj3 (assess$ or measur$)).mp.
24. pain$.mp.
25. (function$ adj5 (mobili$ or outcome$)).mp.
27. (QOL or HRQOL).mp.
28. ambulat$.mp.
29. gait.mp.
30. (walk$ adj5 (speed or distance$)).mp.
31. or/18-30
32. Randomized Controlled Trial.pt.
33. controlled clinical trial.pt.
34. randomized controlled trials.sh.
35. random allocation.sh.
36. double blind method.sh.
37. single blind method.sh.
38. or/32-37
40. 38 not 39
41. Clinical Trial.pt.
42. exp Clinical Trials/
43. (clin$ adj25 trial$).ti,ab.
44. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).ti,ab.
45. placebo$.sh.
46. placebo$.ti,ab.
47. random$.ti,ab.
48. research design.sh.
49. or/41-48
50. 49 not 39
51. comparative study.pt.
52. exp evaluation studies/
53. follow up studies.sh.
54. prospective studies.sh.
55. (control$ or prospectiv$ or volunteer$).ti,ab.
56. or/51-55
57. 56 not 39
58. or/40,50,57
59. 5 and 17
60. 5 and 17 and 31
61. 5 and 17 and 31 and 58
62. limit 61 to yr="1990 - 2008"
63. limit 62 to english language
64. 62 not 63
Appendix F: Letter of introduction for professional organizations

Mary Pack Arthritis Program  
895 West 10th Ave.  
Vancouver, BC V5Z 1L7  
Canada  
Phone: (604) 875-4040  
Fax: (604) 875-4022

[Today’s date]

To Whom It May Concern [name if available]:

We are seeking the [name of organization]’s participation in a project to develop evidence-based clinical practice guidelines for rehabilitation following total hip (THR) and total knee (TKR) replacement. Currently no practice guidelines exist and rehabilitation care varies greatly across Canada and the United States. Our Cochrane systematic reviews have revealed significant gaps in the THR and TKR rehabilitation literature making it difficult for clinicians and patients to make informed decisions about their care.

We are conducting a Delphi survey to gather expert opinion from clinicians and researchers knowledgeable in THR and/or TKR surgery and rehabilitation. Through a series of 3 online anonymous questionnaires, participants will contribute to best practice recommendations for parts of the guidelines lacking clear research evidence. This expert panel will be comprised of allied health professionals, orthopaedic reconstructive surgeons, other physicians and patients.

Participating experts must have effective English writing skills and commit to responding to 3 questionnaires over 4 months beginning later this [date 2008].

Clinician experts should:
- Have minimum 5 years clinical experience with THR and/or TKR care
- Provide care/services beyond the acute care setting/phase (e.g., outpatients, homecare, community)
- Treat a sufficient volume of THR and/or TKR patients/year (e.g., at least 50 patients/year)
- Be viewed as a “clinical expert” or “consultant” to other clinicians at local or provincial/state level

Researcher experts should have a faculty appointment and:
- Have published on the topic (e.g., 2 or more papers specific to THR/TKR surgery or rehabilitation, including review papers, epidemiological or clinical studies)

We believe it is important that your professional organization be represented on this expert panel and ask that you please nominate individuals to participate in the Delphi survey. An information letter will be sent to nominated individuals.

Forward these names and contact information to: Marie Westby (marie.westby@vch.ca) by March 28, 2008.

The clinical guidelines project is funded by the Canadian Institutes of Health Research, The John Insall Foundation for Orthopaedics and the British Columbia Medical Services Foundation.

Thank you for your help with this important project.

Sincerely,

Marie Westby, BSc(PT), PhD Candidate  Catherine Backman, PhD, OT(C)  
Principal Investigator  Co-investigator
Appendix G: Letter of introduction for consumer organizations

Mary Pack Arthritis Program
895 West 10th Ave.
Vancouver, BC V5Z 1L7
Canada
Phone: (604) 875-4040
Fax: (604) 875-4022

[Today’s date]

Dear [name]:

We are seeking the [name of organization]’s participation in a project to develop clinical practice guidelines for rehabilitation following total hip (THR) and total knee (TKR) replacement surgery. Currently no practice guidelines exist and rehabilitation care varies greatly across Canada and the United States. Recent focus groups with patients and health professionals as well as a thorough review of the literature confirms there are major gaps and inconsistencies in THR and TKR rehabilitation making it difficult for clinicians and patients to make informed decisions about their care.

We are conducting a Delphi survey to gather expert opinion from various groups knowledgeable in THR and/or TKR surgery and rehabilitation. Through a series of 3 online anonymous questionnaires, participants will contribute to best practice recommendations for parts of the guidelines lacking clear research evidence. This expert panel will be comprised of individuals who have had a THR or TKR, allied health professionals (e.g. physiotherapists), orthopaedic surgeons and other physicians.

Participating “patient” experts must have effective English writing skills and commit to responding to 3 questionnaires over 4 months beginning later this [date 2008].

Patient experts should:
- Have had a primary (first time) THR or TKR for osteoarthritis within the past 2 years
- Have taken part in some type of rehabilitation or exercise therapy after their surgery
- Have some knowledge about the issues being studied (rehabilitation after joint replacement surgery)
- Live in Canada or the US
- Have high speed e-mail and Internet access at home or at work

We believe it is important that your organization be represented on this expert panel and ask that you please nominate members to participate in the Delphi survey. An information letter will be sent to nominated individuals providing more details about this study.

Please forward these names and contact information to: Marie Westby (marie.westby@vch.ca) by [date 2 weeks from today].

The clinical guidelines project is funded by the Canadian Institutes of Health Research, The John Insall Foundation for Orthopaedics and the British Columbia Medical Services Foundation.

Thank you for your help with this important project.

Sincerely,

Marie Westby, BSc(PT), PhD Candidate   Catherine Backman, PhD, OT(C)
Principal Investigator         Co-investigator
Appendix H: Delphi questionnaire sections

A: Need for post-acute rehabilitation after primary THA/TKA for osteoarthritis (OA)

B: Providers of post-acute rehabilitation after primary THA/TKA

C: Format of post-acute rehabilitation after primary THA/TKA

D: Timing of post-acute rehabilitation after primary THA/TKA

E: Setting for post-acute rehabilitation after primary THA/TKA

F: Types of post-acute rehabilitation interventions after primary THA/TKA

G: Dosage of post-acute rehabilitation after primary THA/TKA

H: Patient outcomes after primary THA/TKA

I: Measuring patient outcomes after primary THA/TKA

J: Follow-up services after primary THA/TKA
Appendix I: Delphi round 3 questionnaire

Dear Panelist,

This is the final questionnaire. Your responses will inform the best practice recommendations for rehabilitation after primary total hip (THR) and total knee (TKR) replacement for osteoarthritis (OA). Recall that we are focusing on POST-ACUTE REHABILITATION for PRIMARY THR and TKR for OA.

In this third Delphi questionnaire on THR surgery, you are asked to do 5 things:

1. **READ** the introduction and instructions at the beginning of each section. Some of the instructions have changed from Round 2.
2. **ANSWER** all of the questions in each of the 10 sections.
3. **REFER TO** the Round 2 feedback while completing the questionnaire. It is important that you have reviewed the responses and panelist comments prior to starting Round 3. Remember, terms in blue font can be found in the Glossary and new terms are included in the e-mail attachment sent earlier.
4. **MAKE COMMENTS** on any topics or items you wish in the comment box provided at the end of each section. If you feel a removed item warrants further discussion, suggest this in the comment box and it will be noted in the discussion of the Delphi manuscript.
5. **COMPLETE** this final questionnaire by **Friday June 12, 2009**. We will send you a reminder notice 3 days before this deadline.

Final tips:
- Items that were important to patient panelists but not 50% of the overall vote are once again marked with an (*).
- Checklist items that were selected by 100% of panelists in both Rounds have been noted after the question and you will not need to select them again.
- If you select ‘strongly disagree’ or ‘disagree’ for any of the key statements, you will not see the specific items related to that statement. Refer to the Round 2 feedback to see what items you skipped.

1. Indicate your level of agreement with the following statement:
   When developing best practice recommendations for post-acute rehabilitation after primary THR for OA, it is important to specify or distinguish between an early and a late phase.
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Neutral
   - [ ] Agree
   - [ ] Strongly Agree
2. Complete the following sentence:
The early phase of post-acute rehabilitation after primary THR surgery starts after discharge from the acute care ward/setting and lasts until approximately: (Select one only)
- 3 weeks post-op (post-surgery)
- 4 weeks post-op
- 6 weeks post-op
- 8 weeks post-op
- 12 weeks post-op
- 16 weeks post-op
- Other (please specify)

3. Complete the following sentence:
The late phase of post-acute rehabilitation after primary THR surgery starts immediately after the early phase and lasts until approximately: (Select one only)
- 8 weeks (2 months) post-op (post-surgery)
- 12 weeks (3 months) post-op
- 16 weeks (4 months) post-op
- 20 weeks (5 months) post-op
- 6 months post-op
- 8 months post-op
- 12 months post-op
- Other (please specify)

4. Indicate your level of agreement with the following statement:
When developing best practice recommendations for post-acute rehabilitation after primary THR for OA, it is important to consider a ‘maintenance’ phase (e.g. post-rehab, often community-based).
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree
5. Comments on stages of rehabilitation:

Individualized Approaches
Another theme that arose was the need for individualized approaches based on patients’ needs, health status and progress.

6. Indicate your level of agreement with the following statement:
The clinical practice guidelines for post-acute rehabilitation after primary THR for OA should clearly acknowledge the importance of individual or patient-specific needs and preferences when applying best practice recommendations (e.g. 'best practice' guidelines are not a substitute for clinical judgment and individual patient needs).

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

7. Section comments:
SECTION A: Need for post-acute rehabilitation after a primary THR for OA.
In this section, we are interested in your opinion on the need for structured post-acute rehabilitation after a primary THR for OA and the contextual factors that contribute to this need. Structured rehabilitation is a planned approach aimed at helping a patient recover from surgery. It includes individual assessment on which to base an organized program of treatment, education and outcome evaluation specific to THR surgery.

8. Indicate your level of agreement with the following statement:
   Patients should be offered structured post-acute rehabilitation after primary THR for OA.
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Neutral
   - [ ] Agree
   - [ ] Strongly Agree

9. Indicate your level of agreement with the following statement:
   It is important to screen patients pre-operatively to assess their need for structured post-acute rehabilitation after primary THR.
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Neutral
   - [ ] Agree
   - [ ] Strongly Agree

10. Indicate your level of agreement with the following statement:
    Personal (patient) factors contribute to the need for structured post-acute rehabilitation after primary THR.
    - [ ] Strongly Disagree
    - [ ] Disagree
    - [ ] Neutral
    - [ ] Agree
    - [ ] Strongly Agree
11. Personal factors that influence a patient’s need for structured rehabilitation after primary THR are: (Select all that apply)

- Age
- General health/co-morbidities
- Body weight (body mass index)
- Fitness/physical activity level
- Pain status
- Physical functional status
- Psychological status (e.g. anxiety)
- Cognitive (mental) status
- Patient's goals and expectations
- Lower limb muscle function
- Patient’s attitude (e.g. positive or negative)
- Patient’s engagement in the rehabilitation process (e.g. active participant)
- Patient empowerment
- Other (please specify)

12. Indicate your level of agreement with the following statement:
External (environmental) factors contribute to the need for structured post-acute rehabilitation after primary THR.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

13. External factors that influence a patient's need for structured post-acute rehabilitation after primary THR are: (Select all that apply)

- Support from spouse and immediate family
- Support from friends
- Surgeon/physician's attitude or beliefs about need for structured rehabilitation
- Health care systems and policies
14. Comments on Section A:

15. Indicate your level of agreement with the following statement:
Post-acute rehabilitation after primary THR should be provided by trained professionals with knowledge and clinical experience in arthritis and THR surgery.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

16. Health care and other professionals who should routinely provide post-acute rehabilitation after primary THR are:

<table>
<thead>
<tr>
<th>Professional</th>
<th>Yes</th>
<th>No</th>
<th>Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical therapist (PT)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupational therapist (OT)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rehabilitation assistant/PT assistant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Community nurse</em></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
17. Indicate your level of agreement with the following statement:
   Standardized, evidence-based training should be available to health professionals in order that they have the knowledge and skills to provide safe and effective rehabilitation care to individuals undergoing THR.
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Neutral
   - [ ] Agree
   - [ ] Strongly Agree

18. Comments on availability of training:

19. Comments on Section B:
SECTION C: Format of post-acute rehabilitation after a primary THR for OA.

In this section, we are interested in identifying the most appropriate format, structure and level of supervision for post-acute rehabilitation after primary THR for OA. Base your responses on the following scenario: patients had a typical acute care length of stay of 5 or fewer days, no peri-operative complications, and no issues related to access to or funding for post-acute rehabilitation. Also, set aside any local customs or current facility policies and think of best practice.

20. Indicate your level of agreement with the following statement:
   Patients require direct supervision by a health professional for post-acute rehabilitation after a primary THR for optimal patient outcomes.
   
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Neutral
   - [ ] Agree
   - [ ] Strongly Agree

21. Appropriate forms of directly supervised rehabilitation by a health professional after primary THR are: (Select all that apply)
   - [ ] Individual treatment (e.g. 1:1 physical therapy)
   - [ ] Group treatment (class with all THR patients)
   - [ ] Combination of individual and group treatment
   - [ ] Other (please specify)

22. Appropriate levels of supervision for group rehabilitation after primary THR are: (Base your responses on a 45-60 minute treatment session) (Select all that apply)
   - [ ] Not applicable - Group treatment not appropriate
   - [ ] One health professional to 3 or 4 patients (1:3-4)
   - [ ] One health professional to 5 or 6 patients (1:5-6)
   - [ ] Other (please specify)
23. Indicate your level of agreement with the following statement:
   It is appropriate for patients to do their post-acute rehabilitation after a primary THR with **indirect or reduced supervision** from a health or fitness professional.
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Neutral
   - [ ] Agree
   - [ ] Strongly Agree

24. Appropriate forms of **indirect or reduced supervision** for post-acute rehabilitation after primary THR are:

<table>
<thead>
<tr>
<th>Form of Supervision</th>
<th>Yes</th>
<th>No</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of a <strong>rehabilitation or PT assistant</strong> under the supervision of a <strong>physical therapist</strong>.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of a trained <strong>fitness professional</strong> under the supervision of a physical therapist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of a trained <strong>fitness professional</strong> under the supervision of a physician</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Self-directed</strong> rehabilitation/exercise program with health professional available on request</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-directed rehabilitation/exercise program with physical therapist consulting via telephone (<strong>Tele-rehab</strong>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-directed rehabilitation/exercise program with physical therapist consulting via video link/conference (<strong>Tele-rehab</strong>)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-directed rehabilitation/exercise program with PT consulting during scheduled surgical post-operative visits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-directed rehabilitation/exercise program with scheduled periodic checks by a PT</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

25. Comments on appropriate forms of **indirect or reduced** supervision:
26. Indicate your level of agreement with the following statement:
It is appropriate for patients to do their post-acute rehabilitation after a primary THR with no supervision from a health or fitness professional.

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

27. Appropriate forms of self directed post-acute rehabilitation after THR are:

<table>
<thead>
<tr>
<th>Form of Self-Directed Rehabilitation</th>
<th>Yes</th>
<th>No</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-directed rehabilitation/exercise program using an illustrated exercise sheet or booklet provided while in the acute care hospital</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Coaching from a family member who received exercise instruction from inpatient PT</td>
<td>[ ]</td>
<td>[ ]</td>
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</tr>
<tr>
<td>Web-based exercise illustrations or video</td>
<td>[ ]</td>
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</tr>
<tr>
<td>Self-directed home exercise program based on video provided from acute care site with a contact number for questions</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

28. Comments on appropriate forms of self directed rehabilitation:

29. Regardless of setting and available supervision, which of the following structured post-acute rehabilitation programs are appropriate following primary THR?

<table>
<thead>
<tr>
<th>Program Description</th>
<th>Yes</th>
<th>No</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>A multi-phased rehabilitation program based on level of medical supervision required (e.g. similar to a cardiac rehabilitation program)</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>A multi-phased rehabilitation program based on stages of tissue healing and recovery of muscle strength &amp; other physical milestones (e.g. similar to an ACL rehabilitation program)</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td><em>An open, flexible rehabilitation program that patients can participate in for as long as they feel necessary</em></td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
SECTION D: Timing of post-acute rehabilitation after a primary THR for OA.
This section looks at the timing of post-acute rehabilitation. Base your responses on the following scenario: patients had a typical acute care length of stay of 5 or fewer days, no peri-operative complications, and no issues related to access to or funding for post-acute rehabilitation. Also, set aside any local customs and current facility policies and think of best practice. Assume that patients were given an exercise and mobility program during their acute care stay.

31. Indicate your level of agreement with the following statement:
The timing of post-acute rehabilitation after a primary THR is important for optimal patient outcomes.
- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

32. How soon after a primary THR should post-acute rehabilitation (in whatever form it takes) be started? (Select one only)
- [ ] Within 1 week of surgery (immediately upon discharge from acute care ward/setting)
- [ ] Between 1 week and less than 3 weeks after surgery
- [ ] Between 3 weeks and less than 6 weeks after surgery
- [ ] Between 6 weeks and less than 9 weeks after surgery
- [ ] Between 9 weeks and less than 12 weeks (3 months)
- [ ] Between 12 weeks and less than 16 weeks (4 months)
- [ ] Anytime after 4 months and before 12 months
- [ ] Any time (e.g. timing doesn’t matter)
- [ ] Other (please specify)
33. Indicate your level of agreement with the following statement:
The timing of post-acute rehabilitation after THR depends on personal (patient) factors.
- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

34. Personal factors that influence the timing (start) of post-acute rehabilitation after primary THR are:
(Select all that apply)

- [ ] Status of surgical wound/tissue healing
- [ ] Post-operative pain level
- [ ] Peri-operative complications (e.g. infection, deep vein thrombosis, anemia)
- [ ] Physical functional status
- [ ] Cognitive status (e.g. ability to follow instructions, confusion)
- [ ] Patient’s attitude (e.g. positive or negative)
- [ ] Other (please specify)

35. Indicate your level of agreement with the following statement:
The timing of post-acute rehabilitation after primary THR depends on external (environmental) factors.
- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

36. External factors that influence the timing (start) of post-acute rehabilitation after primary THR are:
(Select all that apply)

- [ ] Availability of appropriate rehabilitation services in local area
- [ ] Waiting list for rehabilitation services
- [ ] Surgeon/physician's attitudes or beliefs about the timing of rehabilitation
- [ ] Access to appropriate transportation
Support from spouse and immediate family

Attitudes of spouse and immediate family

Other (please specify)

37. Comments on Section D:

38. Indicate your level of agreement with the following statement:
The setting for post-acute rehabilitation after primary THR is important for optimal patient outcomes.

Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree

39. Appropriate settings for post-acute rehabilitation after primary THR are:

<table>
<thead>
<tr>
<th>Setting</th>
<th>Yes</th>
<th>No</th>
<th>Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Out-patient clinic or department in a hospital</td>
<td></td>
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<tr>
<td>In-patient rehabilitation unit/ward of acute care hospital</td>
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<tr>
<td>In-patient rehabilitation facility (IRF)</td>
<td></td>
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<tr>
<td>In-patient post-acute care facility (Transitional Care Unit, SNF)</td>
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<tr>
<td>Person's home</td>
<td></td>
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<tr>
<td>Private physical therapy clinic</td>
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<td></td>
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<tr>
<td>Fitness/recreation center (e.g. community gym, private health club)</td>
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<td></td>
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</tr>
</tbody>
</table>
40. Comments on appropriate settings for rehabilitation:

41. Indicate your level of agreement with the following statement:
The setting for post-acute rehabilitation after primary THR depends on personal factors.

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

42. Personal factors that influence the choice of settings for post-acute rehabilitation after primary THR are: (Select all that apply)

- [ ] Age
- [ ] General health/co-morbidities
- [ ] Fitness/physical activity level
- [ ] Post-operative pain level
- [ ] Physical functional status
- [ ] Psychological status (e.g. anxiety)
- [ ] Cognitive (mental) status (e.g. ability to follow instructions, confusion)
- [ ] Communication/language skills
- [ ] Patient goals and expectations
- [ ] Patient’s engagement in the rehabilitation process (e.g. active participant)
- [ ] Surgical or peri-operative complications
- [ ] Other (please specify)
43. Indicate your level of agreement with the following statement:
The setting for post-acute rehabilitation after primary THR depends on external factors.

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

44. External factors that influence the choice of settings for post-acute rehabilitation after primary THR are: (Select all that apply)

- [ ] Availability of appropriate rehabilitation services in local area
- [ ] Waiting list for rehabilitation services
- [ ] Surgeon/physician's attitudes or beliefs about the setting for rehabilitation
- [ ] Access to appropriate transportation
- [ ] Support from spouse and immediate family
- [ ] Health care systems and policies
- [ ] Health insurance policies and coverage
- [ ] Home (design, layout, accessibility)
- [ ] Surgical procedure/approach (e.g. precautions)
- [ ] Community/health care provider’s attitudes or beliefs about the setting for rehabilitation
- [ ] Climate (weather) (e.g. for reasons of access, safety and mobility)
- [ ] Other (please specify) ____________

45. Comments on Section E:

No Answer
SECTION F: Types of post-acute rehabilitation interventions after primary THR for OA.
In this section, we are interested in the types of post-acute rehabilitation interventions that are appropriate after primary THR for OA. Base your responses on the following scenario: patients had a typical acute care length of stay of 5 or fewer days, no peri-operative complications, and no issues related to access to or funding for post-acute rehabilitation. Also, set aside any local customs or current facility policies and think of best practice. Assume that patients were given an exercise and mobility program during their acute care stay.
(Note: In this round, you will rate the importance of each intervention.)

46. Indicate your level of agreement with the following statement:
It is important to provide appropriate post-acute rehabilitation interventions following primary THR for optimal patient outcomes.

☐ Strongly Disagree
☐ Disagree
☐ Neutral
☐ Agree
☐ Strongly Agree

47. Appropriate and important post-acute rehabilitation interventions following primary THR are:
Therapeutic exercises

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Not appropriate</th>
<th>Appropriate but not important</th>
<th>Appropriate and somewhat important</th>
<th>Appropriate and very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active range of motion</td>
<td></td>
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</tr>
<tr>
<td>Stretching</td>
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<tr>
<td>Muscle strengthening</td>
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<tr>
<td>Postural training</td>
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<td></td>
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<tr>
<td>Back care</td>
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<td></td>
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<tr>
<td>Core/pelvic girdle stability training</td>
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<td></td>
</tr>
<tr>
<td>Home exercise program</td>
<td></td>
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<tr>
<td>Hydrotherapy (pool exercises)</td>
<td></td>
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</tr>
</tbody>
</table>

48. Comments on therapeutic exercises:

No Answer
49. Appropriate and important post-acute rehabilitation interventions following primary THR are:

**Functional exercises**

<table>
<thead>
<tr>
<th></th>
<th>Not appropriate</th>
<th>Appropriate but not important</th>
<th>Appropriate and somewhat important</th>
<th>Appropriate and very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static balance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic balance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stairs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rising/lowering to chair</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Rising/lowering to floor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agility training</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Getting in/out of car</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Getting in/out of bathtub</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Getting on/off toilet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dressing lower limbs (e.g. putting on socks/shoes)</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

50. Comments on functional exercises:

No Answer

51. Appropriate and important post-acute rehabilitation interventions following primary THR are:

**Gait training/movement re-education**

<table>
<thead>
<tr>
<th></th>
<th>Not appropriate</th>
<th>Appropriate but not important</th>
<th>Appropriate and somewhat important</th>
<th>Appropriate and very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct use and progression of walking aides (e.g. cane)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correction of altered gait pattern (e.g. limp, compensatory patterns)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight bearing status (e.g. ensuring proper amount of weight on operated side)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Gait training through forward/backward walking on treadmill”</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
52. Comments on gait training/movement re-education:

53. Appropriate and important post-acute rehabilitation interventions following primary THR are:

**Cardiovascular (CV) training**

<table>
<thead>
<tr>
<th>Not appropriate</th>
<th>Appropriate but not important</th>
<th>Appropriate and somewhat important</th>
<th>Appropriate and very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low to moderate intensity CV training (e.g. 55 - 70% HR max)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Use of appropriate CV machines (e.g. stationary bike, treadmill)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Pool-based CV activities (e.g. Aquafit)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

54. Comments on cardiovascular (CV) training:

55. Appropriate and important post-acute rehabilitation interventions following primary THR are:

**Electrical/thermal modalities**

<table>
<thead>
<tr>
<th>Not appropriate</th>
<th>Appropriate but not important</th>
<th>Appropriate and somewhat important</th>
<th>Appropriate and very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice/cryotherapy</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Superficial heat (hot packs)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td><em>Ultrasound (deep heat)</em></td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

56. Comments on electrical/thermal modalities:
57. Appropriate and important post-acute rehabilitation interventions following primary THR are:

**Manual therapy/techniques**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Not appropriate</th>
<th>Appropriate but not important</th>
<th>Appropriate and somewhat important</th>
<th>Appropriate and very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massage for swelling (e.g. effleurage)</td>
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<tr>
<td>Massage for scar mobility</td>
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<tr>
<td>Passive stretching techniques</td>
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<tr>
<td><strong>Proprioceptive neuromuscular facilitation (PNF)</strong> techniques (e.g. hold-relax)</td>
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</tr>
</tbody>
</table>

58. Comments on manual therapy/techniques:

No Answer

59. Appropriate and important post-acute rehabilitation interventions following primary THR are:

**Patient education topics**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Not appropriate</th>
<th>Appropriate but not important</th>
<th>Appropriate and somewhat important</th>
<th>Appropriate and very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring for complications (e.g. infection, deep vein thrombosis)</td>
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<tr>
<td>Position/movement restrictions (e.g. not bending hip &gt;90 degrees)</td>
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<tr>
<td>Return to driving</td>
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<tr>
<td>Sexual activity/safe positions</td>
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<tr>
<td>Safe use of toilet</td>
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<tr>
<td>Safe use of bath/shower</td>
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<tr>
<td>Return to recreational/sport activities</td>
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<tr>
<td>Ergonomics/work station set up</td>
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<tr>
<td>Use of assistive devices</td>
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<tr>
<td>Appropriate footwear</td>
<td></td>
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<tr>
<td>Use of medications for pain management</td>
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<tr>
<td>Use of non-medicaton techniques for pain management (e.g. deep breathing, relaxation, use of cold)</td>
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<tr>
<td>---------------------------------------------------------------</td>
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<tr>
<td>Body’s adjustment to new prosthetic joint</td>
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<tr>
<td>Leg length issues and management</td>
<td></td>
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<tr>
<td>Signs of overdoing exercise</td>
<td></td>
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<tr>
<td>Safe exercise intensity and progression</td>
<td></td>
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<tr>
<td>Wound care</td>
<td></td>
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<tr>
<td>Long term joint protection</td>
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<tr>
<td>Healthy eating</td>
<td></td>
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<tr>
<td>Prophylactic antibiotics for dental work</td>
<td></td>
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<tr>
<td>Sport-specific education for younger or more active patients (body mechanics, training program)</td>
<td></td>
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<tr>
<td>Self-management techniques</td>
<td></td>
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</tr>
<tr>
<td>Patient’s knowledge and understanding of the stages of recovery</td>
<td></td>
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</tr>
</tbody>
</table>

60. Comments on Section F:

SECTION G: Dosage of post-acute rehabilitation after primary THR for OA.
In this section we are interested in the overall dosage (duration, frequency, amount) of post-acute rehabilitation necessary for optimal patient outcomes after primary THR. Set aside any local customs or current facility policies and think of best practice.

61. Indicate your level of agreement with the following statement:
The overall dosage of post-acute rehabilitation after primary THR is important for optimal patient outcomes.

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree
62. For how long after primary THR should patients routinely participate in structured post-acute rehabilitation for optimal patient outcomes? (Select one only)

- Less than 4 weeks post-operative (post-op)
- Between 4 and 8 weeks post-op
- Between 8 and 12 weeks post-op
- Between 12 and 16 weeks post-op
- Between 16 and 20 weeks post-op
- Between 20 and 24 weeks post-op
- Between 6 weeks and 6 months post-op
- Start at 6 weeks post-op and continue for 6 weeks
- None of these, structured rehabilitation is not necessary
- Not sure
- Other (please specify) 

63. How often after a primary THR should patients routinely participate in structured post-acute rehabilitation for optimal patient outcomes? (Select one only)

- Once a week
- 2 to 3 times a week
- 4 to 5 times a week
- Daily
- Daily at home and once a week through out-patient PT
- Daily at home and 2 to 3 times a week through out-patient PT
- Individualized, based on patient's needs
- None of these, structured rehabilitation is not necessary
- Not sure
- Other (please specify) 

64. Should the frequency of post-acute rehabilitation sessions after primary THR vary over the course of recovery?

- Yes
- No
- Not sure
65. How many (total number) structured post-acute rehabilitation sessions/visits should patients routinely participate in after primary THR for optimal patient outcomes? (Select one only)

- [ ] Less than 5
- [ ] 5 to 9
- [ ] 10 to 14
- [ ] 15 to 19
- [ ] 20 to 24
- [ ] 36 sessions (based on 3 times a week for 12 weeks)
- [ ] *Individualized, based on patient's needs*
- [ ] Not sure
- [ ] None of these, structured rehabilitation is not necessary
- [ ] Other (please specify)

66. Indicate your level of agreement with the following statement:
The overall dosage of post-acute rehabilitation after primary THR depends on personal factors.

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

67. Personal factors that influence the overall dosage of post-acute rehabilitation after primary THR are: (Select all that apply)

- [ ] (Items that were selected by 100% of panelists in both Rounds: Physical response to rehabilitation)
  - General health (co-morbidities)
  - Age
  - Pain status
  - Patient's goals and expectations
  - Patient's engagement in the rehabilitation process (e.g. active participant)
  - Patient’s attitude (e.g. positive or negative)
  - Patient's motivation level
  - Patient's cognitive status (e.g. ability to follow instructions, confusion)
☐ Mismatch between patient’s physical status and self-identified goals
☐ Patient’s knowledge and understanding of the stages of recovery
☐ Other (please specify)

68. Indicate your level of agreement with the following statement:
The overall dosage of post-acute rehabilitation after primary THR depends on external factors.

☐ Strongly Disagree
☐ Disagree
☐ Neutral
☐ Agree
☐ Strongly Agree

69. External factors that influence the overall dosage of post-acute rehabilitation after primary THR are: (Select all that apply)

☐ Availability of appropriate rehabilitation in patient's local area
☐ Waiting list for rehabilitation services (e.g. pressure to discharge from rehabilitation)
☐ Support from spouse and immediate family
☐ Support from friends
☐ Health insurance policies (e.g. funding allotment for rehabilitation)
☐ Health care systems and policies
☐ Employer’s medical leave policies
☐ Surgeon’s preference and protocols
☐ Surgical procedure/approach (e.g. precautions)
☐ Transportation (access, services, policies)
☐ Other (please specify)

70. Comments on Section G:

No Answer
SECTION H: Patient outcomes after primary THR for OA.
We are interested in rehabilitation-related patient outcomes after primary THR for OA. Base your responses on outcomes that are appropriate to assess and/or monitor in a clinical setting. (Note: In this round you will rate the importance of each outcome.)

71. Indicate your level of agreement with the following statement:
It is important to routinely assess and/or monitor outcomes related to body structure and function during post-acute rehabilitation after primary THR.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

72. Appropriate and important body structure and function outcomes to routinely assess or monitor [if applicable] after primary THR are:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Not appropriate</th>
<th>Appropriate but not important</th>
<th>Appropriate and somewhat important</th>
<th>Appropriate and very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain at rest (level/intensity)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Pain with activity (walking, ADL)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Pain coping</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Sleep functions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Range of motion (operated joint)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Range of motion (other lower limb joints)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Leg length discrepancy (LLD)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Posture and alignment (spine and lower limbs)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Gait (pattern, use of aides, limp)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td><em>Joint stability (ligamentous laxity)</em></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Joint proprioception (position sense)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Muscle strength (operated leg)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Muscle strength (non-operated leg)</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Muscle strength (upper limbs)</td>
<td>○</td>
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<tr>
<td>Muscle voluntary activation (recruitment/timing)</td>
<td>○</td>
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<tr>
<td>Muscle atrophy (decreased muscle bulk)</td>
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<tr>
<td>Core stability (trunk/pelvic muscle control)</td>
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<tr>
<td>Soft tissue flexibility (muscle lengths, contractures)</td>
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<tr>
<td>Wound/tissue healing (scar mobility)</td>
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<tr>
<td>Energy and vigor</td>
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</tr>
</tbody>
</table>

73. Comments on appropriate body structure and function outcomes:

74. Indicate your level of agreement with the following statement:
   It is important to routinely assess and/or monitor outcomes related to activity and participation during post-acute rehabilitation after primary THR.

   - Strongly Disagree
   - Disagree
   - Neutral
   - Agree
   - Strongly Agree

75. Appropriate and important activity and participation outcomes to routinely assess or monitor [if applicable] after primary THR are:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Not appropriate</th>
<th>Appropriate but not important</th>
<th>Appropriate and somewhat important</th>
<th>Appropriate and very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static balance (standing still)</td>
<td></td>
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<tr>
<td>Dynamic balance (walking, during activities)</td>
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<tr>
<td>Walking speed (velocity)</td>
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<tr>
<td>Walking distance</td>
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<tr>
<td>Stair ascent/descent</td>
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<tr>
<td>Carrying and lifting</td>
<td></td>
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<tr>
<td>Ability to use public transportation</td>
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<tr>
<td>Ability to drive a vehicle</td>
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<tr>
<td>Activity</td>
<td>Yes</td>
<td>No</td>
<td>May</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
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<tr>
<td>Run errands and shop</td>
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<tr>
<td>Ability to perform self care (e.g. bathing, dressing)</td>
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<tr>
<td>Ability to attend social functions (e.g. theatre, sporting event)</td>
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<tr>
<td>Ability to participate in religious activities (e.g. pray, attend place of worship)</td>
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<tr>
<td>Ability to travel (e.g. air travel, bus tour)</td>
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<tr>
<td>Ability to do light household activities (e.g. cooking, dusting)</td>
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<tr>
<td>Ability to do moderate/heavy household activities (e.g. doing laundry, vacuuming, painting)</td>
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<tr>
<td>Ability to do light outdoor work (e.g. water plants)</td>
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<tr>
<td>Ability to do moderate/heavy outdoor work (e.g. rake leaves, shovel snow)</td>
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<tr>
<td>Ability to participate in sexual activity</td>
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<tr>
<td>Ability to perform care giving activities (e.g. to a child or spouse)</td>
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<tr>
<td>Ability to participate in low/moderate intensity leisure and sporting activities (e.g. walking, golf, water exercises)</td>
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<tr>
<td>Ability to participate in high intensity leisure and sporting activities (e.g. cross country skiing, hiking)</td>
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<tr>
<td>Ability to participate in paid employment</td>
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<tr>
<td>Ability to participate in unpaid/volunteer employment</td>
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</tbody>
</table>

76. Comments on **appropriate** activity and participation outcomes:

![Comments field](image)

No Answer
77. Indicate your level of agreement with the following statement:
It is important to routinely assess and/or monitor outcomes not captured by the ICF framework during post-acute rehabilitation after primary THR.

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

78. Other appropriate and important outcomes to routinely assess or monitor [if applicable] after primary THR are:

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Not appropriate</th>
<th>Appropriate but not important</th>
<th>Appropriate and somewhat important</th>
<th>Appropriate and very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health related quality of life (HRQoL)</td>
<td></td>
<td></td>
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<tr>
<td>Self efficacy for exercise</td>
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<tr>
<td>Self efficacy for rehabilitation</td>
<td></td>
<td></td>
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<tr>
<td>Patient satisfaction (with rehabilitation process and outcomes)</td>
<td></td>
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<tr>
<td>Patient knowledge (e.g. post-operative complications, precautions and process of rehabilitation)</td>
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<tr>
<td>Patient global assessment (i.e. self rating of how he/she is doing)</td>
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</tr>
<tr>
<td>Health professional/physician global assessment (i.e. physician rating of how patient is doing)</td>
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</tr>
</tbody>
</table>

79. Comments on other appropriate outcomes:
80. **Contextual (modifying) factors**
Indicate your level of agreement with the following statement:
Patient outcomes after primary THR depend on personal factors.

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

81. **Personal factors** that influence patient outcomes after primary THR are: (Select all that apply)

- [ ] Age
- [ ] General health/co-morbidities
- [ ] Body weight (body mass index)
- [ ] Other symptomatic joints
- [ ] Fitness/physical activity level
- [ ] Post-operative pain level
- [ ] Physical functional status
- [ ] Psychological status (e.g. anxiety, depressive symptoms)
- [ ] Patient's attitude (e.g. positive or negative)
- [ ] Patient's engagement in the rehabilitation process (e.g. active participant)
- [ ] Patient's goals and expectations
- [ ] Self-efficacy (e.g. self efficacy for exercise)
- [ ] Cognitive status (e.g. ability to follow instructions, confusion)
- [ ] Literacy level (i.e. ability to read and understand written instructions)
- [ ] Relationships with spouse and immediate family
- [ ] Relationships with friends
- [ ] Relationships with health professionals
- [ ] Cultural issues (i.e. beliefs, practices)
- [ ] Religious issues (i.e. beliefs, practices)
- [ ] Surgical or peri-operative complications
82. Indicate your level of agreement with the following statement:
Patient outcomes after primary THR depend on external factors.
- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

83. External factors that influence patient outcomes after primary THR are: (Select all that apply)
- Access to rehabilitation services (proximity to home, access to facility, hours of operation)
- Access to healthcare professionals (consultation, assessment, treatment)
- Attitudes of spouse and immediate family
- Attitudes of healthcare professionals
- *Attitudes of public agencies*
- *Societal attitudes*
- Support from spouse and immediate family
- *Support from friends*
- Financial situation (costs of rehabilitation/health care services/medications)
- Health insurance (access, coverage, policies)
- Transportation (access, services, policies)
- *Home (design, layout, accessibility)*
- *Work/school (design, layout, accessibility)*
- Educational products and materials (reading level, health literacy, translation)
- Access to products and technology for daily activities (adaptive equipment, devices)
- Access to products and technology for mobility (walking aides)
- *Climate (weather)*
- Health care systems and policies
Rehabilitation providers' knowledge and clinical skills (i.e. experience, competence)

Surgeon's knowledge and surgical skills (i.e. experience, competence)

*Type of implant (e.g. metal on high density polyethylene, large diameter head)*

Participation in a research project

Other (please specify)

84. Comments on Section H:

85. Indicate your level of agreement with the following statement:
   It is important to evaluate and/or monitor body structure and function outcomes in a consistent manner using appropriate tools or methods after primary THR for OA.
   - Strongly Disagree
   - Disagree
   - Neutral
   - Agree
   - Strongly Agree

86. Appropriate and feasible tools/methods to routinely evaluate or monitor body structure and function outcomes in a clinical setting after primary THR are: (i.e. "clinically feasible"):

<table>
<thead>
<tr>
<th>Tool/Method</th>
<th>Not appropriate</th>
<th>Appropriate but not feasible</th>
<th>Appropriate, feasible and optional</th>
<th>Appropriate, feasible and should do</th>
<th>Not Familiar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain visual analogue scale (VAS) (e.g. 10 cm line)</td>
<td></td>
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<tr>
<td>Numeric pain rating scale (NPRS) (e.g. 1 to 10)</td>
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<tr>
<td>Goniometer to assess passive ROM (e.g. standard 12 inch model)</td>
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</tr>
<tr>
<td>Goniometer to assess active ROM (e.g. standard 12 inch model)</td>
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<td></td>
</tr>
</tbody>
</table>

SECTION I: Evaluating patient outcomes after primary THR for OA

In this section, we are interested in tools and methods to evaluate and/or monitor patient outcomes during the post-acute phase following primary THR for OA in a clinical setting.

(Note: In this round you will rate the clinical feasibility of each tool/method.)
<table>
<thead>
<tr>
<th>Test Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual observation to assess passive ROM (e.g. estimating the amount of bend)*</td>
<td></td>
</tr>
<tr>
<td>Visual observation to assess active ROM (e.g. estimating the amount of bend)</td>
<td></td>
</tr>
<tr>
<td>Tape measure to assess equality of leg lengths (indirect method) (e.g. ASIS to medial/lateral malleolus)</td>
<td></td>
</tr>
<tr>
<td>Visual observation to assess equality of leg lengths (indirect method) (e.g. supine with knees bent, observe patella levels)</td>
<td></td>
</tr>
<tr>
<td>Lateral hip X-ray to assess ingrowth, positioning and stability of implant</td>
<td></td>
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<tr>
<td><em>Plumb line or grid to assess postural alignment</em></td>
<td></td>
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<tr>
<td>Visual observation to assess lower limb alignment (e.g. genu valgus or knock knees)</td>
<td></td>
</tr>
<tr>
<td>Goniometer to assess lower limb alignment (e.g. measure angle of deviation)</td>
<td></td>
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<tr>
<td>Visual observation to analyze gait (e.g. symmetry of stance/swing phase)</td>
<td></td>
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<tr>
<td>Trendelenburg Test/Sign</td>
<td></td>
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<tr>
<td><em>Patient's ability to reproduce a preset target angle to assess joint proprioception (joint position sense)</em></td>
<td></td>
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<tr>
<td>Skin sensation over operated limb</td>
<td></td>
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<tr>
<td>Manual muscle testing to assess muscle strength (e.g. Grades 0 to 5)</td>
<td></td>
</tr>
<tr>
<td>Isokinetic dynamometer to assess muscle strength (e.g. different velocities)</td>
<td></td>
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<tr>
<td>Hand-held myometer to assess isometric muscle strength (e.g. different joint positions)</td>
<td></td>
</tr>
<tr>
<td>Palpation and observation to assess voluntary activation &amp; muscle recruitment</td>
<td></td>
</tr>
<tr>
<td>Standardized test positions to assess flexibility and muscle lengths (e.g. Thomas Test for hip flexor length)</td>
<td></td>
</tr>
</tbody>
</table>
87. Comments on appropriate body structure and function tools:

88. Indicate your level of agreement with the following statement:
It is important to evaluate and/or monitor activity and participation outcomes in a consistent manner using appropriate tools or methods after primary THR for OA.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

89. Appropriate and feasible tools/methods to routinely evaluate or monitor activity and participation outcomes in a clinical setting after primary THR are: (i.e. "clinically feasible"):

<table>
<thead>
<tr>
<th>Tool Description</th>
<th>Not appropriate</th>
<th>Appropriate but not feasible</th>
<th>Appropriate, feasible and optional</th>
<th>Appropriate, feasible and should do</th>
<th>Not Familiar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timed walk to assess gait velocity (e.g. 10 meter timed walk)</td>
<td>☐</td>
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<tr>
<td>Timed Up and Go (TUG)</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Timed single leg stance to assess static balance (e.g. amount of time person can stand on one leg)</td>
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<tr>
<td>Functional Reach (FR) test (for balance)</td>
<td>☐</td>
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<tr>
<td>Repeated stands test (rising 10 times) (also called sit-to-stand test)</td>
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<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Timed stair ascent/descent</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>6 Minute Walk Test (6MWT)</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>WOMAC Osteoarthritis Index</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Short Form-12 (SF-12)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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<tr>
<td>Harris Hip Score</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Hip disability and Osteoarthritis Outcome Score (HOOS)</td>
<td>☐</td>
<td>☐</td>
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</tbody>
</table>
Performance battery (e.g. timed walk, stair climb and timed-up-and-go)

Single question: “Is there anything that you would like to do that you cannot do as a result of your hip replacement?”

Four square step test (FSST) (e.g. test of dynamic standing balance)

90. Comments on appropriate activity and participation tools:

91. Indicate your level of agreement with the following statement:
   It is important to evaluate and/or monitor outcomes not captured by the ICF framework in a consistent manner using appropriate tools or methods after primary THR for OA.
   - [ ] Strongly Disagree
   - [ ] Disagree
   - [ ] Neutral
   - [ ] Agree
   - [ ] Strongly Agree

92. Other appropriate and feasible tools/methods to routinely evaluate or monitor in a clinical setting after primary THR are: (i.e. "clinically feasible"): (Please select the appropriate level of appropriateness)

<table>
<thead>
<tr>
<th>Tool Description</th>
<th>Not appropriate</th>
<th>Appropriate but not feasible</th>
<th>Appropriate, feasible and optional</th>
<th>Appropriate, feasible and should do</th>
<th>Not Familiar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient satisfaction with functional outcome (e.g. numeric rating or visual analogue scale)</td>
<td>[ ]</td>
<td>[ ]</td>
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</tbody>
</table>

93. Comments on other appropriate tools:

No Answer
94. Indicate your level of agreement with the following statement:
Recommendations for outcome evaluation can be combined for patients with THR or TKR.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

95. Comments on Section I:

SECTION J: Follow-up services after primary THR for OA.
In this final section, we are interested in the follow-up services offered to individuals once any structured post-acute rehabilitation or therapy program is complete and the patient has been discharged from that setting or provider. Base your responses on the following scenario: a patient had a typical course of recovery during the post-acute phase; there were no peri-operative complications; and there are no issues related to access to or funding for follow-up services. Also, set aside any local customs or current facility policies and think of best practice

96. (For this question, base your responses on a short term follow-up period of up to 2 years.)
Indicate your level of agreement with the following statement:
It is important to monitor patients on a short term follow-up basis after primary THR.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

97. (For this question, base your responses on a short term follow-up period of up to 2 years.)
In the initial 2 years after THR, how often should a patient be monitored on a follow-up basis?
(Select one only)

- Monthly
- Every 2 to 3 months
- Every 4 to 5 months
- Every 6 months (twice a year)
98. Indicate your level of agreement with the following statement:
It is important to monitor patients on a long term follow-up basis after primary THR.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

99. For how long after primary THR should patients be seen/monitored on a long-term follow-up basis? (Select one only)

- Up to 1 year
- Up to 2 years
- Up to 3 years
- Up to 4 years
- Up to 5 years
- Up to 10 years
- Up to 15 to 20 years
- Indefinitely (lifetime)
- Lifetime at about every 3 years
- Lifetime at about every 5 years
- At 10 years post-op and then ongoing based on signs and symptoms of wear/failure
- Other (please specify)
100. Indicate your level of agreement with the following statement:

It is important that patients have access to appropriate follow-up services to address their needs in the initial 2 years after primary THR.

- [ ] Strongly Disagree
- [ ] Disagree
- [ ] Neutral
- [ ] Agree
- [ ] Strongly Agree

101. Appropriate forms of follow-up services in the initial 2 years after primary THR and after completion of any post-acute rehabilitation are: (Select all that apply)

- [ ] Telephone support from a health professional (as needed, initiated by patient)
- [ ] *Exercise booster session (with PT)*
- [ ] Community-based TJR exercise program
- [ ] Scheduled follow-up clinic visit with surgeon
- [ ] Scheduled session with PT after routine follow-up clinic visit with surgeon
- [ ] Scheduled session with PT and surgeon together during routine follow-up clinic visit
- [ ] Scheduled follow-up clinic visit with advanced practice PT (e.g. instead of surgeon)
- [ ] Other (please specify)

102. Who should routinely provide follow-up services in the initial 2 years after primary THR and after completion of any post-acute rehabilitation? (Select all that apply)

- [ ] Orthopaedic surgeon
- [ ] General/primary care physician
- [ ] Physician assistant (PA)
- [ ] Physical therapist
- [ ] Advanced practice physical therapist
- [ ] Any health professional trained for the task of follow-up
- [ ] Least expensive trained person with option for more trained person if needed
- [ ] Other (please specify)
103. Indicate your level of agreement with the following statement:
Recommendations for the type, frequency and duration of follow-up services can be combined for patients with primary THR or TKR.

- Strongly Disagree
- Disagree
- Neutral
- Agree
- Strongly Agree

104. Comments on Section J:
Appendix J: THA Delphi panelists

Deirdre Arntz, Seattle, WA, USA
Robert B. Bourne, MD, FRCSC, University of Western Ontario, London, ON, CAN
Pat Carney, Saturna Island, BC, CAN
Bruce Clark, PT, Laurel Rheumatology Centre, Vancouver, BC, CAN
David Dalury, MD, FRCS, Townson, MD, USA
Charles M. Davis III, MD, PhD, Penn State College of Medicine, Hershey, PA, USA
Aileen Davis, PT, PhD, Toronto Western Research Institute, Toronto, ON, CAN
Michael J. Dunbar, MD, PhD, FRSC, Dalhousie University, Halifax, NS, CAN
James Falconer, PTA, Toronto, ON, CAN
Caroline Fanti, PT, Thunder Bay Regional Health Sciences Centre, Thunder Bay, ON, CAN
Victoria Gall, PT, MEd, New England Baptist Hospital, Boston, MA, USA
Sandy Ganz, PT, DSc, The Hospital for Special Surgery, New York, NY, USA
Julie Gordon, PT, Saskatoon, SK, CAN
Nelson Greidanus, MD, FRCS, UBC, Department of Orthopaedic Surgery, Vancouver, BC, CAN
Kevin Harrison, OT, Fraser Health Authority, Vancouver, BC, CAN
John Hope, PT, MSc, Kingston, ON, CAN
Norman Johanson, MD, FRCS, Drexel University College of Medicine, Department of Orthopaedic Surgery, Philadelphia, PA, USA
Allyson Jones, Edmonton, AB, CAN
Mary Jurisson, MD, FRCP, Rochester, MN, USA
Lisa Konstantellis, PT, MS, Hospital for Special Surgery, New York, NY, USA
Robyn Laytham, Trail, BC, CAN
Allison Lieberman, MSPT, New York University Hospital for Joint Diseases, NY, USA
Maureen Loft, RN, ONC, London, ON, CAN
Anthony Magnaye, PT, Alberta Hip and Knee Clinic, Edmonton, AB, CAN
Bassam Masri, MD, FRCS, UBC, Department of Orthopaedic Surgery, Vancouver, BC, CAN
Garey Mazowita, MD, Providence Health Care, Vancouver, BC, CAN
Jess Parkyn, RN, ONC, Williamsport, PA, USA
Ann Read, MScPT, Queen Elizabeth II Health Sciences Centre, Halifax, NS, CAN
Susan Robarts, APP, Sunnybrook Holland Orthopaedic and Arthritis Centre, Toronto, ON, CAN
Mark Rossi, PT, PhD, Miami, FL, USA
Leslie Soever, APP, Mount Sinai Hospital, Toronto, ON, CAN
J. Carter Thorne, MD, FRCP, Newmarket, ON, CAN
Elaine Trudelle-Jackson, PT, PhD, Texas Woman's University School of Physical Therapy, Dallas, TX, USA
Glen Urquhart, BA, Volunteer Advocate, The Arthritis Society, Victoria, BC, CAN
Appendix K: Delphi panelists by geographic location (THA and TKA)
Appendix L: TKA Delphi panelists

Ralph M. Christensen, MD, FRCSC, UBC, Clinical Professor of Surgery Emeritus, Vancouver, BC, CAN
Bruce Clark, PT, Laurel Rheumatology Centre, Vancouver, BC, CAN
David Dalury, MD, FRCS, Townson, MD, USA
Charles M. Davis III, MD, PhD, Penn State College of Medicine, Hershey, PA, USA
Aileen Davis, PT, PhD, Toronto Western Research Institute, Toronto, ON, CAN
Michael J. Dunbar, MD, PhD, FRCSC, Dalhousie University, Halifax, NS, CAN
Patrick P. Embley, PT, Mary Pack Arthritis Program, Vancouver Coastal Health, BC, CAN
James Falconer, PT, Toronto, ON, CAN
Caroline Fanti, PT, Thunder Bay Regional Health Sciences Centre, Thunder Bay, ON, CAN
John Fenerty, Huntington Valley, PA, USA
Patricia Franklin, MD, MPH, University of Massachusetts Medical School, Worcester, MA, USA
Victoria Gall, PT, MEd, New England Baptist Hospital, Boston, MA, USA
Sandy Ganz, PT, DSc, The Hospital for Special Surgery, New York, NY, USA
Julie Gordon, PT, Saskatoon, SK, CAN
Nelson Greidanus, MD, FRCSC, UBC, Department of Orthopaedic Surgery, Vancouver, BC, CAN
Kevin Harrison, OT, Fraser Health Authority, Vancouver, BC, CAN
John Hope, PT, MSc, Kingston, ON, CAN
Norman Johanson, MD, FRCS, Drexel University College of Medicine, Department of Orthopaedic Surgery, Philadelphia, PA, USA
Allyson Jones, Edmonton, AB, CAN
Mary Jurisson, MD, FRCP, Rochester, MN, USA
Lisa Konstantellis, PT, MS, Hospital for Special Surgery, New York, NY, USA
Robyn Laytham, Trail, BC, CAN
Allison Lieberman, MSPT, New York University Hospital for Joint Diseases, NY, USA
Maureen Loft, RN, ONC, London, ON, CAN
Anthony Magnaye, PT, Alberta Hip and Knee Clinic, Edmonton, AB, CAN
Bassam Masri, MD, FRCSC, UBC, Department of Orthopaedic Surgery, Vancouver, BC, CAN
Garey Mazowita, MD, Providence Health Care, Vancouver, BC, CAN
Mary E. McCarthy, RNC, Mead, WA, USA
Ryan L. Mizner, PT, PhD, University of Montana, Missoula, MT, USA
Carol Oatis, PT, PhD, Arcadia University, Glenside, PA, USA
Jess Parkyn, RN, ONC, Williamsport, PA, USA
Ann Read, MScPT, Queen Elizabeth II Health Sciences Centre, Halifax, NS, CAN
Susan Robarts, APP, Sunnybrook Holland Orthopaedic and Arthritis Centre, Toronto, ON, CAN
Mark Rossi, PT, PhD, Miami, FL, USA
Leslie Soever, APP, Mount Sinai Hospital, Toronto, ON, CAN
Jennifer Stevens-Lapsley, MPT, PhD, University of Colorado Denver, Aurora, CO, USA
J. Carter Thorne, MD, FRCPC, Newmarket, ON, CAN
Elaine Trudelle-Jackson, PT, PhD, Texas Woman’s University School of Physical Therapy, Dallas, TX, USA
Appendix M: Professional and consumer organizations’ Delphi participation

<table>
<thead>
<tr>
<th>Participating organizations¹</th>
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<tbody>
<tr>
<td>American Academy of Hip and Knee Surgeons (AAHKS)</td>
</tr>
<tr>
<td>American College of Rheumatology (ACR) – Rehabilitation Division</td>
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<tr>
<td>American Medical Association (AMA)</td>
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<tr>
<td>American Physical Therapy Association (APTA)</td>
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<tr>
<td>American Occupational Therapy Association (AOTA)</td>
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<tr>
<td>Arthritis and Community Research and Evaluation Unit (ACREU)</td>
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<tr>
<td>Arthritis Consumer Education (ACE)</td>
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<tr>
<td>Arthritis Foundation (AF)</td>
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<tr>
<td>Arthritis Health Professions Association (AHPA)</td>
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<tr>
<td>Association of Rheumatology Health Professionals (ARHP)</td>
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<tr>
<td>Bone and Joint Decade (Canada &amp; US)</td>
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<tr>
<td>Canadian Arthritis Patient Association</td>
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<tr>
<td>Canadian Association of Occupational Therapists (CAOT)</td>
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<tr>
<td>Canadian Association of Retired Persons (CARP)</td>
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<tr>
<td>Canadian Orthopaedic Association (COA)</td>
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<tr>
<td>Canadian Orthopaedic Nurses Association (CONA)</td>
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<tr>
<td>Canadian Physiotherapy Association (CPA)</td>
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<tr>
<td>Centre for Surgical Innovation (CSI), Vancouver, BC</td>
</tr>
<tr>
<td>Consumer Advisory Board (CAB) of Arthritis Research Centre of Canada</td>
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<tr>
<td>Greater Toronto Area Rehab Network, ON, Canada</td>
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<tr>
<td>Knee Society</td>
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<tr>
<td>Mayo Clinic, Rochester, NY</td>
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<tr>
<td>National Association of Orthopaedic Nurses (NAON)</td>
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<tr>
<td>NYU Hospital for Joint Diseases</td>
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<tr>
<td>Osteoarthritis Service Integration Service (OASIS), BC, Canada</td>
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<tr>
<td>The Arthritis Society (TAS)</td>
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<tr>
<td>Toronto Rehab Institute, ON, Canada</td>
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<thead>
<tr>
<th>Invited, non-participating organizations²</th>
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<tbody>
<tr>
<td>Alberta Bone and Joint Institute</td>
</tr>
<tr>
<td>American Academy of Orthopaedic Surgeons (AAOS)</td>
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<tr>
<td>American Academy of Physical Medicine and Rehabilitation (AAPMR)</td>
</tr>
<tr>
<td>American Association of Retired Persons (AARP)</td>
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<tr>
<td>Canadian Medical Association (CMA)</td>
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<td>Hip Society</td>
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</tbody>
</table>

¹Participating organizations include those that nominated panelist(s), circulated study information among membership and/or agreed to review draft guidelines or assist with dissemination of guidelines
²Organizations that declined to participate or did not respond to letters of invitation