ACI NSW Agency for Clinical Innovation

Musculoskeletal Network

NSW Evidence Review Preoperative, Perioperative and Postoperative Care of Elective Primary Total Hip and Knee Replacement

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Acknowledgements

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Consultation

The draft elective joint replacement evidence review was presented to clinicians at the following NSW hospitals:

- St.George Hospital
- Royal North Shore Hospital
- Coffs Harbour Health Campus
- Ryde
- Concord
- Hornsby
- Fairfield
- Lismore
- Nepean/Blacktown
- Port Macquarie Base Hospital

Executive Summary

BACKGROUND

Musculoskeletal disorders affect millions of people around the world. As greater numbers of people live to older age and experience increasingly sedentary lifestyles and increased levels of obesity, expectations are that demand for the replacement of damaged painful hip and knee joints, with artificial surfaces, will escalate. It is considered that hip and knee replacement surgery is effective in reducing pain and disability in people with severe joint disease. Since 2003 in Australia, primary total hip replacement has increased by almost 40% and primary total knee replacement by over 70%. There is evidence that increasing disparity exists between the public and private health care sectors in the provision of primary hip and knee replacement, with approximately 10% fewer hip replacements, and approximately 20% fewer knee replacements in the Australian public health sector, as opposed to the private sector, since 2003.

Over recent years, variations in the provision of care, and rising health care costs, have contributed to the need to ensure that the provision of joint replacement remains equitable, efficient and safe. Increasing demand for joint replacement will require effective and resourceful strategies to distribute limited resources, with the aim of continuing to provide equitable provision of joint replacement as part of the Australian system of universal health care. While direct surgical aspects dominate the treatment process for joint replacement, the care of individuals undergoing this surgery should not begin with their hospital admission, or end with discharge from their sub-acute care.

Subjective reports of hip and knee replacement in NSW public hospitals identify the existence of substantial variations in care between different facilities, and between different surgeons within the same facility. Collating the current available literature for identified aspects of elective primary hip and knee replacement is one way of providing health care practitioners access to information that can assist in the provision of evidence based practice to reduce unnecessary clinical variation. The use of available evidence is also a strategy to assist in determining the allocation of resources to provide the most benefit to the most individuals, and to the health care system as a whole.

EVIDENCE

There are a number of guidelines for specific aspects of elective joint replacement, such as venous thromboembolism prophylaxis, surgical blood management and antibiotic prophylaxis. There have been best-practice consensus guidelines for primary hip replacement and primary knee replacement published by the British Orthopaedic Association and the US Department of Health and Human Services, and recent recognition of a need to improve efficiency and quality of service provision has led to projects in Canada, Denmark, the Netherlands and the United Kingdom that have reviewed the processes around elective joint replacement. Several Australian states have reviewed the process of their provision of elective hip and knee replacement. The majority of these programs target the management of people waiting to access either orthopaedic consultation or elective joint replacement surgery.

The ACI Musculoskeletal Network convened a group of clinicians and consumers in November 2010 to identify aspects of joint replacement care for appraisal. This group carried out a review of existing high level evidence relating to areas of care using predetermined strategies and multiple reviewers. Studies were included if they were specific to primary elective hip and/or knee replacement with a primary diagnosis of osteoarthritis, rheumatoid arthritis, avascular necrosis, congenital hip dysplasia or traumatic arthritis. Studies were excluded if they related only to revision hip or knee replacement, joint replacement not of the hip or knee, total hip replacement for fracture or if there was no English language translation available. Studies included in relevant guidelines or systematic reviews were not individually appraised. In several of the

identified topic areas, high level evidence was not available, and the search was extended to evidence obtained from other prospective cohort studies.

The literature search was supplemented with articles identified from the reference lists of retrieved papers and by research papers known to members of the working group that fulfilled the inclusion criteria. The working group would only make a recommendation for clinical care on level I or II evidence, and the evidence review would not incorporate consensus recommendations in the absence of high levels of evidence. In the absence of a recommendation for care, the group would provide comment on the existing body of evidence and would consider making a recommendation for future research. The existing published literature exhibits heterogeneity and methodological limitations that make comparison or pooling of studies difficult. High level evidence comparing outcomes of joint replacement with conservative care is not currently available.

FINDINGS

PREOPERATIVE

Access to joint replacement in NSW appears to be influenced by region, socio-economic group and ability to access public and/or private hospital services. Future research is required to identify factors that affect equity of access to joint replacement specific to the Australian population (III-2 C).

At this time, there is no clear agreement on the timing or prioritisation of people waiting for elective joint replacement surgery (IV D).

On average, people do not deteriorate while waiting less than six months for surgery; however, individuals do not improve and timely provision of treatment is a reasonable expectation of care (III-2 C).
It is recommended that function is promoted while waiting for surgery as worse preoperative function results in poorer outcomes after surgery (III-2 C).

It is recommended a multidisciplinary team is involved in the preparation of people for joint replacement surgery to:

- Optimise surgical outcomes (III-2 C)
- Address expectations of surgery (I B)
- Address post-discharge needs (I B)

Exercise can reduce pain and improve function in people waiting for hip or knee replacement, but its effect on short-term postoperative outcomes is inconclusive. Future trials which specify exercise duration, intensity and frequency, and which use consistent postoperative measures, would enhance current knowledge (I C).

Smoking cessation via a short-term smoking cessation program should be encouraged prior to surgery and in the acute care period (II B).

The presence of co-morbidities, particularly obesity, increases the likelihood of adverse events and poorer functional outcome following hip or knee replacement (III-2 C).

PERIOPERATIVE

The use of a structured care pathway in elective joint replacement can reduce length of stay and show a non-significant improvement in clinical outcomes (III-2 C).

To implement evidence based recommendations for surgical blood management, a multidisciplinary blood management program is necessary in each facility (I B).

The current literature on the effect of procedure volume (surgeon and/or hospital) on individual patient outcomes should be interpreted with caution. There is a need for well designed studies in the Australian context to establish more definitive conclusions (III-3 D).

There is insufficient evidence to show superiority of outcomes related to particular hip or knee prostheses. Patella resurfacing may reduce the risk of reoperation but does not show superiority in pain or function (I C).

Routine antibiotic prophylaxis is recommended in joint replacement with the choice of agent made on the basis of individual patient needs, cost and the local availability of the agent (I A).

Decisions regarding the type of anaesthesia need to be made with consideration given to individual patient and clinician preference, the balance of risks and benefits including available technical skills, and the local context in which the anaesthesia is given (I B).

Tourniquet use does not appear to reduce the need for blood transfusion. Whether it is associated with other complications is unclear. If a tourniquet is used it is recommended that it be deflated prior to wound closure (I B).

Currently, there is insufficient evidence from randomised trials to support the routine use of drains following elective hip or knee replacement (I C).

Decisions regarding catheterisation should be made with consideration of other perioperative factors such as type of anaesthesia/analgesia or age (II C).

Based on randomised trials, regional anaesthesia improves postoperative pain after total hip replacement and regional anaesthesia and/or analgesia improves postoperative pain after total knee replacement (II B).

Multimodal prophylaxis for VTE is recommended after elective joint replacement (I A).

PERIOPERATIVE	Currently, there is insufficient evidence from randomised trials to support the routine use of cryotherapy following elective hip or knee replacement. In the acute postoperative period, it reduces blood loss and improves range of motion (I B).
	Early mobilisation can improve functional independence after joint replacement and reduce clinical complications such as VTE. Optimal intensity and frequency of early mobilisation would benefit from further investigation in trials with improved methodology and the use of standardised outcome measures (I B).
	There is evidence that CPM does not result in clinically relevant improvements in outcomes. Currently, support for its routine use after knee replacement is not available (I A).
	There is currently insufficient knowledge to support or refute the use of hip precautions (protected hip flexion, adduction and rotation) following total hip replacement (I B).
POSTOPERATIVE	Currently, there is insufficient evidence (largely due to a lack of high-quality research) to suggest superiority of one particular type, location, timing or duration of available rehabilitation program after elective hip or knee replacement. The superiority of a group-based program, inpatient program or outpatient program is unable to be determined. Further research that specifies intensity of intervention and uses consistent measures would be beneficial (I C).
	Currently, there is no high level evidence to guide the frequency or duration of follow up after hip or knee replacement (IV D).
	Long term measures of pain, functional ability and quality of life suggest continued improvement is not guaranteed after joint replacement. Further research to improve the understanding of the determinants of outcome after hip or knee replacement would be beneficial (II C).

OPPORTUNITIES FOR FUTURE RESEARCH

The diverse nature of the existing research presents an opportunity to further contribute to the knowledge base for people electing primary total hip and knee replacement. Well designed studies for this population in the Australian context, with common outcome measures, would be beneficial in promoting interventions that are effective and safe. While specific aspects of care would benefit from well designed studies, a pragmatic approach to include care across the preoperative, perioperative and postoperative continuum would also contribute valuable information for future service provision to those electing hip and knee replacement in NSW.

Background to the Guideline

Globally, musculoskeletal disorders or dysfunction affect hundreds of millions of people at some time [1, 2] and the personal and economic costs associated with these conditions is projected to further escalate by 2020 [3]. In Australia, nearly one in five people has arthritis, most of whom have osteoarthritis [4]. A cost effective intervention for end-stage musculoskeletal disorders of the hip or knee is primary joint replacement: surgery to remove painful, damaged joint surfaces and replace them with artificial weight bearing surfaces [5-8]. Greater numbers of people over the age of 60, increased rates of obesity and joint injury, sedentary lifestyles and greater expectations of quality of life as people age more actively [9] drive the increasing demand for joint replacement both internationally and nationally [10-13].

Key Facts

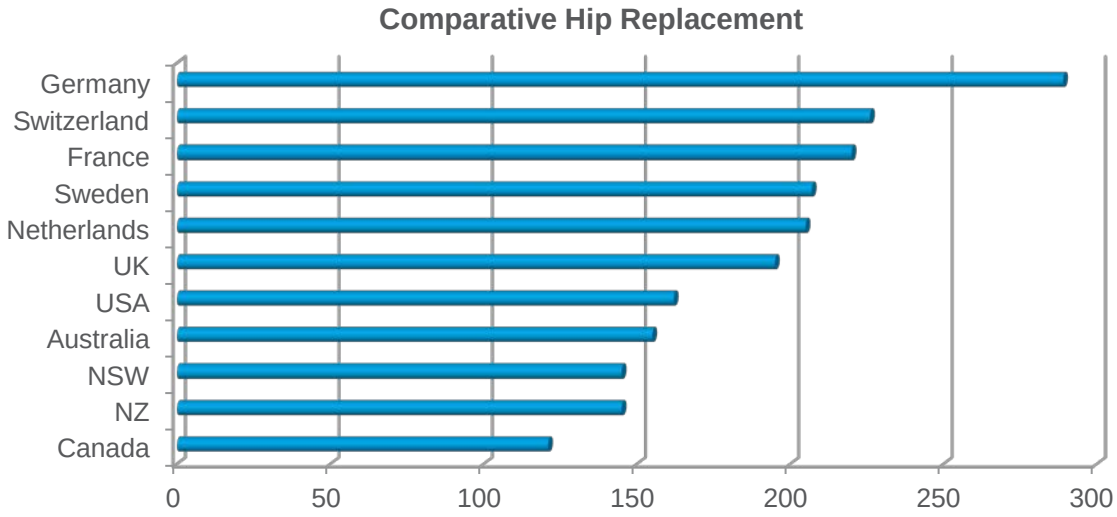
- England and Wales, in 2009/2010,reported over 163,000 hip and knee replacements, which in absolute terms was more than any previous year [12]
- Australia, in 2009, reported over 74,000 joint replacements, an increase of 3.2% from the previous year [13]
- In Australia since 2003, primary total hip replacement has increased by 39.8% and primary total knee replacement by 72.3% [14]
- More than 130,000 hip and knee replacements will be performed annually in Australia by the year 2016 if the current rate of increase continues [9]
- In Australia in 2006, there were approximately 65,000 joint replacements at a cost of over $1 billion [9]
- Prostheses costs accounted for 35% of the total spending for each procedure in Australia in 2006 [15]
- Australian public hospitals performed approximately 37% of all joint replacement surgeries in 2010 [14]

Over recent years, variations in the provision of care and rising health care costs have contributed to the need to ensure that the provision of health care is effective, efficient and safe. Increasing demand for joint replacement will require effective and efficient strategies for the application of limited resources to provide equitable provision of care as part of the Australian system of universal health care. There is existing evidence of disparity between the public and private sectors in the provision of joint replacement nationally [13, 14] and locally [16] as evidenced by the following Australian data.

Public/Private Sectors

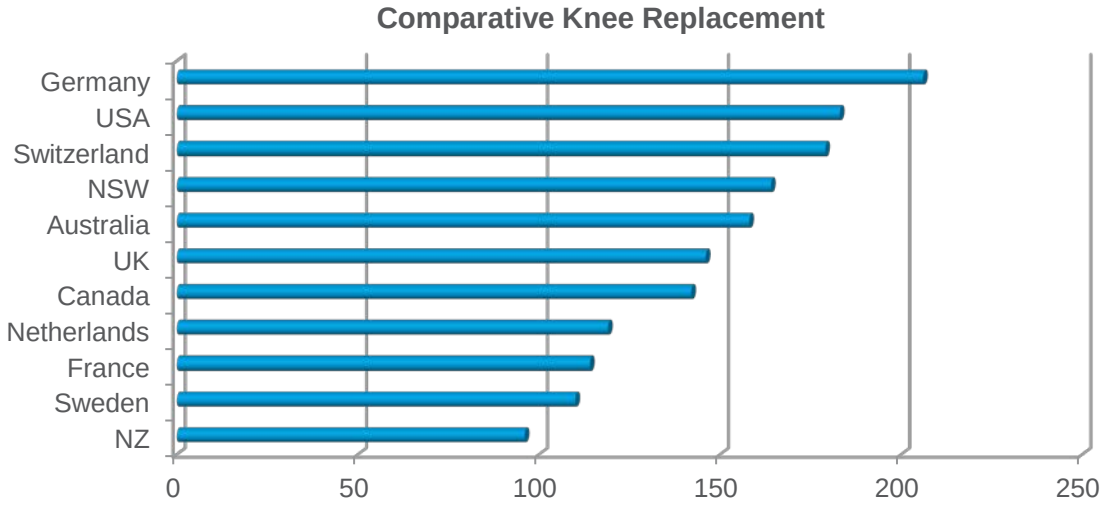
- Hip replacement in the private sector has increased by 36.5% compared to 27% in the public sector since 2003 [14]
- 17,244 private sector primary total hip replacements were reported in 2010, an increase of 4.5% over 2009; in the public sector in 2010, there were 8,816 primary total hip replacements, an increase of 4.4% over 2009 [14]
- Primary total knee replacement in the private sector has increased by 79.1% compared to 59.9% in the public sector since 2003 [14]
- 25,198 private sector primary total knee replacements were reported in 2010, an increase of 9.5% over 2009: in the public sector in 2010, there were 12,245 primary total knee replacements, an increase of 9.7% over 2009 [14]

Graph 1: Hip replacement procedures annually (per 100,000): international comparisons



Source: NSW Bureau of Health Information,*Healthcare in Focus: how NSW compares internationally* (December 2010) [17]

Graph 2: Knee replacement procedures annually (per 100,000): international comparisons



Source: NSW Bureau of Health Information,*Healthcare in Focus: how NSW compares internationally* (December 2010) [17]

While direct surgical aspects dominate the care process for joint replacement, treatment of individuals undergoing this surgery should not begin with their hospital admission, or end with discharge from sub-acute care [1]. Extension of care and management of the individual electing joint replacement, to include services beyond the boundaries of the surgical facility both preoperatively and postoperatively, is an ideal that is both realistic and achievable. Collating the current available literature for identified aspects of elective primary joint replacement is one way of providing health care practitioners access to information that assists in the provision of evidence based practice. The use of available evidence is also a strategy to assist in determining the allocation of resources to provide the most benefit to individuals and to the system.

International

There is a scarcity of published, international literature relating to the complete joint replacement process, although a number of guidelines exist for specific aspects of the process; for example, prevention of venous thromboembolism [18-21], the conservative management of osteoarthritis [22-25], antibiotic prophylaxis [26] and surgical blood management [27]. Our review of the literature did not identify a systematically developed evidence based clinical practice guideline for the preoperative, perioperative and postoperative processes of elective hip or knee replacement. Interestingly, no randomised controlled trials were identified which compared the efficacy of hip or knee replacement with conservative care.

In 1999, the British Orthopaedic Association (BOA) published a statement of current best practice for primary total hip replacement and primary total knee replacement, and a revision of the hip replacement guide was published in 2006 [28, 29]. These documents represented a consensus of best practice from the members of the BOA, the British Association for Surgery of the Knee and the British Hip Society.

The US Department of Health and Human Services released the National Institutes of Health Consensus Statement on Total Knee Replacement in 2003 to provide patients, practitioners and the public with an assessment of the available data on total knee replacement [30].

Recent recognition of the need to improve the efficiency and quality of the elective joint replacement process has resulted in review and redesign projects being undertaken in some countries, such as Canada, Denmark, the Netherlands and the United Kingdom. Implementation of early discharge or express recovery programs in Denmark, the Netherlands and the United Kingdom have been driven by the increasing demand for joint replacement, and recognition that improvements to safety and quality can result from improved surgical processes, early mobilisation and discharge directly home. The development and implementation of these programs use the available supporting evidence [31-36].

In 2004, the Canadian government initiated support to its provinces and territories to reduce their wait times for elective hip and knee replacement. Models of care were developed to improve access to and care through the preoperative, surgical and postoperative phases of surgery, and funds were made available to support the evaluation of the models. Bone and Joint Canada coordinated the projects. They also developed and implemented best practice models of care for people electing hip or knee replacement. The models commenced with the referral for surgery and carried through to rehabilitation after surgery. In 2008/2009, a Canadian national framework was developed by a consensus process, and the project was implemented in three of nine regional health authorities in Alberta using a pragmatic, randomised controlled study design to evaluate the new model compared with existing care (follow the link for more information http://www.boneandjointcanada.com/home.php?sec_id=336&msid=3) [37].

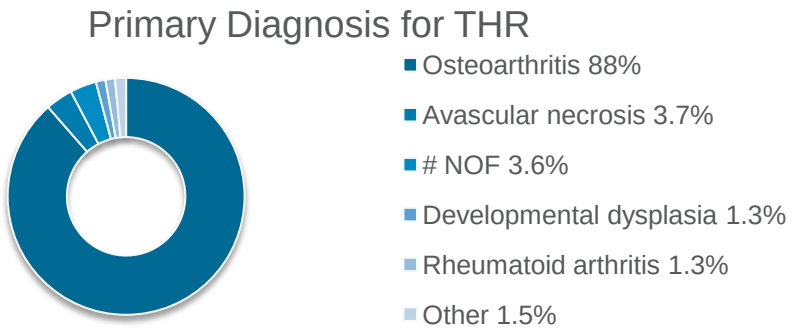
The Alberta approach is an integrated and standardised service delivery model provided by a multidisciplinary team. It aims to ensure people receive the same type and level of care regardless of where they are located. The project highlighted several improvements:

- reduced waiting times for consultation and subsequent surgery
- less pain after surgery
- earlier mobilisation after surgery, with approximately 90% of people mobile on the same day of their surgery
- improvements to length of hospital stay, with reductions of almost 36 hours
- increased patient and surgeon satisfaction
- more cost effective use of health resources

National

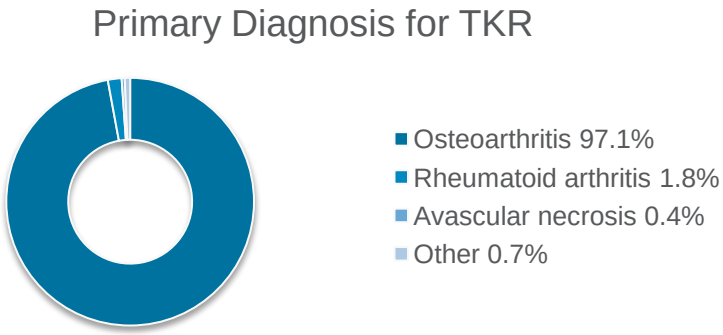
In Australia, over 90% of people electing hip or knee replacement are doing so for the management of osteoarthritis. Rheumatoid arthritis is the diagnosis with the lowest risk of revision, whereas age under 55 years is associated with four and a half times the likelihood of revision compared with those aged over 75 years [13].

Graph 3: Primary diagnosis for total hip replacement in Australia



Source: National Joint Replacement Registry, *Supplementary Report: Demographics of Hip and Knee Arthroplasty*. 2010, Australian Orthopaedic Association: Adelaide, SA Australia [38]

Graph 4: Primary diagnosis for total knee replacement in Australia



Source: National Joint Replacement Registry, *Supplementary Report: Demographics of Hip and Knee Arthroplasty*. 2010, Australian Orthopaedic Association: Adelaide, SA Australia [38]

Table 1: Demographics of primary total hip and knee replacement

	Female% : Male%	Age (min.)	Age (max.)	Age (median)	Age (mean)
THR	56 : 44	12	102	68	67
TKR	57 : 43	11	100	70	69

NOTE: THR and TKR more common in men of younger age and women of older age
Source: National Joint Replacement Registry, *Supplementary Report: Demographics of Hip and Knee Arthroplasty*. 2010, Australian Orthopaedic Association: Adelaide, SA Australia [38]

Several Australian states have recently reviewed the process of their provision of service for elective hip and knee replacement. The majority of these programs target the management of people waiting to access either orthopaedic consultation or non-urgent orthopaedic surgery.

Western Australia

In 2009-2010, 6,240 primary total hip and knee replacements were performed in Western Australia [39]. This is an incidence of 112 total hip replacements and 160 total knee replacements per 100,000 people. In 2008, the Western Australian Musculoskeletal Health Network commenced the development of a service delivery model for elective joint replacement [40]. It was completed in 2010. This model aims to standardise and improve the individual joint replacement pathway, improve safety, quality and efficiency in service provision and ensure a skilled and competent workforce.
http://www.healthnetworks.health.wa.gov.au/modelsofcare/docs/Elective_Joint_Replacement.pdf

Victoria

In 2009-2010, 14,558 primary total hip and knee replacements were performed in Victoria [39]. This is an incidence of 127 total hip replacements and 135 total knee replacements per 100,000 people. Commencing in 2003, the Victorian Department of Human Services funded the development of a system to prioritise and manage people waiting for orthopaedic consultation and surgery [41]. Key components were the development of a tool for prioritising surgery (Multi-attribute Prioritisation Tool) and comprehensive, effective multidisciplinary care for the conservative management of individuals while they waited for surgery. The intention of this program was to provide a preoperative service delivery model to facilitate management of people needing lower limb joint replacement. Service delivery in the perioperative or postoperative phases was not included in this orthopaedic waitlist multidisciplinary model of care.
http://www.health.vic.gov.au/surgery/pubs/owlsumrep.pdf

Queensland

In 2009-2010, 11,748 primary total hip and knee replacements were performed in Queensland [39]. This is an incidence of 93 total hip replacements and 167 total knee replacements per 100,000 people. In 2004-2005, the Orthopaedic Physiotherapy Screening Clinic (OPSC) commenced roll out in Queensland. It is a service model initiated in response to wait lists for initial orthopaedic consultation and subsequent elective orthopaedic surgery. The OPSC provides a consistent approach and multidisciplinary management; an experienced physiotherapist provides assessment and case management to enhance timely and appropriate conservative care. Orthopaedic consultants support the team but do not directly intervene. The program targeted those individuals for whom surgery was not yet indicated, or who had not yet accessed appropriate multidisciplinary care. Organisational outcomes included the measurement of wait list numbers and changes to waiting time.
http://www.health.qld.gov.au/metrosouth/specialty/opsc.asp
http://www.health.qld.gov.au/rbwh/services/physio.asp#opsc_mds

NSW

In 2009-2010,20,365 primary total hip and knee replacements were performed in NSW [39]. This is an incidence of 111 total hip replacements and 171 total knee replacements per 100,000 people. In 2011, the ACI Musculoskeletal Network developed a model of care for the supported management of people with osteoarthritis. The model recognises the significant impact OA has on an individual's physical health and psychological well being, and uses a recognised chronic disease model [42] to support the holistic management of individuals with OA. Development of the model was in recognition of the need to provide people with alternatives to surgical management, and to improve existing co-morbid conditions in those people waiting for joint replacement surgery. NSW is also undertaking a review of the provision of surgical services across the state.
http://www.health.nsw.gov.au/gmct/musculoskeletal/index.asp
http://www.archi.net.au/resources/delivery/surgery/surgery-futures
http://www.archi.net.au/resources/delivery/rural/rural-futures

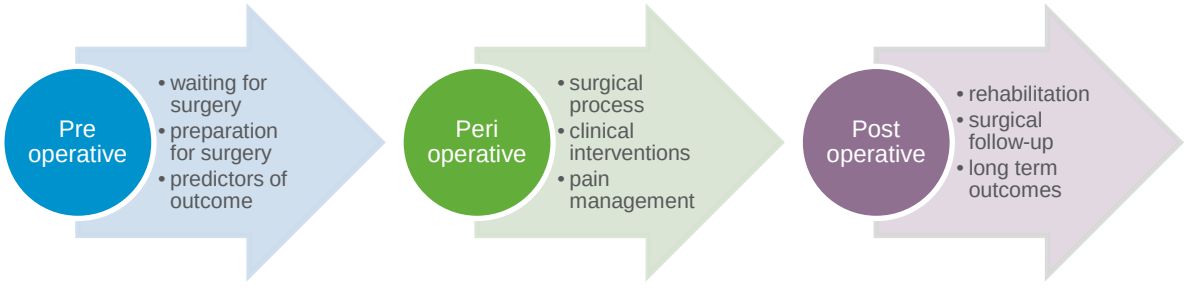
Aim, Scope and Context of this Guideline

To develop a guideline, informed by existing high level evidence, to reduce unnecessary clinical variation, and promote care which is effective and safe, while giving consideration to the use of health care resources through the preoperative, perioperative and postoperative care pathways for people within NSW public health services electing to undergo primary hip or knee replacement.

It is widely acknowledged that joint replacement is effective in helping to restore joint function, reduce joint pain and improve quality of life. Despite being used for over 40 years to manage end-stage joint disease, a comprehensive guide that supports the provision of care for people electing primary joint replacement, and that enhances their short and long term outcomes, has eluded health care providers and consumers.

This document aims to synthesise the existing high level evidence on a variety of aspects of the preoperative, perioperative and postoperative phases of elective, primary hip and knee replacement, with the intent of informing the provision of safe, high quality and cost-effective joint replacement.

The ACI Musculoskeletal Network developed the elective joint replacement guideline in response to identified widespread variation in the provision of care during the preoperative, perioperative and postoperative stages of elective primary hip or knee replacement in the NSW public health care system. Clinicians, researchers, administrators and consumers from the membership of the ACI Musculoskeletal Network collaborated to identify relevant aspects of the joint replacement process (shown diagrammatically below), search for, and subsequently review, the existing evidence around those identified areas. Recommendations for clinical practice and future research were then developed. It is anticipated the ACI Musculoskeletal Network will use this document to inform a best practice, person-centred model of care for the provision of elective primary joint replacement in NSW.



It is important to note that this guideline does not provide a predefined set of rules for the care of people undertaking joint replacement surgery. It is expected all health professionals will exercise their clinical judgment, in conjunction with this document and other high quality evidence, when determining appropriate management in each situation. This guideline does not take precedence over individual responsibility to make suitable decisions in the circumstances of the individual patient, and decisions regarding treatment ought to be undertaken in consultation with the individual and their nominated support person.

The Need for Change

Case Study 1: Jan

67-year old Jan has suffered from pain in both her knees for many years. She has worked her whole life in hospitality and this has involved a great deal of bending, kneeling, walking and carrying heavy loads. Her GP has tried her on many different medications for her pain, but it has been difficult to find the most effective pain medication, especially considering her medications for diabetes and heart disease.

Jan has recently seen an orthopaedic surgeon to discuss a knee replacement and now she is on the waiting list for surgery at the local public hospital. Jan is finding it very difficult to get around and do the things she would like to do, such as watch her grandchildren play sport, or spend a day in the shops with her daughter. When Jan took her admission form to the hospital, no one could give her any idea of when her surgery date might be, except 'about a year' was the usual waiting time. There was no one to talk with to find out about the surgery or what she might be able to do to help herself while waiting. Jan knows other people who have had their knees replaced and they told her she should stay as active as possible to help recover from her surgery, but she didn't know of any exercise groups in her local area, or what other activities she might safely be able to do. Jan thinks it would be good to be able to use the time waiting for her surgery to help herself have the best chance of recovering quickly, and to find out whether there were ways of reducing the possibility of complications after her surgery. Her neighbor had a clot in her leg after her surgery and Jan did not want that to happen to her.

Someone from the hospital rang Jan after 11 months and told her she had to go to the hospital for all her admission tests in ten days time (her operation was in a month). This was a problem, because Jan had promised her neighbour some time ago that she would take him to some appointments scheduled for that day. Jan felt terrible that she had to let her neighbour down but she had become less and less active over the past eight months because of her knee pain and she now felt so depressed, that she couldn't miss this appointment and her opportunity for surgery. Jan organised someone else for her neighbour and went to the hospital at the time she had been given. She had her tests but there was a problem with her heart and the hospital said she would need to see a cardiologist before her operation could go ahead. Jan was told that this would delay her surgery because the cardiologist couldn't fit her in for two weeks and her results would not be available before her surgery, which was scheduled for 4 days later.

Jan was upset and angry. She had waited 11 months to have these tests done. She did not understand why these could not have been done earlier at the hospital, or why her GP couldn't have organised them, which would mean her surgery could still go ahead as planned. Jan had prepared herself, and her family, for all the support she would need during and after her surgery, and now this would need to be re-organised to another time. Her daughter had arranged to take holidays to help her mum, despite being busy with her own family and work. Jan felt terrible for the inconvenience these changes would mean to her family and friends.

Case Study 2: Alan

Alan had waited 12 months for his knee replacement. First he knew he had reached the top of the list was a phone call to come to the hospital the following Wednesday at 9.00am for his surgery. Alan went to the hospital, the hospital staff told his family to go home, and the people at reception sent him somewhere to wait. After about 30 minutes, someone else told him he was in the wrong place, re-directed him to the 'right' place and told him to hurry as "they are waiting for you". A junior surgeon examined Alan's knee, and he was placed on a trolley and wheeled into a room for his anaesthetic. The last thing Alan remembered before he went to sleep was the anaesthetist telling him that he was "in for the most painful experience of his entire life".

On the second day after his operation, a nurse accompanied Alan to the shower and he showered with supervision. He also met the physiotherapist who asked him if he could bend his knee and walk to the doorway with a tall frame. This was the only instruction provided to Alan on exercises to assist his recovery. The next day, the nurse told Alan he was to shower on his own. The shower was a fair way away, and he had to go a bit further to get himself a towel. It took Alan about 30 minutes to shower and he reckons he had never felt so ill in all his life. He managed to get back to his bed, and there he stayed for the rest of the day.

On the fifth day after his knee replacement, Alan asked the nurse about discharge home. The nurse responded that it would certainly not be today, maybe tomorrow, but most likely the day after that. Alan's daughter had rung that morning to ask about a discharge day and she had been given the same information. When a doctor he had not previously met came to his room and told him he could "go home now" it took Alan by surprise. He had no day clothes, only the pyjamas he was wearing, so the hospital staff wrapped him in a blanket and moved him to an open room with several other people to wait to be discharged. Alan waited for many hours and was told the delay was due to problems contacting his family. In fact, Alan discovered later that day his family had not been advised of the change in plans for his discharge. They arrived for their usual visit around 3pm unaware of Alan's discharge plans. Alan went home without any assessment of his home environment, but thankfully, his daughter had arranged for various bits and pieces, such as a frame and shower chair, otherwise Alan would have found it difficult looking after himself.

Alan was pleased to be able to get home but was concerned about some pain in the back of his leg. He had been complaining for several days of the same area of pain in his operated leg and had told several people while in hospital. The doctor had said it was because "he was using muscles he had not previously worked". Alan thought this strange because at age 76 he thought he might have used those muscles at one time or another! Alan's GP visited him at home when his leg became so painful he could not put weight through it and his GP immediately called an ambulance. After two days in another hospital, Alan was diagnosed with a clot in his leg that required daily injections for over a month. Alan now needs his other knee replaced. He has discussed this with his family and he has decided not to go back to the same hospital. The surgeon did a good job, but he would like a hospital that makes him feel safe, and which cares about the quality of the care they provide. At the very least, a hospital with staff which tries to make "the most painful experience of his life" as comfortable as it can possibly be.

The Evidence Review

Search Strategy

Areas of the preoperative, perioperative and postoperative processes of elective hip and knee replacement were identified for appraisal and questions developed around these various aspects of care. Members of the working group carried out a review of the existing literature relating to those identified areas using predetermined strategies and multiple reviewers. The aim of the review was to source existing high level evidence on the identified areas of care.

The databases consulted were Medline (1948 to present), Embase (1980 to present), the Cochrane Central Register of Controlled Trials (CENTRAL) and the Cochrane Database of Systematic Reviews to April 2011. A Medline search string for hip and knee arthroplasty and study type was developed by two members of the working group (Appendix 1). Individual group members created relevant search strings for each topic area (to be used with the developed arthroplasty and study strings) and developed appropriate search terms for Embase, CENTRAL and the Cochrane databases. These were developed in conjunction with medical librarians or research colleagues using the Medline strategy as a guide. Initially, existing guidelines, systematic reviews of randomised controlled trials (RCT) and individual RCT studies were identified. Studies were included if they were specific to primary elective hip and/or knee replacement with a primary diagnosis of osteoarthritis, rheumatoid arthritis, avascular necrosis, congenital hip dysplasia or traumatic arthritis. Studies were excluded if they related only to revision hip or knee replacement, joint replacement not of the hip or knee, total hip replacement for fracture or if there was no English language translation available. Duplicates from the separate databases were excluded. Studies included in relevant guidelines or systematic reviews were not individually appraised. In several of the identified topic areas, high level evidence was not available, and the search was extended to evidence obtained from other prospective cohort studies.

The structured literature searches were supplemented with articles identified from the reference lists of retrieved papers and by research papers known to members of the working group that fulfilled the inclusion criteria. Screening for relevance and possible inclusion was initially undertaken by viewing title and abstract (Appendix 2). The full text versions of potentially relevant articles were requested and reviewed, and the relevant results were provided to the working group for consideration. Grading of articles was according to the National Health and Medical Research Council [43] levels of evidence (Appendix 3). The working group would only make a recommendation for clinical care on level I or II evidence, and this guideline would not incorporate consensus recommendations in the absence of high levels of evidence. In the absence of a recommendation for care, the group would provide comment on the existing body of evidence and would consider making a recommendation for future research.

The following documents were also considered during the development of this guideline:

- The NSW Agency for Clinical Innovation Musculoskeletal Network Osteoarthritis Chronic Care Program Model of Care 2011 [44]
- The Western Australia Musculoskeletal Health Network Elective Joint Replacement Service Model of Care 2010 [40]
- The Royal Australian College of General Practitioners Referral for Joint Replacement: a management guide for health providers 2007 [45]
- The National Health Priority Action Council National Service Improvement Framework for Osteoarthritis, Rheumatoid Arthritis and Osteoporosis 2006 [46]
- The National Health Priority Action Council National Chronic Disease Strategy 2006 [47]

Preoperative Elective Primary Hip and Knee Replacement

SUMMARY OF FINDINGS: PREOPERATIVE

Access

- Access to joint replacement in NSW appears to be influenced by region, socio-economic group and ability to access public and/or private hospital services. Future research is required to identify factors that affect equity of access to joint replacement specific to the Australian population (III-2 C).

Surgical admission

- At this time, there is no clear agreement on the timing or prioritisation of people waiting for elective joint replacement surgery (IV D).

Impact of waiting

- On average, people do not deteriorate while waiting less than six months for surgery; however individuals do not improve and timely provision of treatment is a reasonable expectation of care. It is recommended that function is promoted while waiting for surgery as worse preoperative function results in poorer outcomes after surgery (III-2 C).

Multidisciplinary preparation

- It is recommended a multidisciplinary team is involved in the preparation or people for joint replacement surgery to:
    1. Optimise surgical outcomes (III-2 C)
    2. Address expectations of surgery (I B)
    3. Address post-discharge needs (I B)

Preoperative exercise

- Exercise can reduce pain and improve function in people waiting for hip or knee replacement, but its effect on short-term postoperative outcomes is inconclusive. Future trials that specify exercise duration, intensity and frequency, and which use consistent postoperative measures, would enhance current knowledge (I C).

Interventions for co-morbid conditions

- Smoking cessation via a short-term smoking cessation program should be encouraged prior to surgery and in the acute care period (II B).

Predictors of outcome

- The presence of co-morbidities, particularly obesity, increases the likelihood of adverse events and poorer functional outcome following hip or knee replacement (III-2 C).

Access

QUESTION:	**Which factors influence access to elective primary total hip replacement and total knee replacement?**

Summary: Equity of access underpins universal health care. Disparities in access to healthcare can arise from a variety of system wide or individual factors, which include health related behaviour, existing disability levels, variable demand, unmet need, service provision and cost, discrimination, cultural or linguistic inhibitions or poor health literacy [48]. As musculoskeletal conditions are a leading cause of cost and disability [49], disparities in the access to, and use of health care and health services are particularly important, as early and effective treatment can reduce symptom severity, disability and possibly improve individual outcome.

Few studies identifying factors that influence surgical access were specific to the Australian population, and this limits generalisability of the available research to the Australian context. In the Australian population, there are identified disparities between the rate of doctor-diagnosed osteoarthritis and the uptake of hip or knee replacement surgery. This disparity may be related to geography, socioeconomic status, gender and country of birth [48, 50]. Males have a greater rate of both hip and knee replacement despite carrying a lower burden of disease than females. Groups identified with lower socioeconomic status had lower rates of hip replacement despite being more likely to suffer from osteoarthritis. However, the rate of knee replacement was higher, and this is consistent with the higher prevalence of osteoarthritis in this population [48].International studies have identified differences in access to joint replacement surgery being attributable to geography, population density, socio-demographic and socio-economic factors, disease severity and individual willingness or preference for surgery [51-54].Other factors include structural factors due to health policy, preferences of general practitioners and a lack of specific criteria for specialist referral [55, 56]. The NSW CEC chart book [16] shows the provision, or supply, of hip and knee replacements increased between 2004 and 2008, but there was wide variation in rates across area health services. Despite these increases, disparities exist in access to surgery between the public and private health care sectors: 41% of hip replacements and 31% of knee replacements were performed in the public sector in 2009, with cumulative increase over 5 years (to 2009) of 17% in the public sector and 24% in the private sector [13, 39, 57].

Evidence Level:	I	II	III-1	**III-2**	III-3	IV
Grade:	A	B	**C**	D		

Comment:	**Access to joint replacement in NSW appears to be influenced by region, socio-economic group and ability to access public and/or private hospital services. Future research is required to identify factors that affect equity of access to joint replacement specific to the Australian population.**

Surgical admission

QUESTION:	Is there evidence to support prioritisation of people waiting for surgery?

Summary: To date, no strong evidence has been identified to support a specific tool for the determination of clinical urgency or the adequacy of joint replacement in people with degenerative or inflammatory joint disease. The use of broad, non-specific groupings for the allocation of surgery is currently based on a system-wide category of utilisation of service rather than accurately defined health states. A number of international and national groups have attempted to develop acceptable tools for the clinical prioritisation of hip or knee replacement surgery, but the validity and reliability of these tools remains uncertain.

A working group established by OMERACT/OARSI attempted to categorise the severity of symptomatic osteoarthritis using identified domains of pain, functional status and structural damage to correspond with referral for joint replacement [56, 58]. They concluded there was wide variability in surgeon's recommendations for joint replacement, but this was an important factor in who received surgery. While the level of symptoms were higher amongst people the surgeons referred for surgery, there was no cut off point based on pain or disability to allow for discrimination between those referred for joint replacement and those who were not. A Canadian group developed the hip and knee replacement priority criteria tool (HKPT) as part of the Western Canada Waiting List Project http://www.wcwl.ca/tools/joint_replacement/ [59, 60]. The tool ranks individuals according to urgency for hip or knee replacement [61]. While high and low categories of urgency were well discriminated, there was overlap of adjacent urgency categories, suggesting further evaluation is required to assess the clinical validity and acceptability of this tool. New Zealand has also developed a priority criteria tool for hip and knee replacement to provide consistency and transparency to the process of prioritising access to surgery [62, 63]. An Australian tool has been developed to determine access to surgical consultation: the Multi-attribute Prioritisation Tool (MaPT) developed by the University of Melbourne Centre for Rheumatic Disease with support from the Victorian Department of Human Services (http://www.health.vic.gov.au/surgery/pubs/owlsumrep.pdf), is a tool to prioritise and manage people considering hip or knee replacement surgery. There was no published evidence identified that reported the MaPT's validity and reliability.

Evidence Level:	I	II	III-1	III-2	III-3	**IV**
Grade:	A	B	C	**D**		

Comment:	**At this time, there is no clear agreement on the timing or prioritisation of people waiting for elective joint replacement surgery.**

Impact of waiting

QUESTION:	**Does the waiting time for elective primary total hip or total knee replacement affect individual factors before or outcomes after surgery?**

Comment: In NSW, calculation of waiting time for surgery commences at formal entry to a surgical wait list. At present, it is unclear whether the waiting time for hip or knee replacement surgery influences individual factors before surgery, or the outcomes following surgery. It is known that individuals with worse pain and function at the time of surgery do not recover to the same absolute level as those who are less impaired at the time of surgery [64-67], and a significant minority (up to 25%) do not improve after elective joint replacement [68]. There is discussion as to whether extended waiting time results in a relatively impaired function and quality of life (due to the progression of the disease process), a lesser total recovery after surgery, or both.

One systematic review [69] that analysed the impact of waiting for total joint replacement on pain and functional status, identified fifteen prospective studies (n = 788 hips and n = 858 knees) of varied quality. Two good quality studies showed strong evidence that waiting times of less than 180 days do not result in increased levels of pain for both hip and knee OA, or reduced self reported function in hip OA. There was conflicting evidence regarding function in knee OA. This review was unable to identify high quality studies that reported on pain and/or function for wait times over 180 days. When the measures of methodological quality were relaxed, an analysis of six other studies concluded that a waiting time of more than six months may result in increased levels of pain for people with hip OA, but pain in knee OA, and function in both hip and knee OA, is equivocal. One implication of these results is waiting times for surgery of less than six months require no additional prioritisation process. This is of value given the absence of an agreed tool for clinical prioritisation of urgency. A randomised controlled trial published after the above review found that waiting time did not affect health related quality of life and pain at three and twelve months after knee replacement [70].

Evidence Level:	I	II	III-1	**III-2**	III-3	IV
Grade:	A	B	**C**	D		

Comment:	**On average, people do not deteriorate while waiting less than six months for surgery; however, individuals do not improve and timely provision of treatment is a reasonable expectation of care. It is recommended that function is promoted while waiting for surgery as worse preoperative function results in poorer outcomes after surgery.**

Multidisciplinary preparation

QUESTION:	**What is the role of multidisciplinary preparation for people waiting for elective primary total hip and knee replacement?**

Summary: Surgical preparation of people for joint replacement in NSW public hospitals usually occurs after allocation of a surgical date. Traditionally, people waiting for joint replacement do not receive active intervention prior to allocation of a surgical date to address other health conditions, despite evidence that suggests improvements to preoperative, perioperative or postoperative outcomes can be achieved.

A systematic review of nine RCT's (n = 782) for people undergoing hip or knee replacement [71] found preoperative education has a beneficial effect on preoperative anxiety, especially when targeted at individuals with more complex needs. One of these studies (n = 133) reported a significant effect of education on reducing length of stay for more physically disabled people undergoing hip replacement [72]. A subsequent review [73] found that physiotherapy or occupational therapy combined with education influenced discharge location and length of stay. Again, this was particularly evident in the most fragile individuals undergoing hip or knee replacement. Two RCT's subsequent to these reviews, found intervention prior to surgery was able to influence health related quality of life while waiting for surgery [74] and modify expectations at 12 months after surgery [75].

In addition to the management of individual expectations and discharge needs, medical and nursing assessment can optimise surgical planning and assessment by identification of factors which potentially complicate surgical outcome [76-78]. One study [78] prospectively screened 1,438 people in a hospital based program who were planning to undergo joint replacement. Previously undiagnosed conditions led to postponement (13%) or cancellation (2.5%) of joint replacement surgery, and 21% of individuals were referred for cardiac stress test.

Evidence Level:	**I** II III-1 III-2 III-3 IV
Grade:	A **B** C D

Comment:	**It is recommended a multidisciplinary team is involved in the preparation of people for joint replacement surgery to:** **1. Optimise surgical outcomes (III-2 C)** **2. Address expectations of surgery (I B)** **3. Address post-discharge needs (I B)**

Preoperative exercise

QUESTION:	**Is there high level evidence to support physiotherapy or exercise prior to total hip or knee replacement to improve postoperative outcomes?**

Summary: Research findings consistently support exercise intervention for people with osteoarthritis to improve their pain and level of function [11, 79-82]. It is unclear whether preoperative physiotherapy or exercise has an effect on short term postoperative outcomes, such as length of stay, after hip or knee replacement.

A systematic review of randomised controlled trials [83] found only five studies (three for TKR and two for THR) which fulfilled the authors inclusion criteria. Immediate preoperative intervention for people having TKR appeared to make no difference to outcomes, whereas for THR the results were inconclusive. Aggregated conclusions were not feasible due to the substantial variation in outcomes measured. Since this review, nine randomised controlled trials were identified [84-92]. Again, heterogeneity in outcome measures and aspects of study methodology necessitate caution when interpreting the results. Exercise prior to joint replacement surgery can reduce pain and improve function preoperatively, but there is currently insufficient evidence to determine if it is effective in improving immediate postoperative outcomes.

Given that the current body of evidence assesses exercise programs over short durations, predominantly within two months of surgery, there is a potential opportunity to study the effect of programs designed to improve cardiovascular fitness and strength initiated earlier in the preoperative period. The value of future trials that determine the effect of physiotherapy and/or exercise on postoperative outcome would be improved if the exercise intensity, duration and frequency is specified, and consistent outcome measures were used.

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	A	B	**C**	D		

Comment:	**Exercise can reduce pain and improve function in people waiting for hip or knee replacement, but its effect on short-term postoperative outcomes is inconclusive. Future trials which specify exercise duration, intensity and frequency, and which use consistent postoperative measures, would enhance current knowledge.**

Interventions for co-morbid conditions

QUESTION:	**Is there high level evidence to show that the risk of adverse events or complications are reduced by pre-operative interventions to improve common co-morbidities in patients waiting for total hip or knee replacement?**

Summary: Co-morbid conditions and other risk factors for cardiovascular disease are common among people electing total joint replacement. In people with anaemia, or haemoglobin levels on the lower limit of normal, there is a high risk for donor blood transfusion perioperatively or postoperatively [93, 94]. A history of smoking is also a known predictor of complications after surgery [95-97]. High level evidence exists that demonstrates the positive effects of interventions, such as diet and exercise, on chronic conditions like diabetes [98-100], cardiovascular disease [101-103], obesity [104, 105] and hyperlipidaemia [106-108]. A search for similar, high level evidence was undertaken to assess the efficacy of preoperative interventions in reducing the risk of post-operative complications after hip or knee replacement. No RCTs or systematic reviews were found for this population relating to the co-morbid conditions of hypertension, diabetes, heart disease (heart failure, arrhythmias, ischaemic heart disease), respiratory disease, obesity and hyperlipidaemia.

One RCT (n = 81) was found that demonstrated the benefit of providing pre-operative oral iron supplements at least four weeks prior to surgery [94], with the authors concluding that iron stores were improved, therefore buffering the drop in postoperative haemoglobin. Results were inconclusive for reduction of blood transfusion after joint replacement surgery. Given the potential for gastrointestinal side effects, routine prescription of oral iron supplements may not be advisable. Another RCT (n = 108, 3 related publications) evaluated the effects of preoperative smoking cessation programs on complications following hip or knee replacement surgery [97, 109, 110]. Postoperative complications were significantly less in patients assigned to a 6-8 week smoking cessation program consisting of weekly meetings and nicotine substitutes (18% vs 52%, $p < 0.001$). The greatest improvement was in wound related complications. Further analysis revealed that men, and patients with a good social network, were more likely to successfully quit smoking [110], and long term follow up of the participants indicated that the intervention group had a significantly higher quit rate one year after the preoperative program [109]. A subsequent systematic review of 11 RCT's (n = 1194) of smoking cessation interventions across a range of surgical conditions found the smoking cessation interventions significantly reduced the risk of complications after surgery [111].

Evidence Level:	I	**II**	III-1	III-2	III-3	IV
Grade:	A	**B**	C	D		

Comment:	**Smoking cessation via a short-term smoking cessation program should be encouraged prior to surgery and in the acute care period.**

Predictors of outcome

QUESTION:	**What are the possible predictors of adverse events and functional recovery after surgery for primary hip or knee replacement?**

Comment: An individual's decision to undergo elective joint replacement surgery is predicated on a balance between the potential risks and potential benefits of surgery. An understanding of factors that preoperatively predict an increased risk of operative adverse events, or adverse functional outcome, would assist individuals and providers with their decisions. Though the findings among studies are not uniform [112, 113], several prospective [112, 114-116] and retrospective [117-129] studies indicate that cardiovascular disease, obesity, diabetes and hyperglycaemia are risk factors for complications, including death and deep infection. There is evidence that obesity [114, 115], other joint disease [130], mental health status [131-133] and metabolic syndrome [121] undermine functional outcomes or quality of life after total hip or knee replacement. There is an increased risk of revision surgery in younger persons and amongst males [134].

Two recent Australian studies prospectively followed people electing primary total joint replacement to determine the effect of obesity on outcomes in the 12 months after surgery. For people electing hip replacement (n = 471) [115], all patients demonstrated improvement in function and quality of life scores at 12 months. Compared with non-obese people, the obese and morbidly obese had significantly improved mental health scores but a significantly higher risk of a postoperative complication. In the study of outcome after knee replacement (n = 529) [114], obese and morbidly obese people had a significantly higher rate of adverse events despite improvements in function and quality of life.

Evidence Level:	I	II	III-1	**III-2**	III-3	IV
Grade:	A	B	**C**	D		

Comment:	**The presence of co-morbidities, particularly obesity, increases the likelihood of adverse events and poorer functional outcome following hip or knee replacement.**

Perioperative Elective Primary Hip and Knee Replacement

SUMMARY OF FINDINGS: PERIOPERATIVE

Clinical pathways

- The use of a structured care pathway in elective joint replacement can reduce length of stay and show a non-significant trend towards improved clinical outcomes (III-2 C).

Blood management

- To implement evidence based recommendations for surgical blood management, a multidisciplinary blood management program is necessary in each facility (I B).

Surgeon and hospital volume

- The current literature on the effect of procedure volume (surgeon and/or hospital) on individual patient outcomes should be interpreted with caution. There is a need for well designed studies in the Australian context to establish more definitive conclusions (III-3 D).

Prostheses

- There is insufficient evidence to show superiority of outcomes related to particular hip or knee prostheses. Patella resurfacing may reduce the risk of reoperation but does not show superiority in pain or function (I C).

Prophylactic antibiotics

- Routine antibiotic prophylaxis is recommended in joint replacement with the choice of agent made on the basis of individual patient needs, cost and local availability of the agent (I A).

Anaesthesia

- Decisions regarding the type of anaesthesia need to be made with consideration given to individual patient and clinician preference, the balance of risks and benefits including available technical skills, and the local context in which the anaesthesia is given (I B).

Tourniquet use in total knee replacement

- Tourniquet use does not appear to reduce the need for blood transfusion. Whether it is associated with other complications is unclear. If a tourniquet is used it is recommended it be deflated prior to wound closure (I B).

Wound drains

- Currently, there is insufficient evidence from randomised trials to support the routine use of drains following elective hip or knee replacement (I C).

Urinary catheters

- Decisions regarding catheterisation should be made with consideration of other perioperative factors such as type of anaesthesia/analgesia or age (II C).

Pain management

- Based on randomised trials, regional anaesthesia improves postoperative pain after total hip replacement, and regional anaesthesia and/or analgesia improves postoperative pain after total knee replacement (II B).

Prophylaxis for venous thromboembolism (VTE)

- Multimodal prophylaxis for VTE is recommended after elective joint replacement. The development of a decision analysis tool to assist with the balance of risk and benefit may be an area of future research (I A).

Cold therapy

- Currently, there is insufficient evidence from randomised trials to support the routine use of cryotherapy following elective hip or knee replacement. In the acute postoperative period it reduces blood loss and improves range of motion (I B).

Mobilisation

- Early mobilisation can improve functional independence after joint replacement and reduce clinical complications such as VTE. Optimal intensity and frequency of early mobilisation would benefit from further investigation in trials with improved methodology and the use of standardised outcome measures (I B).

Continuous passive motion in total knee replacement

- There is evidence that CPM does not result in clinically relevant improvements in outcome. Currently, support for its routine use after knee replacement is not available (I A).

Hip precautions

- There is currently insufficient knowledge to support or refute the use of hip precautions (protected hip flexion, adduction and rotation) following total hip replacement (I B).

Clinical pathways

QUESTION:	**Is there high level evidence to support the use of clinical pathways in elective primary hip or knee replacement?**

Summary: Clinical pathways are structured, multidisciplinary processes for the organisation and coordination of care decisions for a well defined group of patients. Their aim is to enhance the delivery and quality of care. These pathways have been found to be associated with improved documentation and reduced in-hospital complications, without negatively affecting length of stay and hospital costs [135]. Despite being used in a number of settings since the mid 1990's [136], there is still debate about their effect on financial costs and specific postoperative outcomes in elective joint replacement within an Australian context.

Methodological limitations within the existing literature, such as the lack of randomisation and the use of historical controls, provoke a high risk of bias when determining the effect of clinical pathways. A recent systematic review and a subsequent meta-analysis [137, 138] found significant positive effects of clinical pathways on financial and process outcomes. The meta-analysis [137] found clinical pathways reduced postoperative complications after joint replacement, although the previous systematic review [138] found the effect of pathways on clinical outcomes was mixed. Only one study included in the meta-analysis was a randomised controlled trial [139]. This trial, undertaken within an Australian context, found significant reductions in length of stay and non-significant improvements in other clinical outcomes. Further information on clinical workflows and advanced knowledge management technologies for healthcare, such as point-of-care decision support systems, can be found at http://www.openclinical.org/clinicalpathways.

Evidence Level:	I	II	III-1	**III-2**	III-3	IV
Grade:	A	B	**C**	D		

Comment:	**The use of a structured care pathway in elective joint replacement can reduce length of stay and show a non-significant improvement in clinical outcomes.**

Blood management

QUESTION:	**What is the optimal management to reduce the need for blood transfusion in people electing primary hip or knee replacement?**

Summary: Blood products are limited in supply, and allogeneic (donor) transfusion is associated with increased risk of morbidity, mortality, ICU and hospital length of stay. The avoidance of unnecessary transfusion in some patients may be as important as the need to provide transfusion in others. For these reasons, the use of blood products during or following surgery is a major concern for surgical facilities, and for the individual electing joint replacement [40, 140]. The West Australian Musculoskeletal Health Network included blood management guidelines as part of their model of care for elective joint replacement [40] and the review and update of the *2001 Clinical Practice Guidelines for the use of Blood Components [27, 141]*, steered by the NHMRC, Australian and New Zealand Society of Blood Transfusion (ANZSBT) and the National Blood Authority (NBA), has recently been completed. The focus of these guidelines is on the clinical management of individuals rather than on the blood products. This update has several recommendations relevant to elective joint replacement:

- Pre operative anaemia should be identified, evaluated and managed to reduce red cell transfusion (III C)
- Evaluate elective surgery patients using the pre-operative haemoglobin assessment and optimisation template, as early as possible to allow assessment and management (II B)
- Patients with, or at risk of iron deficiency, should be treated with iron (II B)
- Routine use of preoperative autologous donation is not recommended (waiting for level, C)
- If substantial blood loss is anticipated with surgery, consideration should be given to the use of intra-operative blood salvage (I and II C), acute normovolaemic haemodilution (I and II C) and antifibrinolytics (I B)
- In adult patients undergoing total knee replacement, in whom significant postoperative blood loss is anticipated, post-operative cell salvage should be considered (I and II C). In the absence of acute myocardial or cerebrovascular ischaemia, post operative transfusion may be inappropriate for patients with a haemoglobin level of >80g/L unless associated with signs and symptoms

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	A	**B**	C	D		

Comment:	**To implement evidence based recommendations for surgical blood management, a multidisciplinary blood management program is necessary in each facility.**

Surgeon and hospital volume

QUESTION:	**Does the procedure volume of the facility or the surgeon influence individual patient outcomes after primary total hip or total knee replacement?**

Summary: There has been minimal focus on the influence of procedure volume in orthopaedic surgery, despite a positive correlation existing between increased surgeon and facility volumes, and enhanced outcomes, in other surgical procedures, such as coronary bypass graft, carotid endarterectomy and cancer surgery [142]. Based on large retrospective data reviews, it is postulated that a similar correlation exists for primary hip and knee replacement surgery [143, 144]. These reports suggest that higher volumes may be associated with fewer adverse events, reduced mortality and reduced length of stay. However, other studies of similar methodology, suggest that the effect of volume on patient outcomes has not yet been well established [145-149]. To date, a clear delineation of the number of cases which characterise low or high volume has not been well defined [144], and it is still unclear as to whether hospital or surgeon volumes have the greatest influence on outcome [149]. A multi-centre study in the United Kingdom [150] prospectively followed a cohort of people undergoing elective hip replacement (n = 1501) to investigate whether there was an association between patient outcomes and the level of experience of the operating surgeon. Five year follow up with the Oxford Hip Score, and measurement of dislocation and revision rates, showed no statistically significant differences between patient outcomes and surgeon experience.

Currently, no studies have reported prospective comparisons of the effect of hospital or surgeon volume on individual patient outcomes in the Australian context. One international jurisdiction has used the existing literature to inform its national policy on minimum facility numbers for providing joint replacement [151]. Another recent review [152], which assessed the efficacy of centralisation for TKR surgery, has suggested caution when using the current evidence to determine surgical services for knee replacement, as the type of joint replacement (revision or primary surgery) has the potential to influence outcomes.

Evidence Level:	I	II	III-1	III-2	**III-3**	IV
Grade:	A	B	C	**D**		

Comment:	**The current literature on the effect of procedure volume (surgeon and/or hospital) on individual patient outcomes should be interpreted with caution. There is a need for well designed studies in the Australian context to establish more definitive conclusions.**

Prostheses

QUESTION:	**Do particular implant characteristics provide superior patient outcomes among people undergoing elective primary hip or knee replacement?**

Summary: Advances in technology and a desire to improve prosthesis survival and individual outcome in joint replacement contribute to continuous development of new implant materials and designs. Avoiding revision of the primary prosthesis is a significant contributor to satisfaction of outcome in people electing joint replacement. The development of national joint replacement registries in many countries over the past forty years was in response to the introduction of new technologies without documentation from clinical trials (http://www.dmac.adelaide.edu.au/aoanjrr/ http://www.efort.org/education/registers.aspx).

The registries provide an objective surveillance role and evaluate implant performance by measuring time to implant revision. These large data repositories have shown some characteristics of the prosthesis, such as exchangeable femoral necks, some metal on metal hip prostheses and some tibial bearing surfaces in knee replacement, to have an increased risk of revision [14]. The National Institute for Clinical Excellence (NICE) regards the best prostheses as those that demonstrate a revision rate of 10% or less at 10 years [153]. For newer implants, NICE accepts a minimum of 3 year data which shows the prostheses is performing at levels consistent with its 10 year benchmark. It would be prudent for both clinicians and consumers to be informed by the large population based data available through the national and international joint replacement registries when determining the most appropriate prosthesis for each individual (http://www.dmac.adelaide.edu.au/aoanjrr/publications.jsp).

Currently, there is insufficient high level evidence to show superiority of patient outcomes (pain and function) due to the specific characteristics of the prosthesis used [154-161]. Patella resurfacing at the time of primary knee replacement is likely to reduce the risk of reoperation, but there is no difference in pain and function outcomes after primary surgery [156, 162-164].

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	A	B	**C**	D		

Comment:	**There is insufficient evidence to show superiority of outcomes related to particular hip or knee prostheses. Patella resurfacing may reduce the risk of reoperation but does not show superiority in pain or function.**

Prophylactic antibiotics

QUESTION:	**Is there high-level evidence supporting the use of prophylactic antibiotics in elective primary total hip or total knee replacement?**

Summary: Surgical site infection following joint replacement can have overwhelming consequences such as further surgery for prosthetic revision or excision, prolonged or recurrent hospital stays and increased health care costs. The administration of routine, prophylactic antibiotics is thought to reduce the likelihood of infection as a surgical complication [165, 166]. Current practice is to provide a broad range of antibiotic coverage for all people undergoing joint replacement, but there is variation in protocols to address the use of special antibiotics in patient groups with high infection risks [167].

One systematic review of antibiotic prophylaxis in total joint replacement identified 26 RCT's (n = 11 343) which met the authors inclusion criteria [168]. These studies included comparisons of any prophylaxis with none, systemic antibiotics with that of those in cement, cephalosporins with glycopeptides, cephalosporins with penicillin-derivative, and second-generation with first generation cephalosporins. Methodological quality of the included studies was variable, and follow-up time frames ranged from ten days to ten years. In a meta-analysis of seven of these studies (n = 3065), antibiotic administration reduced the relative risk of wound infection by 81% and the absolute risk by 8% compared with no prophylaxis ($p < 0.00001$). This means the prevention of one wound infection for every 13 people treated with antibiotics.

Analysis of other studies in this review showed no significant difference in clinical effect when comparing different antibiotic agents (a finding supported by a recent RCT [169]), or when comparing systemic antibiotics with antibiotic impregnated cement, which is consistent with another large review [170]. A separate meta-analysis of randomised controlled trials within this review, comparative trials and non-comparative cohort studies of antibiotic loaded versus non-antibiotic cement, found the use of antibiotic loaded cement in cemented hip replacement delivered a reduced postoperative infection rate compared with non-impregnated cement [170].

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	**A**	B	C	D		

Comment:	**Routine antibiotic prophylaxis is recommended in joint replacement with the choice of agent made on the basis of individual patient needs, cost and the local availability of the agent.**

Anaesthesia

QUESTION:	**Is there high level evidence to support the use of a particular type of anaesthesia for people electing primary total hip or knee replacement?**

Summary: Joint replacement is amenable to regional anaesthetic techniques that can improve patient outcomes. There is debate as to whether regional anaesthesia decreases mortality, cardiovascular morbidity, deep venous thrombosis and pulmonary embolism, blood loss, duration of surgery, pain, opioid related adverse effects, cognitive defects or length of stay. Several meta-analyses suggest patients undergoing elective total hip or knee replacement under regional anaesthesia have better outcomes (reduced operating time, need for transfusion and incidence of thromboembolic disease) than those under general anaesthesia [171-173].

A systematic review of RCT's that compared general anaesthesia and/or systemic analgesia with regional anaesthesia and/or regional analgesia for total knee replacement included 28 studies involving 1538 patients [174]. This review found no difference in perioperative blood loss or duration of surgery in patients who received general anaesthesia against regional anaesthesia. Compared with general anaesthesia and/or systemic analgesia, regional anaesthesia and/or systemic analgesia reduced postoperative pain, morphine consumption, and opioid related adverse effects. Three of twelve studies found evidence of reduced length of stay for people undergoing regional anaesthesia and analgesia, and six of fourteen studies reported facilitated rehabilitation milestones for total knee replacement, but not for total hip replacement, with regional anaesthesia and analgesia.

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	A	**B**	C	D		

Comment:	**Decisions regarding the type of anaesthesia need to be made with consideration given to individual patient and clinician preference, the balance of risks and benefits including available technical skills, and the local context in which the anaesthesia is given.**

Tourniquet use in total knee replacement

QUESTION:	**Does the use of a tourniquet in total knee replacement affect patient outcomes?**

Summary: Tourniquet use in total knee replacement is common practice and is used to provide a bloodless field to improve surgical visualisation [175] and to minimise blood-cement mixing during cement fixation and setting of the prosthesis [176, 177]. Complications associated with tourniquet use include wound dehiscence, haematoma formation requiring drainage, knee stiffness, deep vein thrombosis (DVT), thigh pain and infection [175, 178]. Review of the evidence in support of tourniquet in terms of pain relief, functional recovery, health-related quality of life, blood loss (blood transfusion) and other complications was completed. Two systematic reviews and four subsequent RCT's [175, 178-182] were identified that examined short term outcomes, but none of these included long term patient function.

One systematic review and meta-analysis [178] reviewed studies up to 2008 that compared the use of tourniquet with no use of tourniquet in patients undergoing total knee replacement. The authors concluded there was no advantage in using a tourniquet in knee replacement surgery for reducing blood transfusions and total blood loss. Due to significant heterogeneity, there were no firm conclusions regarding complications. Since this review, Li et al [179] conducted an RCT that reported increased total blood loss in the group where a tourniquet was used. Another study [180] showed no difference in total blood loss or resultant complications between the two groups.

There is also considerable debate on whether the timing of tourniquet release influences patient outcomes. Proponents of tourniquet release prior to wound closure argue that it allows better haemostasis. A meta-analysis of RCT's up to 2005 [175] compared the use of tourniquet release before and after wound closure in patients undergoing total knee replacement. The authors concluded that tourniquet release prior to wound closure increased total blood loss, while tourniquet release after wound closure increased the risk of early postoperative complications needing another operation. These complications included wound dehiscence, haematoma, infections and knee stiffness requiring manipulation under anaesthetic. Since this review, two RCTs [181, 182] showed no difference in total blood loss or blood transfusion rates between the two groups. There are currently no reports of patient related outcomes for the effect of duration of tourniquet inflation.

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	A	**B**	C	D		

Comment:	**Tourniquet use does not appear to reduce the need for blood tranfusion. Whether it is associated with other complications is unclear. If a tourniquet is used it is recommended that it be deflated prior to wound closure.**

Wound drains

QUESTION:	**Is there high level evidence to support the routine use of drains after elective total hip or total knee replacement?**

Summary: The aim of using surgical drains in orthopaedic surgery is to reduce haematoma formation and its associated pain, assist with drainage of blood and other fluids, reduce the chance of infection and improve wound healing. There is considerable variation in the use of drains, and in the type of drain used.

A systematic review in 2007 [183], compared the use of closed suction drains to no drains following orthopaedic surgery. Twenty of the thirty six studies included for review related to hip and or knee replacement, and found no statistically significant difference between the drained or undrained groups for wound infections, wound haematoma, wound dehiscence or reoperations for wound healing complications. Blood transfusion was required more frequently in people who had received a closed suction drain, while those without a drain were more likely to exhibit bruising and require reinforcement of the wound dressings. The reviewers advised that caution be taken in interpreting the study results due to small study sizes and short follow up time for the included studies. The findings of four subsequent RCT's (n = 470) [184-187] support the conclusions of the 2007 review, despite similar limitations of small study numbers and short follow up. One study [187] did follow their cohort to 12 months and found no difference in outcomes between groups. Another study [184] compared autologous drain, suction drain and no drain after total hip replacement and found no statistical difference in the need for transfusion, postoperative haemoglobin, length of stay or wound infection between the group with no drain and the group with the autologous drain.

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	A	B	**C**	D		

Comment:	**Currently, there is insufficient evidence from randomised trials to support the routine use of drains following elective hip or knee replacement.**

Urinary catheters

QUESTION:	**Is there high level evidence to inform the optimal use of urinary catheters in people undergoing total hip or total knee replacement?**

Summary: Urinary retention and other voiding problems are potential causes of morbidity in people electing joint replacement surgery and an optimal method for their management has not been well documented. In current practice, wide variation exists between the use of an in-dwelling catheter and intermittent catheterisation for symptoms of urinary retention when present. The most effective method continues to be debated with the existing body of evidence (specific to joint replacement) consisting of small trials of variable methodological quality [188-194].

A systematic review attempted to determine the advantages or disadvantages of alternative approaches to short term bladder drainage in adults [195]. It included two studies specific to joint replacement that found there is limited evidence to suggest that the use of intermittent catheterisation is associated with a lower risk of bacteriuria than in-dwelling urethral catheterisation. Another general review [196] reported conflicting outcomes in efficacy of the two methods. These reviews, and three prospective randomised controlled studies [188-190], report conflicting outcomes with respect to infection and urinary retention. Therefore, the ability to draw conclusions to inform current best practice is limited. The decision to use a particular catheterisation method may be based on other perioperative factors, such as type of anaesthetic and patient age. This aspect of joint replacement surgery would benefit from a well designed study in the Australian context.

Evidence Level:	I	**II**	III-1	III-2	III-3	IV
Grade:	A	B	**C**	D		

Comment:	**Decisions regarding catheterisation should be made with consideration of other perioperative factors such as type of anaesthesia/analgesia or age.**

Pain management

QUESTION:	**Is there high-level evidence for optimal pain management perioperatively for elective primary total hip or knee replacement?**

Summary: Although both hip and knee replacements are commonly performed operations, there is no consensus about the most appropriate anaesthetic and analgesic techniques to use for each procedure. A recent systematic review [173] compared regional anaesthesia and general anaesthesia for hip replacement. 18 randomised trials (n = 1239) fulfilled the search criteria and the benefits of regional anaesthesia were limited to improved pain scores, less blood loss and fewer opioid related adverse events (for example, nausea and vomiting). Another systematic review [174] of 28 randomised trials (n = 1538) found regional anaesthesia and/or analgesia reduced postoperative pain, morphine consumption and opioid-related adverse effects following knee replacement. Prospect (www.postoppain.org) reviewed general anaesthesia, systemic opioids, central neuraxial block and peripheral nerve block for hip and knee replacement, and have published their consensus recommendations supporting the use of spinal anaesthesia and lumbar plexus block techniques [197, 198]. Two other studies [171, 199] support the use of both spinal and lumbar plexus block for hip replacement. For hip and knee replacement, conventional NSAID/COX-2-selective inhibitors together with opioids titrated to effect, and paracetamol, are recommended for postoperative pain of moderate to high intensity [197, 198, 200].

Local infiltration analgesia is a new analgesic technique currently undergoing formal investigation after initial clinical experience suggested it might have some benefit in lower limb joint replacement [201-203]. Later studies suggest there is little evidence to support the use of the technique in hip replacement either intraoperatively, or with a post-operative wound infusion catheter technique, provided that multimodal, oral, non-opioid analgesia is given. In knee replacement, the data supports the intra-operative use of the local infiltration technique but not the post-operative use of wound catheter administration. In knee replacement, a compression bandage prolongs the analgesic effect [204]. There is limited evidence to support the use of NSAIDs or epinephrine in the infiltration solution and the data on post-operative hospitalisation and recovery are conflicting. Shorter lengths of stay have been achieved by oral multimodal, non-opioid analgesia together with organisational optimisation of care [35, 204, 205].

Evidence Level:	I	**II**	III-1	III-2	III-3	IV
Grade:	A	**B**	C	D		

Comment:	**Based on randomised trials, regional anaesthesia improves postoperative pain after total hip replacement and regional anaesthesia and/or analgesiaimproves postoperative pain after total knee replacement.**

Prophylaxis for venous thromboembolism (VTE)

QUESTION:	**Is there evidence to guide prophylaxis in people undergoing elective primary hip or knee replacement to prevent morbidity and mortality associated with VTE?**

Comment: VTE is a complication which can affect people after surgery for hip or knee replacement. Sudden pulmonary embolism (PE) can result in almost immediate death with survivors of PE experiencing a protracted course of recovery. Deep vein thrombosis (DVT), while often asymptomatic, can also cause significant long term morbidity with symptoms such as chronic limb swelling and ulceration adding to the burden of VTE [206]. The American College of Chest Physicians [18] report the incidence of DVT without prophylaxis after major orthopaedic surgery as 40-60%. With thromboprophylaxis, the proportion of people who develop symptomatic VTE decreases to 1-10% [18].

Several guidelines have been developed to provide recommendations for VTE prophylaxis [18-21, 207, 208] and there have been several systematic reviews of the different modalities used in prevention of VTE [209-211]. In 2009, a systematic review of published international guidelines was undertaken [212]. The authors concluded that based on the same available literature, different guidelines recommend different regimens. This is likely to be a result of disagreement on the relevance of different endpoints. Different bodies, such as the American College of Chest Physicians [18] and the American Academy of Orthopaedic Surgeons [19], disagree on the use of asymptomatic DVT or clinically important VTE as end points for intervention.

Another review undertaken in 2008 [213], focused on three different, but commonly used, thromboprophylaxis regimens and attempted to determine the incidence of all-cause mortality and symptomatic, non-fatal PE after elective primary total hip and knee replacement. Twenty publications (618 identified) met the authors' criteria for inclusion. Studies were required to include documentation of six week and three month mortality, the type of prophylaxis used and be published in English between 1998 and 2007. Only consecutive case series with documented follow up and randomised trials were included. Results are summarised below (Table 2).

Table 2: All cause mortality and symptomatic non-fatal PE with three different prophylaxis regimes (6 week and 3 month mortality)

	Potent anticoagulants± (12 studies) n=14,750	**Multi modal with aspirin (6 studies) n=7,193**	**Warfarin (5 studies) n=5,006**
All cause mortality*	0.41% (0.0-0.62%)	0.19% (0.0-0.29%)	0.40% (0.1-0.67%)
Symptomatic, non-fatal PE*	0.60% (0.0-1.2%)	0.35% (0.0-0.62%)	0.35% (0.1-0.8%)

*Source: Sharrock et al (2008), *Potent anticoagulants are associated with a higher all-cause mortality rate after hip and knee arthroplasty.* Clinical Orthopaedics and Related Research [213]
± Potent anticoagulants include low-molecular weight heparin, ximelagatran, fondaparinux or rivaroxaban.

Recently, newer agents have become available for thromboprophylaxis after joint replacement [214-217]. These agents have been developed as oral alternatives without a

need for monitoring due to a predictable anticoagulant response. Results from randomised controlled trials that compared enoxaparin and rivaroxaban, suggest that rivaroxaban is more effective than enoxaparin for prevention of VTE without an increase in bleeding events [218-221], although a subsequent pooled analysis found rivaroxaban was associated with significantly higher clinically relevant non-major bleeding [222]. Randomised controlled trials for dabigatran etexilate [223-225], another oral anticoagulant, show it is as effective as enoxaparin in reducing the risk of venous thromboembolism with a similar safety profile. These oral agents were approved for use in Australia following hip or knee replacement in 2008, although there is currently insufficient data to comment on rare or long-term adverse effects.

Existing guidelines support a multimodal prophylaxis as a key component of modern surgical practice. There is a need for continuing research in this area as surgical techniques and perioperative and postoperative management continues to change. When using the existing guidelines to inform practice, an approach incorporating the following strategies is advised:

- Preoperative risk assessment for VTE and bleeding
- Education and knowledge transfer re: VTE risk associated with joint replacement surgery, the signs and symptoms of VTE, the effectiveness of the prophylaxis measures available and the risks and benefits of prophylactic options
- Decision regarding regional anaesthesia made in consultation with the anaesthetic team
- Mechanical prophylaxis in all patients unless contraindicated, and used as per manufacturers recommendations
- Chemical prophylaxis in all patients unless contraindicated, and administered as per safety and usage recommendations
- Early mobilisation as routine care
- Use of a temporary IVC filter in exceptional circumstances only

Evidence Level:	**I** II III-1 III-2 III-3 IV
Grade:	**A** B C D

Comment:	**Multimodal prophylaxis for VTE is recommended after elective joint replacement. The development of a decision analysis tool to assist with the balance of risk and benefit may be an area of future research.**

Cold therapy

QUESTION:	**Is there high-level evidence to support the routine use of cryotherapy in the acute postoperative period for people who have undergone total knee replacement?**

Summary: The use of ice or other cooling mechanisms following total knee replacement is based on theories that local cooling may affect neural and vascular function and subsequently reduce pain and swelling. There is substantial variation in the use of cold therapy after total knee replacement in current Australian practice [226]. A recent systematic review and meta-analysis of eleven randomised controlled trials (n = 793) assessed the efficacy of cryotherapy on blood loss, transfusion rate, pain, analgesia use, range of motion and length of hospital stay after primary knee replacement. Despite significant differences between the studies, meta-analysis found benefits of cryotherapy for blood loss and early ROM but no significant benefit on the other short term outcome measures [227]. There would be benefit in well designed studies to evaluate the effect of cryotherapy on rates of blood transfusion in the immediate postoperative period.

Studies which assess the efficacy of cold therapy on individually reported function and quality of life outcomes, as well as preference and satisfaction, are currently under-investigated and reported. Measures of individual satisfaction and the use of ice are an area that would benefit from future research, especially if there is an emphasis placed on the measurement of person specific outcomes. Based on the existing literature, cold therapy may form part of the postoperative pain management protocol, but its routine use following knee replacement surgery is not currently supported.

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	A	**B**	C	D		

Comment:	**Currently, there is insufficient evidence from randomised trials to support the routine use of cryotherapy following elective hip or knee replacement. In the acute postoperative period, it reduces blood loss and improves range of motion.**

Mobilisation

QUESTION:	**Is there high level evidence to support early mobilisation postoperatively following total primary hip or knee replacement?**

Summary: There has been a steady decline over the past 20 years in the time to initial mobilisation after hip or knee replacement as surgical techniques have changed, demand for resources has increased and the recognition of benefits associated with early functional activity. Early mobilisation and accelerated post-operative physical activity to achieve functional mobility are common features of current perioperative protocols [228-231]. In part, the drive to commence mobilisation in the early postoperative period has been a result of the need to reduce individual length of stay, and agreement that it reduces certain complications such as venous thromboembolism.

A systematic review identified two trials (n = 261) commencing early activity in inpatient settings. Despite methodological limitations, early commencement of rehabilitation led to more rapid attainment of functional milestones, shorter hospital stay, fewer post-operative complications and reduced costs in the first three to four months after surgery [231]. A subsequent RCT (n = 87) included standardised requirements for mobilisation which commenced on the day of surgery and targeted four hours out of bed on the first postoperative day [232]. This study found significant decreases in length of stay and improvements in quality of life when measured at three months. Early mobilisation is part of an optimisation-of-care process, although there is insufficient evidence to guide optimal timing of mobilisation and duration and intensity of this early activity.

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	A	**B**	C	D		

Comment:	**Early mobilisation can improve functional independence after joint replacement and reduce clinical complications such as VTE. Optimal intensity and frequency of early mobilisation would benefit from further investigation in trials with improved methodology and the use of standardised outcome measures.**

Continuous passive motion (CPM) after knee replacement

QUESTION:	**Is there high level evidence to support the routine use of continuous passive motion (CPM) on people after total knee replacement?**

Summary: Continuous passive motion is a way of providing motion to the knee joint using a specifically designed machine. The time, velocity and arc of motion parameters of the CPM device can be adjusted to an individual's requirements. CPM has been used since the 1960's as an adjunct to other therapies to address joint stiffness, pain and range of joint motion during hospital stay following total knee replacement. One systematic review of RCT's to January 2009 was identified from the Cochrane Database of Systematic Reviews, and there were no subsequent RCT's identified [233]. Studies were included in the systematic review if the experimental group received CPM and otherwise similar postoperative care following total knee replacement for arthritis. Twenty RCT's with 1335 participants met the criteria for inclusion, although all studies showed vulnerability to bias related to method of allocation, randomisation and/or reporting of results.

The review found there was high level evidence that CPM increased both passive and active knee flexion in the short term but the degree of increase (2° and 3° respectively) was not clinically meaningful. There were unclear effects on knee range in the medium to long term. Low quality evidence was available that CPM reduced the need for subsequent joint manipulation under anaesthesia, and that CPM had no effect on hospital length of stay. Its effects on function, pain, swelling and quadriceps muscle strength were unclear. There is little available evidence to identify the optimal parameters for use (time, velocity or motion arc); however, this review showed response is not dose related.

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	**A**	B	C	D		

Comment:	**There is evidence that CPM does not result in clinically relevant improvements in outcomes. Currently, support for its routine use after knee replacement is not available.**

Hip precautions

QUESTION:	**Is there high level evidence to support the use of hip precautions to prevent dislocation after elective primary total hip replacement?**

Summary: Activity restrictions following hip replacement are currently a routine aspect of postoperative care designed to minimise the risk of dislocation and reduce instability of a new hip. Reported rates of dislocation are between 2 and 4%, with the first few months after surgery carrying the greatest risk. The use of protocols aimed at reducing the likelihood of prostheses dislocation are variable, although precautions consisting of limited hip flexion, adduction and rotation are advocated. Perioperative factors, such as surgical approach, component positioning and size, and wound closure techniques, are also important factors in relation to risk of dislocation.

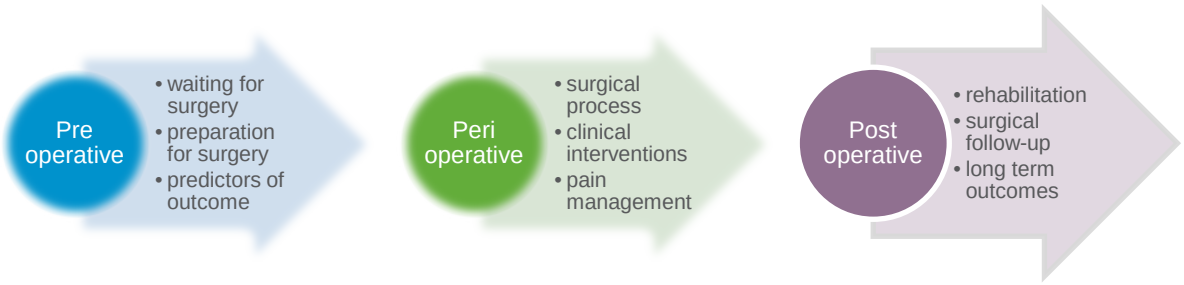
Studies identified that reviewed the role of precautions in reducing prosthetic hip dislocation included one systematic review and subsequent RCT and two prospective cohort studies [234-237]. All participants in the identified studies underwent an anterior or antero-lateral approach, making extrapolation of conclusions to other surgical approaches inappropriate. All studies included movement restrictions for both control and intervention groups, but in the intervention group additional requirements such as abduction pillows and high seats for toileting were removed. Studies had methodological susceptibilities related to participation, allocation and length of follow-up, which make recommendations regarding the use of hip precautions in the prevention of hip dislocation uncertain.

Future research could investigate variables that possibly influence hip dislocation, such as provision of preoperative information, prosthetic selection, surgical technique and specific individual factors. Measures of patient satisfaction, with or without dislocation precautions, are another area of required knowledge.

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	A	B	**C**	D		

Comment:	**There is currently insufficient knowledge to support or refute the use of hip precautions (protected hip flexion, adduction and rotation) following total hip replacement.**

Postoperative Elective Primary Hip and Knee Replacement



SUMMARY OF FINDINGS: POSTOPERATIVE

Rehabilitation and discharge

- Currently, there is insufficient evidence (largely due to a lack of high-quality research) to suggest superiority of one particular type, location, timing or duration of available rehabilitation program after elective hip or knee replacement. The superiority of a group-based program, inpatient program or outpatient program is unable to be determined. Further research that specifies intensity of intervention and uses consistent outcome measures would be beneficial (I C).

- Rehabilitation is defined by the World Health Organisation as "…appropriate measures, including…peer support, to enable persons…to attain and maintain their maximum independence, full physical, mental, social and vocational ability, and full inclusion and participation in all aspects of life" [238]. In all cases, the provision of rehabilitation should help to empower the person and their family. Greater clarity of the purpose of postoperative care after hip or knee replacement in NSW public hospitals is required.

Surgical follow-up

- Currently, there is no high level evidence to guide the frequency or duration of follow up after hip or knee replacement (IV D).

Long term outcomes

- Long term measures of pain, functional ability and quality of life suggest continued improvement is not guaranteed after joint replacement. Further research to improve the understanding of the determinants of outcome after hip or knee replacement would be beneficial (II C).

Rehabilitation

QUESTION:	**Is there high-level evidence that demonstrates whether a particular rehabilitation setting, rehabilitation intervention, timing or duration will provide superior results after total hip or total knee replacement?**

Summary: Following total hip or knee replacement, it is common in NSW to provide continued rehabilitative care after hospital discharge. Existing published literature reports variation in the timing, type of intervention, location, intensity and duration of this care [226, 239-242]. Possible explanations for this variation include alternative definitions of rehabilitation, a lack of high quality trials to guide practices to achieve optimal outcomes, or competing demands for limited resources. This results in both the clinician and the individual setting their expectations of recovery at the low end of the scale. Drawing conclusions from the existing evidence on the most effective care after discharge is difficult as there is substantial variation in outcome measures. Two recent systematic reviews assessed the effectiveness of post-acute rehabilitation following total hip or total knee replacement [243, 244]. Most of the included RCT's had design or methodological issues putting them at risk of bias. The reviews identified aspects relating to rehabilitation setting, type of rehabilitation (such as land based treatment versus water-based or functional training compared with traditional) and the timing of commencement of rehabilitation. No studies were identified that gave clear guidance on the optimal intensity of intervention to attain maximum function after surgery. There is consistent low quality evidence that delayed outpatient physiotherapy of either 8 or 15 weeks duration has a favourable impact on physical function after hip replacement. Studies reviewing participation in postoperative rehabilitation after five or six months, or rehabilitation initiated after the sub-acute period, were not identified. Tele-rehabilitation via web based communication following knee replacement (comparable to one to one treatment without the provision of a "hands on" component) may be an option for people located remotely [245].

Research in the area of provider or consumer preferences for rehabilitation has been minimal. There is evidence from observational and qualitative studies that considerable variation in preferences for treatment after total joint replacement exists. Future trials would benefit from large numbers of participants, comparable outcome measures and reports on level of intensity of exercise intervention.

Evidence Level:	**I**	II	III-1	III-2	III-3	IV
Grade:	A	B	**C**	D		

Comment:	**Currently, there is insufficient evidence (largely due to a lack of high-quality research) to suggest superiority of one particular type, location, timing or duration of available rehabilitation program after elective hip or knee replacement. The superiority of a group-based program, inpatient program or outpatient program is unable to be determined. Further research that specifies intensity of intervention and uses consistent measures would be beneficial.**

Surgical follow-up

QUESTION:	**Is there high-level evidence that demonstrates optimal surgical follow up (how long and how often) after elective primary total hip and total knee replacement?**

Summary: Complications after joint replacement can have an overwhelming effect on an individual's quality of life and daily function. These complications include loosening of the prosthesis, joint instability or dislocation, deep or superficial joint infection, peri-prosthetic fracture and component wear. While some complications are obvious or painful, others present without apparent symptoms and may only be evident on radiographs. Recommendations for periodic clinical and radiographic evaluation are common, yet efficacy of follow up protocols for the prevention or identification of complications have not been well evaluated. The AOA position statement on minimum long term follow up after joint replacement (http://www.aoa.org.au/Libraries/eCM_Files/ArthPosFollow_pdf_1.sflb.ashx) reflects current practice trends only, rather than recommendations based on an existing evidence base. Anecdotally, variation exists in both the duration of follow-up and the frequency of surgical follow-up.

A review of the literature found that overall, study quality is poor and the majority of studies have methodologies which retrospectively evaluate surgeon or patient adherence to post operative review after total hip or knee replacement [246-252]. Based on existing low quality evidence, it is reported that the current practice of routine, face to face follow-up of asymptomatic total joint replacement may be excessively costly and unnecessary, but the level of the existing evidence does not allow determination of a recommendation for follow-up.

Evidence Level:	I	II	III-1	III-2	III-3	**IV**
Grade:	A	B	C	**D**		

Comment:	**Currently, there is no high level evidence to guide the frequency or duration of follow up after hip or knee replacement.**

Long term outcomes

QUESTION:	**What is the long term effectiveness of total hip or total knee replacement with respect to quality of life, pain and function?**

Summary: Short term measures of outcome after hip or knee replacement indicate improvements in pain and return of function for the majority of people electing this surgery [253-255], but a large proportion of people are neutral or dissatisfied with their outcomes [68, 256-258]. Given the large minority of people (up to 25%) in which joint replacement does not achieve its goal, and evidence that existing physical therapy programs used during the sub-acute phase of recovery do not effectively restore individual physical and functional performance [259], identification of factors which determine optimal recovery of function and ability after lower limb joint replacement would be beneficial. A large body of evidence shows that people with a total hip or knee replacement have higher levels of disability in mobility and self-care when compared to their age-matched peers in the general population at one year [260-266].

A number of studies [256, 267, 268] report benefit of joint replacement surgery is not guaranteed, and over longer time-frames, maintenance of early improvement cannot be assumed. A large population based study [265] found that activity limitations were greater, and self reported health worse, amongst those who had had hip or knee replacement than those who had not, even after adjusting for gender, age and co-morbidities. High quality studies which prospectively quantify the effect of joint replacement surgery on pain, function and quality of life at time points longer than 1-2 years would be beneficial.

Despite more than 63,000 primary total hip and knee replacements being undertaken in Australia in 2010 [14], randomised controlled trials of the efficacy of total joint replacement compared to non-operative alternatives do not exist. Long term measures of patient relevant health and function outcomes, included as part of the surveillance process provided by the national joint replacement registry, would provide substantial population level data on the efficacy of hip or knee replacement from an individual's perspective. Some international registries have recently commenced the collection of patient relevant outcomes and have recommended determination of a well defined purpose when making decisions around what to evaluate.

Evidence Level:	I	**II**	III-1	III-2	III-3	IV
Grade:	A	B	**C**	D		

Comment:	**Long term measures of pain, functional ability and quality of life suggest continued improvement is not guaranteed after joint replacement. Further research to improve understanding of the determinants of outcome after hip or knee replacement would be beneficial.**

Ideal Experience

Case Study 3: Marina

Marina had experienced a difficult and painful couple of years with progressively increasing hip pain despite her careful management of her osteoarthritis. Marina's GP had referred her several years ago to a local osteoarthritis management program run through the local hospital and this program had been primarily responsible for delaying her hip replacement surgery. At that time, a multidisciplinary team led by a physiotherapist had assessed her ability to do various daily tasks. They took baseline measures of her quality of life and functional ability and with Marina had developed a management plan to use conservative, evidence based treatments to reduce her symptoms. As part of this program, Marina had reviewed her medications with her GP and pharmacist to achieve an effective pain relief strategy. She had commenced a twice weekly water based exercise program with the local branch of Arthritis NSW and she had arranged several visits to a local dietitian through the chronic disease items available through Medicare. This had stopped the steady "kilo creep" that had been happening over the previous ten years as her joints had become more painful and her activity level had diminished. She had been able to improve her high blood pressure through her regular exercise program.

Now, though, Marina could no longer manage the many stairs at home and the pain and resulting sleeplessness had become a big issue. Her orthopaedic surgeon had advised there were few options left besides a joint replacement, as her hip joint was now 'bone on bone'. Marina was reluctant to embark on another major surgical procedure. She had had a number of surgeries over the years for her osteoarthritis, with the last one on her shoulder about 12 months ago.

Marina had heard many stories about long waits and cancellations of joint replacement surgery at the local public hospital, so she was very surprised when contacted by the hospital musculoskeletal case coordinator a couple of days after submitting her admission form. The coordinator arranged a convenient time to speak with Marina about her general health and medical history, and the coordinator arranged blood tests and other investigations via her GP. Marina was able to arrange attendance at an information session which helped her understand what to expect from her upcoming surgery and the subsequent recovery. There was opportunity to discuss the planned procedure, practice with the equipment she might use postoperatively and discuss her fears about coping after the surgery given her hands, elbows and shoulders were also severely affected by arthritis.

The tests arranged found that Marina's haemoglobin was low and that she was struggling to resolve a persistent urinary tract infection. Marina, her GP and the Musculoskeletal Coordinator worked together to resolve these issues in the time she was waiting for surgery. The coordinator also arranged the Occupational Therapist to review her home as Marina lived on a hill and had 29 steps to her front door and another 12 inside. This early review meant there was plenty of time for installation of handrails and for the supply of equipment to allow Marina to be safe after surgery. This meant Marina would be discharged directly home with extra services provided from community programs.

When Marina commenced her surgical planning in the month prior to surgery, she felt well prepared and confident for her hip replacement. Her haemoglobin levels and tests for infection were normal, and her surgery went ahead as scheduled. She was confident (with her daughter's support) advocating against particular types of pain medication during her postoperative recovery. She well knew which drugs made her feel disturbed and anxious, so this time she would not be placated by the doctors. Documentation of her personal knowledge and medication preferences occurred as part of the surgical planning process.

As Marina had continued her regular water exercise as close to surgery as possible, she felt ready to get out of bed the same day as her operation! She was able to walk (with a walking frame) about 100 metres and started her muscle strengthening exercises the same day. The next day she increased her activity level by doing several laps of the ward, many repetitions of the hip exercises she had been given and she managed to shower herself with only indirect supervision from the hospital staff. Marina was actively involved in all discussions about her care, and determined that she was ready for discharge home the following day as the necessary planning to go home had been completed prior to admission.

Marina was pleased to be home – she felt tired and a bit sore but it was good to be among familiar things. The community nurse visited in the first week, which allowed Marina to ask questions that had arisen since discharge. The physiotherapist had called to provide an opportunity for Marina to talk about her physical recovery and to confirm her attendance at a group rehabilitation session about a month after her surgery. She was looking forward to sharing her experiences with others who were in the same situation. This seems to make it easier to recover rather than struggle along at home alone. At this group session, all the participants were given the opportunity to plan their ongoing rehabilitation. Marina elected to return to her twice weekly Arthritis NSW pool exercise group with telephone support from the Musculoskeletal Coordinator. Others chose to go on their own way with no support at all, and still others chose the supported hospital group program.

Marina was amazed at the quality of her experience. Being able to be prepared well in advance, and to have access to the knowledge of the hospital clinicians, gave her a good understanding of what to expect. The best thing about her hip replacement is that her knee has stopped being painful. She can now manage all her stairs and get to the letterbox without either her hip or knee hurting!

Marina was pleased to be able to tell her friends of the positive experience of her hip replacement at the local public hospital.

Abbreviations

ACI	Agency for Clinical Innovation
ANZSBT	Australian and New Zealand Society of Blood Transfusion
BOA	British Orthopaedic Association
CEC	Clinical Excellence Commission
CENTRAL	Cochrane Central Register of Controlled Trials
CPM	Continuous Passive Motion
DVT	Deep Vein Thrombosis
EJR	Elective Joint Replacement
GP	General Practitioner
HKPT	Hip and Knee Prioritisation Tool
ICU	Intensive Care Unit
LOS	Length of Stay
MaPT	Multi-attribute Prioritisation Tool
MSK	Musculoskeletal
NBA	National Blood Authority
NHMRC	National Health and Medical Research Council
NICE	National Institute of Clinical Excellence
NJRR	National Joint Replacement Registry
NSAID's	Non-steroidal Anti-inflammatory Drugs
NSW	New South Wales
OA	Osteoarthritis
OARSI	Osteoarthritis Research Society International
OMERACT	Outcome Measures in Rheumatology
OPSC	Orthopaedic Physiotherapy Screening Clinic
PE	Pulmonary Embolus
RCT	Randomised Controlled Trial
ROM	Range of Motion
SR	Systematic Review
THA	Total Hip Arthroplasty
TJA	Total Joint Arthroplasty
TKA	Total Knee Arthroplasty
THR	Total Hip Replacement
TJR	Total Joint Replacement
TKR	Total Knee Replacement
VTE	Venous Thromboembolism
WHO	World Health Organisation
WOMAC	Western Ontario and McMaster Universities Arthritis Index

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Appendix 1:

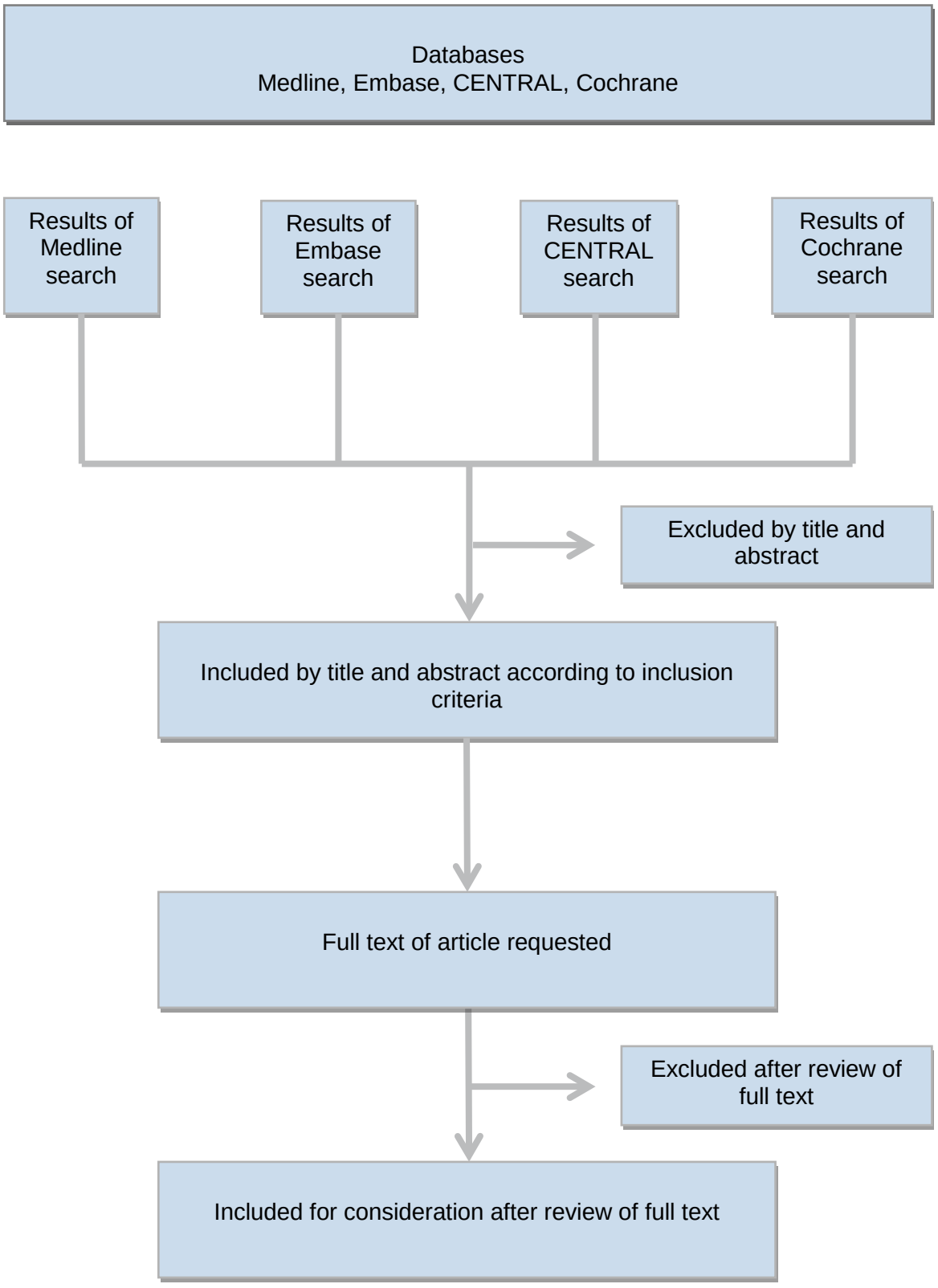
Medline search strings for arthroplasty (1-19) and study type (20-35)

1	arthroplasty, replacement, knee/
2	arthroplasty, replacement, hip/
3	knee prosthesis/
4	hip prosthesis/
5	tkr .tw.
6	thr.tw.
7	exp knee/
8	exp hip/
9	knee$.tw.
10	hip$ .tw.
11	7 or 9
12	8 or 10
13	11 or 12
14	exparthroplasty/
15	joint prosthesis/
16	(arthroplast$ or prosthe$ or replac$) .tw.
17	or/14-16
18	13 and 17
19	or/1-6, 18
20	randomi#ed controlled tria1.pt.
21	controlled clinical trial.pt.
22	randomi#ed.ab.
23	placebo.ab.
24	clinical trials as topic .sh.
25	randomly.ab.
26	trial. ti.
27	meta analysis/
28	meta analysis. pt .
29	(metaanaly$ or meta analys$) .tw.
30	(systematic$ adj3 (review$ or overview$)) .mp.
31	exp Guideline/
32	guidelin$.tw.
33	or/20-32
34	exp animals/ not humans.sh.
35	33 not 34

* Arthroplasty and study type search strings for Embase, CENTRAL and Cochrane developed by individual working group members in conjunction with support from facility libraries or research colleagues using the Medline strategy as a guide.

Appendix 2:

Literature Review Strategy



Appendix 3:

NHMRC Descriptions of Evidence Levels, Grade of Recommendation and Body of Evidence Assessment Matrix [269]
(www.nhmrc.gov.au)

Table 1: Descriptions of Evidence Levels

NHMRC Level of Evidence	Description
I	Evidence obtained from a systematic review of all relevant randomised controlled trials
II	Evidence obtained from at least one properly-designed randomised controlled trial
III-1	Evidence obtained from well-designed pseudo-randomised controlled trials (alternate allocation or some other method)
III-2	Evidence obtained from comparative studies (including systematic reviews of such studies) with concurrent controls and allocation not randomised, cohort studies, case-control studies, or interrupted time series with a control group
III-3	Evidence obtained from comparative studies with historical control, two or more single arm studies, or interrupted time series without a parallel control group
IV	Evidence obtained from case series, either post-test or pre-test/post-test

Table 2: Grade of Recommendation

NHMRC Grade of Recommendation	Description
A	Body of evidence can be trusted to guide practice
B	Body of evidence can be trusted to guide practice in most situations
C	Body of evidence provides some support for recommendation(s) but care should be taken in its application
D	Body of evidence is weak and recommendation must be applied with caution

Table 3: NHMRC Body of Evidence Assessment Matrix

Component	A Excellent	B Good	C Satisfactory	D Poor
Volume of evidence	Several Level I or Level II studies with low risk of bias	One or two Level II studies with low risk of bias or a systematic review (SR) / multiple Level III studies with low risk of bias	Level III studies with low risk of bias or Level II studies with moderate risk of bias	Level IV studies or Level I–III studies with high risk of bias
Consistency	All studies consistent	Most studies consistent and inconsistencies may be explained	Some inconsistency reflecting genuine uncertainty around the clinical question	Evidence is inconsistent
Clinical impact	Very large	Substantial	Moderate	Slight or restricted
Generalisability	Population(s) studied in body of evidence are the same as the target population for the guideline	Population(s) studied in the body of evidence are similar to the target population for the guideline	Population(s) studied in the body of evidence different to the target population for the guideline but it is clinically sensible to apply this evidence to the target population (e.g. results obtained in adults that are clinically sensible to apply to children)	Population(s) studied in the body of evidence different to the target population for the guideline and hard to judge whether it is sensible to generalise to the target population
Applicability	Directly applicable to Australian health care context	Applicable to Australian health care context with few caveats	Probably applicable to Australian health care context with some caveats	Not applicable to Australian health