COUNTING THE COST

PART 1 HEALTHCARE COSTS

The current and future burden of arthritis

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Foreword

About this report:

Counting the Cost: The Current and Future Burden of Arthritis provides up to date estimates of the prevalence and costs of arthritis from 2015 to 2030 under a 'business as usual' scenario. It also models the impact of implementing non-surgical interventions for knee osteoarthritis to illustrate the potential benefits for individuals, governments and the economy from better arthritis care.

Part 1 Healthcare Costs estimates the current and future prevalence of arthritis and the associated costs to the health system. Part 2 Economic Costs considers the economic costs of arthritis, including lost personal income, increased welfare payments, reduced taxation revenue and lost GDP.

Arthritis is one of the most common, costly and disabling chronic conditions in Australia. In its many forms, it affects nearly four million people of all ages, including children.

The personal, social and economic costs of arthritis, as highlighted in this report, are immense but tend to be poorly recognised. These costs amount to many billions of dollars a year and include healthcare costs, lost personal income and national productivity losses from reduced work capacity due to arthritis and, of course, the immeasurable cost of lost wellbeing.

With arthritis prevalence set to reach 5.4 million people by 2030, associated costs will continue to grow, putting increasing pressure on the sustainability of the health, welfare and aged care systems.

Yet much can be done to alleviate these costs by implementing simple programs to prevent and better manage arthritis. As highlighted in this report, a simple intervention for knee osteoarthritis could achieve savings to the health system of over $170 million a year, as well as helping to keep more people in the work force, yielding additional economic benefits.

The time has come to give programs that provide better care and support for people with arthritis the priority they deserve. With the health and welfare system costs of arthritis set to grow by more than $150 million a year, we simply can't afford not to.

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Acknowledgments

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Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
bDMARD	Biological disease-modifying anti-rheumatic drug
BMI	Body mass index
CI	Confidence interval (95%)
DMARD	Disease-modifying anti-rheumatic drug
DRG	Diagnosis Related Group
EQ-5D	European Quality of Life 5 dimension instrument
HRQOL	Health-Related Quality of Life
ICER	Incremental cost-effectiveness ratio
JIA	Juvenile idiopathic arthritis
MBS	Medicare Benefits Scheme
NHS	National Health Survey
NSAID	Non-steroidal anti-inflammatory drug
OA	Osteoarthritis
PBS	Pharmaceutical Benefits Scheme
QALY	Quality-adjusted life year
RA	Rheumatoid arthritis
RCT	Randomised controlled trial
RPBS	Repatriation Pharmaceutical Benefits Scheme
SD	Standard deviation
SF-36	Short Form-36 Health Survey
THPI	Total Health Price Index
THR	Total hip replacement
TJR	Total joint replacement
TKR	Total knee replacement
WOMAC	Western Ontario and McMaster Universities Osteoarthritis Index
YLD	Years Lived with Disability

Executive summary

Arthritis is a debilitating disease. People with arthritis typically experience pain, stiffness, impaired physical functioning, and reduced quality of life. Arthritis is also very common. In 2014-2015, 15.3% of the Australian population was affected by some form of the disease. Arthritis also carries a heavy cost burden, including direct costs (for example, medications, hospitalisations, and out-of-pocket expenses) and indirect costs (for example, carer costs and the costs due to lost productivity). In 2007, arthritis was estimated to cost the Australian healthcare system $4.2 billion annually. As significant as this amount is, the costs of managing the condition are expected to increase markedly in the decades ahead.

This report estimates the future prevalence of arthritis in Australia and projected healthcare costs to the year 2030. It provides estimates for arthritis as a whole, and also individual estimates for the most common forms of arthritis in Australia: osteoarthritis (OA), rheumatoid arthritis (RA) and for children, juvenile idiopathic arthritis (JIA). These forms of arthritis were also selected because they are the focus of the Arthritis and Musculoskeletal Conditions National Health Priority Area. The report also models the potential benefits of early and late conservative management programs for mild-moderate and severe knee OA, respectively.

The current and projected economic costs of arthritis, including lost personal income, increased welfare payments, reduced taxation revenue and lost GDP, are estimated in *Counting the Cost*, *Part 2 Economic Costs*.

An epidemiological model of the Australian population was developed to forecast the future burden of arthritis, in terms of prevalence and healthcare costs. Data on the national prevalence of arthritis, OA and RA were obtained from the Australian Bureau of Statistics (ABS) National Health Survey 2014-2015. The national prevalence of JIA was obtained from Australian Institute of Health and Welfare (AIHW) publications. The future prevalence of these conditions was estimated using ABS population projections for the years 2015, 2020, 2025 and 2030. Data on healthcare costs for arthritis, OA, RA and other musculoskeletal conditions (including other forms of inflammatory arthritis, but not including back pain or osteoporosis) were obtained from an AIHW healthcare expenditure report. Costs for JIA were based on healthcare resource utilisation data obtained from the Royal Children's Hospital in Melbourne. The healthcare costs of arthritis, OA, RA, other musculoskeletal conditions and JIA were forecast for the years 2015, 2020, 2025 and 2030. National estimates are provided for arthritis prevalence and healthcare costs, as well as estimates for individual states and territories. Outcomes data (regarding health-related quality of life and delayed need for joint replacement) from published randomised controlled trials were used to quantify the potential benefits of implementing conservative management programs for knee OA at the population level.

The main findings of this report are:

- The number of people with arthritis is expected to increase nationally by 38% from 2015 to 2030, from 3.9 million to 5.4 million Australians.
- By 2030, people aged 75 years and older will represent the largest group with arthritis in absolute terms, comprising over 1.5 million people.
- The number of people with OA is expected to increase nationally from almost 2.2 million in 2015 to almost 3.1 million Australians in 2030.
- People with RA comprised 10.8% of the total arthritis population in 2015. Between 2015 and 2030, the number of Australians with RA is projected to increase from 422,309 in 2015 to 579,915 in 2030.
- With future population growth, the number of children and adolescents affected by JIA is expected to increase by 22% from 6,006 in 2015 to 7,334 in 2030.
- The healthcare costs for arthritis were estimated to exceed $5.5 billion in 2015. By the year 2030, these costs are projected to exceed $7.6 billion.
- The healthcare costs for OA alone were estimated to be over $2.1 billion in 2015 and by the year 2030, these are forecast to exceed $2.9 billion. On average, this equates to $970 for every person with the condition.
- The healthcare costs for RA were estimated to be over $550 million in 2015 (including $273 million spent on biological disease-modifying anti-rheumatic drugs). This equates to $1,303, on average, for every person with the condition. Healthcare costs for RA are projected to rise to over $755 million by the year 2030.
- Available data from a case study suggest that if all children with JIA were treated according to a best practice model of care the total cost to the health system could be approximately $40.3 million dollars per year. By 2030, this could rise to nearly $49.2 million dollars per year.
- Implementing conservative (non-surgical) management strategies for people with mild to moderate knee OA could be highly cost-effective.
- Implementing conservative management strategies for people with severe knee OA could result in substantial cost savings for the Australian healthcare system, if implemented at a broader population level. The potential cost savings from avoiding or delaying knee replacements alone would be over $170 million in 2015, increasing to over $233 million in 2030.

Structure of the report

This report consists of the following sections:

Section 1: Introduction

This section provides a summary of the research aims and an overview of the pertinent literature. This includes a description of the types of arthritis conditions that are considered in this research (OA, RA and JIA), the main risk factors associated with each condition, and contemporary treatment approaches.

Section 2: Methods

This section summarises the key data sources utilised for this research. The methods used for analysis are also described, including modelling procedures used to: (1) estimate the prevalence of arthritis in 2015, 2020, 2025 and 2030; (2) forecast the healthcare costs of arthritis at these time points; and (3) estimate the potential benefits of two conservative management programs for knee OA.

Section 3: Results

This section presents the results of the prevalence analyses, including national and state/territory-based projections for each type of arthritis. The national estimates are also stratified by age group. This section also presents the projected healthcare costs of arthritis to the year 2030, as well as a case study of the projected costs of optimal care for children and adolescents with JIA. The benefits of conservative management programs for mild to moderate and severe knee OA are also presented.

Section 4: Summary of key findings and discussion

This section provides an overview of the key findings, and a summary of the pertinent strengths and limitations of the research. This section also highlights important clinical and public health implications, contextual issues relevant to the Australian healthcare system, and directions for future research.

Section 5: Appendices

This section provides supplementary material that is referred to in the Methods (Section 2) and Results (Section 3).

1 Introduction

1.1 Research aims

The overarching aim of this research was to forecast the future burden of arthritis in Australia (to the year 2030), in terms of disease prevalence and healthcare costs. Specifically, this research aimed to:

1. Provide national and state/territory projections of the prevalence of arthritis, OA, RA and JIA in Australia for the years 2015, 2020, 2025 and 2030;
2. Provide national and state/territory projections of the healthcare costs for arthritis and other musculoskeletal conditions (including specific projections for OA, RA, and other musculoskeletal conditions) for the years 2015, 2020, 2025 and 2030;
3. Undertake a case study of healthcare resource utilisation and costs by children with JIA at a tertiary paediatric rheumatology unit delivering a 'best practice' model of care, and estimate the costs of JIA care at the national level for the years 2015, 2020, 2025 and 2030 based on this model; and
4. Model the potential benefits of implementing a key element of Arthritis Australia's *Time to Move: Arthritis* strategy[1] (strategies for promoting conservative management of OA) for people with mild to moderate and severe knee OA.

1.2 Background

This research follows on from earlier reports concerning the current and future burden of arthritis-related healthcare costs in Australia.[2-6] It is also informed by the national strategies proposed by Arthritis Australia for improving the care of Australians living with arthritis, including OA, RA, and JIA.[1,7-9]

In 2007, Arthritis Australia released a report prepared by Access Economics, titled *Painful realities: the economic impact of arthritis in Australia in 2007*.[3] This report focused on the prevalence and costs of arthritis (including OA, RA and other forms of arthritis), and used data from the 2004-2005 National Health Survey and demographic data from the Australian Bureau of Statistics (ABS) to estimate the future prevalence of these conditions. AIHW health expenditure data from 2000-2001 were updated to 2007 prices and used to determine the healthcare costs associated with managing arthritis.

In 2013, Arthritis and Osteoporosis Victoria published a report based on analyses by Deloitte Access Economics, titled *A problem worth solving: The rising cost of musculoskeletal conditions in Australia*.[5] This report focused on the prevalence and costs of OA, RA, osteoporosis, and back problems, and utilised healthcare costs from the earlier Arthritis Australia report[3] that were updated to 2012 prices. Therefore, the most recent reports on arthritis healthcare expenditure have been extrapolated from cost data that are now over a decade old. During this time, rates of joint replacement surgery (performed predominantly for OA) have continued to rise and treatment strategies for inflammatory arthritis have changed dramatically, largely due to the advent and utilisation of new types of disease-modifying anti-rheumatic drugs (DMARDs). These factors undoubtedly have implications for the costs of healthcare for people with arthritis.

The present report provides updated projections for the future prevalence of arthritis, as well as projected healthcare costs for arthritis, RA, and OA, utilising the most up-to-date data available. This study also incorporates the first comprehensive costing analysis for JIA treatment in Australia. To our knowledge, there have not been any empirical studies reporting the healthcare costs of JIA within the Australian healthcare system, and our approach has used individual data from a major tertiary paediatric rheumatology unit delivering a 'best-practice' model of care.[9]

1.3 Types of arthritis

Arthritis is an umbrella term for over 100 different diseases, all of which affect the joints. Arthritis is one of the most common ailments in Australia. The most recent National Health Survey found that 15.3% of the Australian population have arthritis, equating to over 3.5 million people living with the condition in 2014-2015.[10] Arthritis can be a debilitating disease, associated with pain, reduced physical function and decreased quality of life. Many types of arthritis can progress over time, with worsening symptoms and joint damage if not managed appropriately. This report considers 'arthritis' as a collective condition, and individually considers the two most common forms of arthritis among adults (OA and RA). The report also considers arthritis conditions experienced by children and adolescents (collectively termed 'JIA').

1 Introduction

1.3.1 Osteoarthritis

OA is the most common form of arthritis among adults. It is estimated to affect over 2 million Australians.[10] Traditionally OA has been considered a degenerative disease of the joints, although in recent years an important inflammatory component has been recognised.[11,12] OA is characterised by the loss of articular cartilage (cartilage lining the articular ends of the bones), as well as changes to bone and other joint structures. Symptoms commonly present as pain, stiffness and reduced joint range of movement. OA can affect any joint in the body but is more common in the hands, spine and large weight-bearing joints such as the knee and hip. There is a spectrum of OA from mild disease to severe, or 'end-stage' joint disease. According to the landmark Global Burden of Disease study, OA is the 13th leading cause of years lived with disability (YLD) globally.[13] Specifically, knee and hip OA exert a significant impact on health systems internationally, given the substantial costs related to joint replacement surgery for these conditions. In 2010, the global age-standardised prevalence of knee and hip OA was 3.8% and 0.85%, respectively, and over 17 million YLDs were attributable to hip and knee OA collectively.[14]

1.3.2 Rheumatoid arthritis

RA is the second most common form of arthritis in Australia, affecting over 405,000 people in 2014-2015.[10] It is a systemic autoimmune condition that can occur in adults of any age. A form of inflammatory arthritis, RA commonly affects the smaller joints in the hands and feet but can also affect other joints, as well as other parts of the body. RA arises when the body's immune system attacks synovial membranes within a joint, causing inflammation and synovial thickening. The adjacent bone and articular cartilage can subsequently be affected. As a result, the joint becomes painful, swollen and stiff. If the disease is left untreated it can lead to irreversible joint damage, with significant deformity and disability. RA can also affect the eyes, skin, lungs and the cardiovascular system. Globally, the prevalence of RA was estimated to be 0.24% and the condition was associated with almost 3.8 million YLDs in 2010.[15]

1.3.3 Juvenile idiopathic arthritis

JIA is a term used to describe many different forms of inflammatory arthritis in children and adolescents; 'juvenile' meaning the condition occurs in young people, 'idiopathic' meaning the cause of the condition is uncertain, and 'arthritis' referring to joint inflammation. The first symptoms of JIA are usually apparent before the age of 16 but the disease can continue into adulthood. Similar to RA, most forms of JIA are thought to be autoimmune disorders, whereby the body's own immune system attacks synovial membranes within a joint. Typically, the knees, elbows, wrists and/or ankles are affected. JIA is a systemic condition so children with the condition may experience complications affecting their eyes, skin or other tissues. JIA can cause severe pain, growth abnormalities, serious joint damage and permanent disability.[9] The importance of treating JIA early and effectively cannot be overemphasised. If untreated, JIA can have major lifelong impacts on an individual's wellbeing. Between 5,000 and 6,000 Australian children are estimated to have JIA,[9,16] and the condition has a similar prevalence to juvenile diabetes, which affects approximately 5,700 children.[17] Estimates of the global prevalence and broader impact of JIA are not available from the Global Burden of Disease Study.

1.3.4 Other musculoskeletal conditions

As described in the health expenditure data source, this category comprises a wide range of other inflammatory and autoimmune forms of arthritis including ankylosing spondylitis, psoriatic arthritis, gout and systemic lupus erythematosus. It also includes less common related disorders such as systemic connective tissue disorders and other disorders of the musculoskeletal system. Back pain and osteoporosis are not included.

1.4 Key risk factors

This section provides a brief overview of key risk factors for OA, RA and JIA, in order to provide context for contemporary disease management strategies and public health implications. It is not intended to provide an exhaustive review of the literature regarding risk factors for the development and progression of these conditions.

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1.4.1 Key risk factors for osteoarthritis

Age

Age is the most prominent risk factor for OA. Approximately 30% of people aged 65 years and over have OA, whereas less than 3% of people aged under 35 are affected by the condition.[10] This may relate to cartilage changes with ageing or the cumulative effects of joint 'wear and tear', referring to natural degeneration of the joints over time. The number of people with age-related OA in Australia is likely to increase with population ageing and longer life expectancy. However, OA is not an inevitable consequence of ageing and may be preventable in some cases.

Obesity

Obesity is associated with an increased risk of developing OA. A 5-unit increase in body mass index (BMI) has been associated with an 11% increase in the risk of developing hip OA[18] and a 35% increase in the risk of knee OA.[19] In Australia, a national study found that people who were obese were over seven times more likely to have knee OA than people who were of a healthy weight or underweight.[20]

It has been estimated that obesity causes 24.5% of OA in Australia.[21] The mechanism by which obesity increases the risk of developing OA is thought to be both biomechanical and inflammatory. Weight-bearing joints (such as the hips and knees) experience increased joint loads in people who are overweight or obese, while inflammatory molecules produced by body fat are associated with metabolically-driven inflammation.[12,22] The latter is particularly relevant for non-weight-bearing joints, such as the hands. As well as increasing the risk of developing OA, excess body weight can also exacerbate the symptoms of established OA. People with OA who have a higher BMI have more pain associated with their condition.[23]

Joint injury

Joint injury is a major risk factor for the development of knee OA, with research showing that it is the leading cause of knee OA in younger people.[24] In this context, the mechanism for developing future OA is largely thought to be biomechanical. Injury (such as sporting injury or work-related injury) can result in joint instability, increased contact forces and weakness of the surrounding musculature. In turn, this can lead to altered joint loading and consequently, the structure and integrity of the joint may be compromised.

Other factors

Abnormalities in the shape of the hip joint bones (for example, due to congenital hip dysplasia) and/or abnormal contact between the hip joint surfaces (femoro-acetabular impingement) are associated with an increased risk of hip OA.[25,26]

1.4.2 Key risk factors for rheumatoid arthritis

There is no single known cause for RA, and it is suspected that an interaction between genetic and environmental factors contributes to the development of the disease.

Genetic factors

It is estimated that genetic factors contribute 50-60% of the risk of developing RA.[27] Specific genes have been identified that are strongly linked to developing RA.[27] Studies of twins also support the genetic hypothesis, with a national cross-sectional study from the United Kingdom finding that identical twins had a 15.4% concordance for developing RA while fraternal twins only had a 3.6% concordance for developing the condition.[28]

Environmental factors

Various environmental factors could trigger RA in those with a genetic predisposition. Studies have found links between an increased risk of developing RA and smoking, bacterial or viral infection, dietary factors, environmental pollutants and urbanisation.[27] Of these, smoking is considered the most prominent risk factor.[27] In a study of over 370,000 women, those who smoked at least 25 cigarettes a day for more than 20 years had a 39% increased risk of RA, compared with women who had never smoked.[29]

Hormonal factors

Hormones have also been implicated in the development of RA, as women are three times more likely to have RA than men and oestrogen is known to have a stimulatory effect on the immune system.27 Testosterone levels may also be relevant, as men with RA tend to have lower than normal testosterone levels.[30]

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1.4.3 Key risk factors for juvenile idiopathic arthritis

Similar to RA, a definitive cause for JIA has not been identified, and it is believed that a combination of genetic and environmental factors may play a role in the development of the disease.

Genetic factors

Evidence of a genetic predisposition for JIA is derived from sibling studies and genome analyses. The siblings of JIA patients have an increased risk of developing the disease themselves. The identical twin of a child affected by JIA will develop the disease in 25-40% of cases, and several genes have been identified that are associated with an increased risk of developing JIA.[31]

Environmental factors

It is considered that genetic predisposition alone is not enough to cause JIA, and that environmental factors such as bacterial or viral infections could trigger onset of the disease.[31] Longitudinal studies have reported that JIA incidence is cyclical, with peaks roughly every ten years.[32,33] This suggests that environmental changes might influence JIA development, although the specific triggers are not known.

1.5 Management of osteoarthritis

1.5.1 Clinical guidelines

A range of national and international guidelines have been developed to support the timely and effective management of OA, and particularly, hip and knee OA.[34-37] National clinical care standards for the management of OA are also currently being developed by the Australian Commission on Safety and Quality in Health Care.

There is considerable overlap in the core recommendations for OA management, and these recommendations can be broadly summarised as:

- Conservative (non-surgical) management involving weight loss, exercise, disease-relevant education and self-management support are first-line treatment strategies;
- If required, analgesia should be added to the core treatments; and
- Referral for consideration of surgery should be made where symptoms are no longer responsive to non-surgical management.

1.5.2 Conservative management of osteoarthritis

Weight loss

For people who are overweight or obese, weight loss is recognised as both an effective treatment for reducing pain and disability associated with OA, and also a major preventative strategy.[34] For obese people with established OA, weight loss of between 5-10% of their body weight can result in significant pain relief, and this may in turn manifest in improvements in mobility, physical function and quality of life.[22] Strategies to support weight loss in people with OA may include informal advice, referral to a dietician for appropriate counselling and structured weight loss programs (incorporating dietary changes and/or exercise).

Exercise

There is a large body of evidence indicating that exercise has clinically significant benefits for people with OA. In particular, a Cochrane review found that land-based exercise offers several benefits for patients with knee OA, including short-term improvements in knee pain and physical function.[38] The magnitude of improvement was comparable to that reported for non-steroidal anti-inflammatory drugs (NSAIDs). Improvements in pain and function following exercise programs for hip OA have also been shown.[39] Therapeutic water-based exercise has also been shown to have benefits for patients with lower limb (hip or knee) OA.[40] Small but significant improvements in pain, stiffness, physical functioning and quality of life were reported. Adverse effects of exercise, including increased pain, were low in frequency and not serious in nature.[38,40]

Education and self-management support

Patient education forms a key component for the management of all chronic diseases, including OA. Education and self-management support can be provided within healthcare consultations, online or via telephone-based resources, or using a structured, community-based program approach. Self-management and disease education programs are designed to assist people with OA in managing their condition. These programs commonly provide disease information and

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teach practical strategies for controlling pain and minimising the impact of OA on everyday life. There is some disparity in the literature regarding the effectiveness of formal self-management programs for OA. A Cochrane review concluded that self-management education programs resulted in small or no benefits for people with OA.[41] Other reviews have reported positive results from patient education programs for OA. A review by Brosseau et al found that patient educational programs reduced pain in the short term and increased short-term and longer-term compliance to exercise,[42] and there are preliminary data on the outcomes and acceptability of internet-based educational programs for people with OA.[43]

Pharmacological management

There are many pharmaceutical options available for managing the pain and symptoms associated with OA. Paracetamol and NSAIDs are first-line approaches, with opioids considered for more severe pain.[34] Pharmacological management is the most popular treatment strategy for OA in Australia, with pharmaceuticals recommended at 85.9% of GP encounters for OA between the years 2005 and 2010.[44] The most commonly prescribed medicines were NSAIDs (recommended at 31% of encounters), followed by paracetamol (recommended at 25% of encounters). Although the use of glucosamine supplements is not supported by evidence,[45] these were still recommended at 3.5% of GP encounters.[44]

1.5.3 Surgery

A range of surgical procedures are available for the management of more severe OA that is no longer responsive to conservative treatment. These include osteotomy (excision of bone to alter joint alignment), partial joint replacement (prosthetic replacement of one joint surface or compartment) or total joint replacement surgery (prosthetic replacement of both joint surfaces). Total hip replacement (THR) and total knee replacement (TKR) are cost-effective interventions for people with severe, end-stage hip or knee OA. Surgery involves replacement of the failed joint surfaces with a prosthesis to relieve pain and restore normal movement and function. Over 46,000 primary total knee replacements and over 32,000 primary total hip replacements were performed in Australia in 2014, and the majority of these procedures were undertaken in the private sector.[46] The rate of joint replacements performed in Australia has increased steadily over the past decade.

A recent review has shown that patients experience both immediate and long-term benefits from joint replacement surgery, including significant reductions in pain and improvements in function and quality of life.[47] A recent randomised controlled trial (RCT) from Denmark found that individuals who were randomised to TKR experienced significantly greater improvements in pain, function and quality of life at 12 months than those who received conservative management,[48] although both groups demonstrated improved outcomes after treatment.

Despite the demonstrated effectiveness of joint replacement surgery, not all patients experience optimal outcomes and as with all surgical procedures there is a risk of complications. As joint replacement prostheses have a limited lifespan, future revision surgery may also be required. Joint replacement surgery also poses a considerable societal cost. In 2008-2009, the in-hospital costs for OA were estimated at over $1.2 billion, with a large proportion of these costs attributable to joint replacement surgery.[49] In view of these considerations, national and international clinical guidelines recommend that joint replacement surgery should only be offered for severe, symptomatic OA after conservative management strategies have been trialled.[34,37]

1.6 Management of rheumatoid arthritis

1.6.1 Clinical guidelines

National and international guidelines for the management of RA[50-53] include the following key themes:

- RA should be managed by a rheumatologist;
- Treatment should begin immediately after RA diagnosis;
- Anti-inflammatory and analgesic medications should be tailored to individual needs;
- Conventional DMARDs should be administered as soon as possible, as first-line therapy. If there is no improvement at 3 months or disease targets are not achieved at 6 months, then a biological DMARD (bDMARD) should be commenced;
- Patients with RA need to be monitored every 1-3 months while the disease is active and every 6-12 months after remission is achieved;
- Patients should be educated about their disease and its management.

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1.6.2 Pharmacological management

Pharmacological management is the mainstay of RA treatment, and many medications are used to manage the disease. Analgesics and anti-inflammatory drugs (NSAIDs and intra-articular corticosteroid injections) are commonly used to treat the symptoms of RA, by reducing pain and inflammation. Immunosuppressive medications (known as DMARDs) are needed to reduce disease activity, limit disease progression and joint destruction, and induce disease remission. There are two main categories of DMARDs: conventional DMARDs and the newer biological DMARDs (bDMARDs). Both work to suppress the body's immune system. In Australia, conventional DMARDs are recommended as first-line, immediate treatment for RA.[50] If these fail to improve symptoms, then bDMARDs (also commonly referred to as 'biologics') may be offered. In Australia, a cross-sectional survey found that 29% of RA patients were taking a bDMARD (either by itself or in combination with conventional DMARDs).[54]

DMARDs, including bDMARDS, are vital for the effective treatment of RA. The Royal Australian College of General Practitioners classes the evidence for DMARD efficacy as 'Grade A'.[50] The American College of Rheumatology also strongly recommends the use of DMARDs for RA, as either single therapy for low disease activity or as combination therapy for moderate or high disease activity.[53] DMARDs have been shown to halt disease progression and their use commonly results in clinical remission.[55] DMARDs have also been shown to effectively control the symptoms of RA; they decrease disease activity, reduce pain, increase physical function and improve the quality of life of patients with RA.[55-58] Although DMARDs are expensive, they are considered cost-effective because of the clear benefits of these medicines.[59]

While the benefits of DMARDs are well-demonstrated, adverse drug reactions are not uncommon. Abasolo et al found that the incidence rate of adverse drug reactions among RA patients taking DMARDs was 15.2 per 100 patient-years.[60] Of these, 69% were considered moderate reactions (leading to drug discontinuation) and 11% were severe, requiring hospitalisation. Due to the variety of DMARDs available, patients who experience adverse drug reactions are often able to switch to a more tolerable therapy.

1.6.3 The 'window for treatment'

There is a limited 'therapeutic window for treatment' for DMARDs in RA, which is approximately 3-6 months from disease onset. Patients who initiate DMARD treatment within this window experience enhanced outcomes, compared with those who begin treatment later.[61,62] If the 'window for treatment' is missed, DMARD treatments can still be highly effective but achieving remission is less likely. Van Neis et al reported that the likelihood of achieving disease-free remission begins to diminish in patients who begin treatment 15-20 weeks after disease onset.[63] Gremese et al also found that receiving treatment before 12 weeks was predictive of disease remission.[64]

1.6.4 Non-pharmacological management

While obesity may be more closely associated with OA, dietary advice and maintenance of a healthy weight are important to minimise risk factors for cardiovascular disease among people with RA.[50] Exercise to maintain muscle strength, joint range of movement and general fitness is also important, and health professionals such as physiotherapists can assist in designing an appropriate exercise program.[51] Occupational therapists can assist with joint protection strategies, energy conservation approaches for minimising fatigue, and splinting to support painful joints, as needed.

1.7 Management of juvenile idiopathic arthritis

1.7.1 Clinical guidelines

The Royal Australian College of General Practitioners recommends the following management approaches for children and adolescents living with JIA[65]:

- Treatment should begin immediately after JIA diagnosis;
- If symptoms persist for more than 4 weeks, the patient should be referred to a paediatric rheumatologist;
- An individualised care plan should be devised for all patients with JIA, and multidisciplinary care (such as ophthalmology, physiotherapy, occupational therapy) should be adopted where necessary;

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- Traditional NSAIDs, simple analgesics and weak opioids should be prescribed to control pain and disease symptoms; these should be tailored to individual needs and adjusted as the disease changes;
- Conventional DMARDs and/or bDMARDs are prescribed by specialist paediatric rheumatologists to control disease activity;
- Patients and their guardians should be educated about the disease and provided with psychosocial support, if required;
- Dietary advice should be provided, including advice regarding adequate calcium and vitamin D intake for children on corticosteroids;
- Disease activity should be assessed at least three times per year; and
- A paediatric rheumatologist review should be scheduled for at least twice a year.

1.7.2 Pharmacological management

Although there is no known cure for JIA, pharmacological treatments are effective and patients with JIA can achieve disease remission.[66,67] Pharmacological treatments for JIA are very similar to those used for RA. Analgesics and anti-inflammatories are used to reduce disease symptoms and relieve pain, while DMARDs are used to lessen disease activity and induce remission.[66,68]

Biologics, in particular, have revolutionised the treatment of JIA by improving the efficacy and tolerability of treatment.[67] There is evidence of short-term and longer-term benefits of bDMARDS used to treat JIA.[69,70] In Australia, the use of bDMARDs for JIA has increased significantly over the last decade. In 2013-2014, bDMARD prescriptions for JIA were over 20 times more common than they were in 2003-2004 (4,517 prescriptions dispensed versus 188 prescriptions, respectively).[16]

As with RA, there is thought to be an opportune 'window for treatment' for JIA, and treatment with intensive therapy within this window is associated with improved outcomes and disease remission.[67] It has been estimated that the likelihood of achieving remission increases by a factor of 1.3 for each month earlier that a patient is treated.[68] Van Rossum et al found that JIA patients treated early (with sulfasalazine) had better long-term outcomes.[71]

1.7.3 Non-pharmacological management

Core components of multidisciplinary non-pharmacological management for JIA include exercise (land-based and/or aquatic) to maintain general fitness and muscle strength, as well as strategies to provide symptomatic relief, including orthotic management (such as resting and functional splints, and foot orthoses) and thermotherapy (hot or cold packs, warm baths and/or ice massage).[65]

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Studies about disease prevalence and costs of illness provide vital information to governments and other healthcare funders charged with healthcare planning and allocation of resources. It is therefore important that the most up-to-date data are used for burden of disease analyses.

All analyses were performed using Stata version 13.1 (StataCorp, USA) or Microsoft Excel™ (Microsoft, USA).

2.1 Data sources

This research utilised the most recent data available to provide contemporary estimates of the prevalence and costs of managing arthritis in Australia. The data sources utilised for this research comprised:

- The Australian Health Survey 2011-2012 (comprising the National Health Survey and the National Nutrition and Physical Activity Survey)
- The National Health Survey 2014-2015
- ABS population projections for 2012-2101
- AIHW Healthcare expenditure for arthritis and other musculoskeletal conditions 2008-2009 report (published in 2014)
- National Hospital Cost Data Collection, Round 13 (2008-2009)
- National Hospital Cost Data Collection, Round 16 (2011-2012)
- Patient-level data from the Paediatric Rheumatology department of the Royal Children's Hospital, Melbourne (collected in 2012)
- The Medical Benefits Scheme (MBS) Online (accessed in 2015)
- The Pharmaceutical Benefits Schedule Item Reports (accessed in 2015-2016)

Further details about these data sources and how they were utilised for the analyses are provided in the following sections. Where government and/or national data were not available, relevant data were sourced from the published literature.

2.2 Projected prevalence of arthritis in Australia

2.2.1 Prevalence data for arthritis, osteoarthritis and rheumatoid arthritis

We obtained prevalence data for total arthritis (referred to herein as 'arthritis'), OA, RA and 'other arthritis' (non-OA and non-RA) from the 2014-2015 National Health Survey.[10] While these national data reported a breakdown of prevalence by arthritis type, the state-based data did not report a similar breakdown. We therefore obtained additional data (the proportion of people with OA, RA and 'other arthritis' within the total arthritis population in each state) from the 2011-2012 Australian Health Survey.[72]

The 2014-2015 National Health Survey was conducted by the ABS and comprised 19,259 participants from 14,723 randomly selected private dwellings across the Australia (household response rate 82%).[10] One child and one adult from each dwelling were randomly selected for inclusion in the survey. Adults were interviewed by trained ABS interviewers (including about one child in the dwelling). Data were collected from both urban and rural areas, but very remote areas of Australia and discrete Aboriginal and Torres Strait Islander communities were excluded.

As part of the arthritis module in the National Health Survey, participants were asked whether they have or had ever had a range of conditions including arthritis, RA and OA. Participants were then asked whether they had ever been told by a doctor or nurse that they had this condition. These methods were adopted to reduce the number false-positive reports (i.e. people incorrectly reporting they have arthritis when it is actually another condition). Information on arthritis conditions was also collected as part of the long-term conditions module of the National Health Survey, although this relied on self-reported (rather than doctor-diagnosed) diagnosis.

2.2.2 Prevalence data for juvenile idiopathic arthritis

Given that JIA is not specifically documented in the National Health Survey, we conducted a search of the peer-reviewed literature for JIA prevalence data. Manners and Bower undertook an international review of epidemiological studies investigating the

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prevalence of JIA in various OECD countries.[73] The aim of this review was to quantify variation in estimations of JIA prevalence rates and explore reasons for these variations. For Australia, two epidemiological studies were identified. The first was a community based screening program of 2,241 12 year-old children conducted in a West Australian primary school.[74] Each child was assessed for JIA by a single rheumatologist. The rate of JIA within this population was found to be 4.01 children per 1000 (95% CI 1.84 to 7.53). This was the highest rate of JIA recorded among the 34 included studies. The result was likely due to the study's methodology, in which previously undiagnosed children were examined for JIA. Their results suggest that JIA is often undiagnosed (relying on clinical diagnosis would have produced a prevalence of 0.89 per 1000 children). A subsequent study, performed in the same city, found that the incidence of clinically-diagnosed JIA was 0.106 per 1000 children (95% CI 0.076 to 0.143).[73]

The most recent National Health Survey (2014-2015) reported a 0.0% prevalence of arthritis among people aged 0-14 years, although this estimate was associated with a high relative standard error (>50%). Given the wide variation in estimates from the literature and National Health Survey, we have used the generally accepted Australian prevalence of JIA for our analyses (0.1% of children aged 0-15 years, based on self-reported data from the 2004-2005 and 2011-2012 National Health Survey.[16,75] This equates to 5,000-6,000 Australian children affected, according to contemporary estimates.[9,16]

2.2.3 Australian population projections

Data on the current and projected population of Australia were sourced from the ABS National Demographic Statistics.[76] This dataset provides population projections for Australia by age and sex from 2012 to 2101. It also provides individual projections for state and territories to 2061. Predictions of the future population by age and gender are based on assumptions regarding the expected rates of fertility, mortality and migration. The ABS considers three scenarios in their population projections: series A represents the scenario with the highest population growth, series B represents medium population growth and series C has the lowest population growth. Series B estimates were utilised for the current prevalence estimates, which predict a medium rate of fertility (a decline to 1.8 babies per woman to 2026 and then remaining stable), a medium mortality rate (life expectancy will continue to increase but at a declining rate; in 2060 life expectancy at birth will be 85.2 years for men and 88.3 years for women) and a medium migration rate (the number of migrants will increase to 240,000 people in 2020-21 and will remain constant thereafter).

2.2.4 Methods used to estimate the prevalence of arthritis

Prevalence rates for each age group for arthritis, OA, RA, 'other arthritis' and JIA were based on the data sources described in the previous section. These rates were then applied to the relevant age group population estimates from the ABS National Demographics Statistics for the years 2015, 2020, 2025 and 2030. Data for arthritis, OA, and RA are presented as the total number of people with a condition in each year by age group and in total. Prevalence estimates for 'other arthritis' were used for the projected healthcare costs analyses (Section 2.3) and are not presented separately in this report. For JIA, the projected prevalence estimates refer to the 0-19 age group, reflecting the age categories used for the ABS population projections.

As state and territory prevalence rates were available only for 'arthritis' (separate prevalence rates for OA and RA are not available from the 2014-2015 National Health Survey), we applied the distribution of OA and RA within each state and territory (as a proportion of all arthritis) from the 2011-2012 National Health Survey to the arthritis prevalence data from the 2014-2015 National Health Survey. Using the projected population by age group within each state, we estimated the projected prevalence of arthritis, OA and RA for each state and territory for the years 2015, 2020, 2025 and 2030. For JIA, a constant prevalence rate of 0.1% was applied to each state and territory's population aged 0-19 years.

All prevalence estimates were rounded up to the nearest whole number. The sum of the projected number of people with a condition in each state and territory was slightly less than the national estimates of the projected burden of each condition. This likely relates to the limitations of state-based prevalence estimates as noted above, and the smaller sample sizes and high relative standard errors reported for some states. As national

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prevalence estimates were based on more robust data, these are considered as the gold standard for the projected burden. However, state and territory data are also presented to provide an indication of the relative burden of these conditions in each geographic area.

2.3 Projected healthcare costs of arthritis in Australia

The direct healthcare costs of arthritis were estimated from the perspective of the Australian public healthcare system and did not include any out-of-pocket costs borne by people with arthritis and their families.

2.3.1 Healthcare expenditure data

To estimate the direct healthcare costs of arthritis in Australia, we sourced information from the 2014 AIHW report entitled 'Health-care expenditure on arthritis and other musculoskeletal conditions 2008-09'.[49] This report provides the most recent published government data on the healthcare costs of arthritis, and captures 'in-hospital costs', 'out-of-hospital costs', and 'prescription medication costs' (see Appendix 1 for a summary of included and excluded costs).

There are some notable limitations to the AIHW dataset, with the AIHW estimating that it captures approximately 70% of total direct expenditure on arthritis. The most significant limitation of this AIHW report is that it underestimates the cost of prescription medications for inflammatory arthritis. This is because costs data were sourced from the BEACH survey and then applied to Pharmaceutical Benefits Scheme (PBS) and Repatriation Pharmaceutical Benefits Scheme (RPBS) payments made for pharmaceuticals. The BEACH survey collects information from general practitioners (GPs) across Australia.[77] It is a comprehensive snapshot of the conditions addressed and treatment plans prescribed in general practice. However, it does not include the costs of medications supplied by specialists. Therefore the full costs of conventional DMARDs and bDMARDs for RA and JIA may not be captured, as these are typically prescribed by rheumatologists and clinical immunologists. Furthermore, expenditure on 'Highly Specialised Drugs' used in hospitals (including bDMARDs) has not been included. DMARDs and biologics are expensive treatments for RA and JIA, therefore excluding them from the present analysis would lead to a significant underestimation of costs.

To account for this, we reported the cost of biologics (for RA and JIA) separately, using data on PBS expenditure for each bDMARD that is currently reimbursed by the PBS for RA[78] and patient-level and PBS data for JIA.

2.3.2 Methods used to estimate the costs of direct healthcare expenditure for arthritis

Categories of arthritis

As the AIHW healthcare expenditure report contained separate expenditure estimates for OA, RA and 'other musculoskeletal conditions',[49] these categories were summed to generate an estimate of the costs for 'arthritis' for the current study. The AIHW category 'other musculoskeletal conditions' was included as part of 'arthritis' as it includes the costs of care for other forms of inflammatory arthritis (such as gout, ankylosing spondylitis, systemic lupus erythematosus and JIA) which would otherwise have been missed. It is important to note that that the AIHW category 'other musculoskeletal conditions' does not include cost data for osteoporosis or back problems, which are reported as separate cost categories. However, while the conditions in this category predominantly fall under the arthritis umbrella, other less common non-arthritic conditions such as soft tissue disorders are also included. Therefore our 'arthritis' category included some non-arthritic conditions. It was assumed that the healthcare costs associated with these non-arthritic conditions were negligible compared to the cost of other inflammatory arthritic conditions within the group, as inflammatory arthritic conditions are, in general, far more costly to treat.

Costs of biologics and other medications for rheumatoid arthritis

As described earlier, the costs of biologics were not fully captured in the AIHW healthcare expenditure dataset. Therefore, we examined PBS expenditure data for bDMARDs that were indicated to treat RA over the period 1 July 2014 to 30 June 2015.[78] These data are summarised in Appendix 2. Expenditure was reported according to 2014-2015 financial year prices. To project the cost of bDMARDs for the years 2020, 2025 and 2030, we assumed that these costs would grow in proportion to RA prevalence for each of those years (i.e. a 10% increase in prevalence would result in a 10% increase in costs).

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The costs of medications for RA were calculated based on the total cost of bDMARDs plus other medications (for example, conventional DMARDS, analgesics and anti-inflammatory medications). The cost of other medications was derived from published national pharmaceutical expenditure data for RA[4] and assumed to be $171,782,965 in 2015 ($132 million in 2008-2009 dollars, updated to 2015-2016 dollars).

Calculation of projected healthcare costs

Expenditure data for hospital expenses, out-of-hospital medical expenses and pharmaceuticals were extracted from published 2008-2009 national data[49] and updated to 2015-2016 Australian dollars using the weights provided for the Total Health Price Index (THPI).[79] These weights were calculated by the AIHW (based on annual ratios of estimated total national health expenditure at current prices) to estimate total national health expenditure at constant prices. For RA, we replaced the reported costs of pharmaceuticals with our new estimates for the costs of biologics and other medications (as described in the previous section), to avoid underestimating the pharmaceutical costs (and in turn, total healthcare costs) for this disease.

Using the projected prevalence estimates (as described in Section 2.2.4), the national costs of healthcare for OA, RA and 'other musculoskeletal conditions' were separately calculated for each age group according to the following formula:

$$\text{Cost of disease per age group} = \text{total cost}^* \frac{\text{(number of people with the disease in this age group)}}{\text{(Total population with the disease)}}$$

As data on the specific prevalence of OA, RA, and 'other musculoskeletal conditions' by state were not available from the 2014-2015 National Health Survey, state-based prevalence data for 'total arthritis' were used. In order to calculate the projected costs of OA, RA and 'other musculoskeletal conditions', it was assumed that an increase in prevalence for OA, RA and other arthritis (compared to the 2011-2012 data) was similar across all three groups. Estimates for the number of people with OA, RA, and other arthritis in 2014-2015 were calculated based on the total number of people with arthritis (from the 2014-2015 National Health Survey) multiplied by the proportion of those with OA, RA, or other arthritis from the 2011-2012 National Health Survey. The costs of OA, RA and 'other musculoskeletal conditions' for each state and territory in 2015 were then estimated according to the following formula:

$$\text{Cost of disease per state} = \text{total cost}^* \frac{\text{(number of people with the disease living in the state)}}{\text{(Total population with the disease)}}$$

For the national and state-based analyses, healthcare cost projections for the years 2020, 2025 and 2030 were calculated based on the relative increase in population projections assuming unchanged disease prevalence. Healthcare costs for 'arthritis and musculoskeletal conditions' were estimated for 2015, 2020, 2025 and 2030 by summing the costs for the OA, RA and 'other musculoskeletal conditions' categories for each year. All cost estimates were rounded up to the nearest whole number.

2.3.3 Methods used to estimate the costs of direct healthcare expenditure for juvenile idiopathic arthritis: A case study

Australian cost data for the management of JIA (beyond the cost of biologics) do not currently exist. Few cost studies of JIA have been undertaken since the advent of bDMARDs[80-83] and this is known to be a major driver of healthcare costs. Comprehensive data are required to generate a more complete snapshot of the costs of treating children and adolescents with JIA in Australia. In the absence of published expenditure data for JIA, a case study approach was used to describe resource use and associated costs in children with JIA at a tertiary paediatric rheumatology unit delivering a best practice model of care, from the perspective of the Australian healthcare system.

Patient cohort

This was a cross-sectional study of paediatric rheumatology patients with a primary diagnosis of JIA treated by a single rheumatologist at the Royal Children's Hospital (RCH) from 1 January 2012 to 31 December 2012. Data for the JIA cohort of a single clinician from the paediatric rheumatology database maintained at the RCH was chosen as it was known to be a complete dataset and was therefore considered to provide representative data on patient resource use.

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Ethics approval for accessing these data was obtained from the RCH.

The paediatric rheumatology database is a comprehensive clinical tool coded in Microsoft Access™ in which patient demographic details, diagnoses, medications, clinic visits, procedures, external pathology results, correspondence from external providers, internal patient-related team communications and external communications with patients, their families and community care providers are recorded prospectively on searchable proformas. De-identified, patient-level data were extracted from the database, including primary diagnosis, coded according to the International Classification of Diseases, version 10[84] (modified to include the 7 subtypes of JIA per current International League of Associations for Rheumatology criteria[85]), consultations with ophthalmologists, imaging, hospital admissions, laboratory investigations and allied health consultations that occurred for any JIA patient treated by the participating rheumatologist during the study period. Information on type, dose and duration of medications prescribed was also extracted from the database. Where data on ophthalmology consultations, imaging, laboratory investigations or other external services were not recorded in the database because they had not been reported to the clinician, these were extracted from other RCH medical record, administrative and pathology systems.

Healthcare costs for juvenile idiopathic arthritis

The unit costs for services used by patients with JIA are summarised in Appendix 3 (Table 21). Hospital costs were based on the National Hospital Cost Data Collection Round 16 (2011-2012) and inflated to 2015 values using the THPI.[79] Costs for all outpatient management were based on the Medicare Benefits Scheme (MBS) reference costs.[86] As the type of allied health practitioner was not able to be obtained from the database, we assumed a cost for physiotherapy as this has been shown to be the most commonly used allied health service among JIA patients.[87] We also assumed that 43% of children would access these services through the public hospital system, as this reflects the national rate of private health insurance membership.[72] Data on individual pathology tests were not available, so we conservatively assumed the cost of one test only. Medication costs were based on the PBS dispensed price per maximum amount/quantity (DPMA/DPMQ) for the formulation that most closely reflected the prescribed dose and duration with wastage (i.e. the vial/pack size may have been greater than the prescribed dose). Medications were assumed to be generic (i.e. the least costly option), unless the brand was specified. In 2012, RCH ordered vials of subcutaneous methotrexate individually for each patient according to their dosage requirements. The average cost of each vial was estimated to be $45 based on advice from the hospital pharmacy. The full listing of medications and associated costs are presented in Appendix 3 (Table 22).

Costs for each child were calculated by multiplying unit costs by the total number of services received over the study period. Total costs were calculated by summing all costs in each category for the entire cohort. Total costs, average costs, standard deviations and ranges were calculated and all costs are reported in 2015 Australian dollars.

The projected healthcare costs for JIA were calculated by multiplying the average cost per child by the projected number of children with JIA in 2015, 2020, 2025 and 2030. The methods for estimating the number of children with JIA in each of these years have been described in Section 2.2 of this report.

2.4 Modelling the potential benefits of conservative management strategies for knee osteoarthritis

Knee OA is a major contributor to disability and lost productivity and the condition places a significant financial burden on the Australian health system, with over 46,000 primary TKR procedures performed annually.[46] An Australian study found that 50.5% of OA encounters at a GP were for knee OA.[44] For these reasons, we specifically chose knee OA for these analyses. These models focus on the potential benefits of non-surgical intervention packages (comprising components such as education, exercise and weight loss), given that these elements are routinely recommended in clinical guidelines and are supported by a robust evidence base. The demonstrated benefits of these interventions include improvements in pain, function and quality of life for people with mild to

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moderate knee OA[88-90] and for people with severe knee OA, improvements in these constructs that for some individuals can delay the need for joint replacement surgery.[48,91]

2.4.1 Data sources

Mild to moderate knee osteoarthritis: the ADAPT trial

To model the potential benefits of a conservative management package for people with mild to moderate knee OA, we used data from the Arthritis, Diet and Activity Promotion Trial (ADAPT) conducted in the United States.[88-90] This RCT provides health outcomes and costs data that were required for our analyses. During this study, 316 participants were randomised to one of four treatment groups: (1) dietary weight loss, (2) exercise, (3) dietary weight loss plus exercise (combined intervention), or (4) healthy lifestyle (control). The intervention ran for 18 months. Participants were eligible if aged over 60 years with a BMI ≥28kg/m², if they suffered from knee pain on most days of the month, had difficulty with physical activities, and had radiological evidence of knee OA. Individuals were excluded if they required assistive devices for walking, had a low Mini-Mental State score, had a serious medical condition that precluded exercise participation, or if they reported a high weekly alcohol consumption. Health-related quality of life (HRQoL) outcomes were collected using the SF-36 health status instrument. At follow up, the combined intervention group reported significantly greater improvement in SF-36 physical function summary scores, compared to the control group (effect size 0.73).

Severe knee osteoarthritis: randomised, controlled trial of total knee replacement

To model the potential benefits of a conservative management package for people with severe knee OA, we used data from a recent RCT published in the New England Journal of Medicine.[48] The aim of the RCT was to investigate the effectiveness of TKR plus non-surgical treatments in comparison to non-surgical interventions alone. One hundred patients were recruited from the Aalborg University Hospital in Denmark. Patients with moderate to severe knee OA who were eligible for TKR were included (Kellgren Lawrence radiographic score ≥2 indicating definite OA). Patients were excluded if they had a visual analogue pain scale score of greater than 60mm (range 0-100mm, higher scores indicate greater pain), or if they had a previous TKR in the same knee. Participants were randomised to either: (1) TKR followed by 12 weeks of non-surgical treatments, or (2) 12 weeks of non-surgical treatments only. The non-surgical treatments were identical for each group. Delivered by physiotherapists and dieticians, these treatments consisted of exercise, education, dietary advice, use of insoles and pain medication. Although both groups reported significant improvements in pain, HRQoL and functional outcomes, the TKR group experienced greater improvements at 12 months. The study also found that only 26% of the non-surgical group went on to have TKR in the following year, suggesting that the non-surgical intervention delayed the need for surgery for 74% of participants.

2.4.2 Methods used to evaluate the potential benefits for people with mild to moderate knee osteoarthritis

As joint-specific prevalence data are not available from the National Health Survey, we had to make an assumption about the proportion of people with knee OA among the overall population with OA. To do this, we used data from a national study that reported on 489,900 OA-related GP presentations according to affected joints and age.[44] Using these age-specific data, we were able to estimate the proportion of OA patients that were likely to have affected knees. To estimate the proportion of people with mild to moderate knee OA, we utilised data from the Global Burden of Disease Study, where the proportion of mild, moderate and severe OA in high income countries (classified using WOMAC Index pain scores) was 71%, 27% and 2%, respectively.[14] These proportions were then applied to the total number of people with knee OA to estimate the number with mild to moderate disease.

To estimate the potential benefits and cost-effectiveness of implementing the ADAPT intervention in the Australian population, we estimated the incremental cost-effectiveness ratio (ICER) for having the ADAPT intervention versus not having the intervention. The ICER was calculated by dividing the difference in net costs by the difference in net quality-adjusted life years (QALYs), as shown in the equation below:

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$$\text{ICER} = \frac{\textit{Total Cost (intervention)} - \textit{Total Cost (no intervention)}}{\textit{Health utilities (intervention)-Health utilities (no intervention)}}$$

The cost of the intervention (reported in US dollars) was taken from the paper by Sevick et al,[90] converted to Australian dollars using current exchange rates (1 USD = 1.33 AUD, as at April 2016), and updated to 2015-2016 Australian dollars using the THPI.[79] The final assumed cost of the intervention was $AUD150.19 per person. To estimate utilities, we transformed the SF-36 scores reported in the study to EQ-5D utility scores using an established equation.[92] A utility score of 1.0 indicates perfect health, while a utility score of 0 indicates the poorest health. Using this approach, the estimated improvement in HRQoL was 0.08 EQ-5D utility units for the diet plus exercise group. The difference between costs and health utility benefits of having the intervention versus not having the intervention for the entire population with mild to moderate knee OA was used to calculate the ICER.

2.4.3 Methods used to evaluate the potential benefits for people with severe knee osteoarthritis

Using the methods described in Section 2.4.2, we were also able to estimate the number of people with severe knee OA in the Australian population. While the trial by Skou et al involved people with moderate to severe knee OA, we restricted our analyses to those with severe knee OA only, because at the population level it is less likely that people with moderate joint disease would be undergoing TKR.

To estimate the potential cost savings related to conservative management for severe knee OA, we assumed that a proportion of patients with severe knee OA were able to avoid TKR in the year after intervention and, therefore, TKR-related costs for these individuals would be avoided in that year. The proportion avoiding TKR in the year after intervention (74%) was obtained from the study by Skou et al, as described previously.[48] The average cost of TKR was estimated using the average cost per Diagnosis Related Group (DRG) for unilateral knee replacement (item I04Z) from the public and private sectors as reported in the National Hospital Cost Data Collection, Round 13 (2008-2009). The 2008-2009 version was used, as this was the last version that reported costs separately for public and private hospital settings. Costs were then updated to 2015 values using the THPI.[79] It was assumed that 70.3% of patients received TKR in the private sector based on the most recent National Joint Replacement Registry annual report,[46] which examined all knee replacements reported to the registry in 2014. This proportion was assumed to remain constant over time. Using this approach, the average cost of TKR was calculated to be $21,491 per hospital episode, after inflating to 2015 values. This was found to be broadly consistent with direct hospital costs for TKR reported in the literature.[93] Cost savings for 2015, 2020, 2025, and 2030 were estimated by multiplying the average cost of TKR by the number of patients with severe knee OA that would avoid having surgery in each year due to conservative management.

3 Results

3.1 Projected prevalence

3.1.1 Projected prevalence of arthritis to 2030

Based on National Health Survey 2014-2015 data and Australian population projections, the number of people with arthritis is expected to increase nationally by 38% from 2015 to 2030, from 3.9 million to 5.4 million Australians (Figure 1).

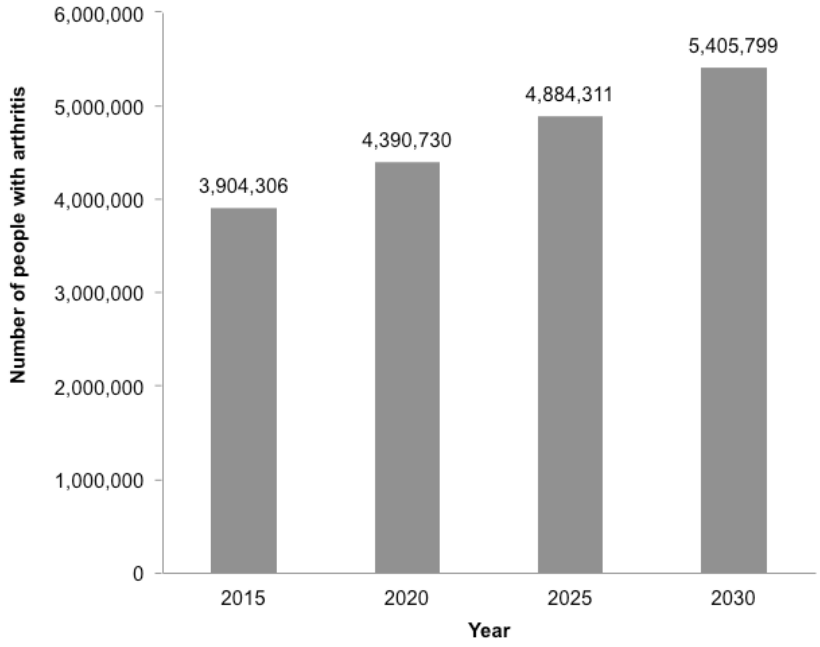

Figure 1. Projected national prevalence of arthritis in Australia, 2015-2030

3 Results

In 2015, the greatest burden of arthritis was borne by the 65-74 age group (1,041,519 people affected). By the year 2030, people aged 75 and older will represent the largest group with arthritis in absolute terms, comprising over 1.5 million people (Table 1).

Table 1. Projected national prevalence of arthritis to 2030, by age group

Age group	Arthritis prevalence	2015	2020	2025	2030
0 - 14	0.0%	0	0	0	0
15 - 24	1.6%	50,112	51,614	55,043	59,845
25 - 34	3.5%	127,961	136,738	140,459	143,418
35 - 44	7.1%	241,947	263,727	297,306	314,663
45 - 54	17.4%	565,516	595,499	620,811	672,768
55 - 64	34.9%	1,010,206	1,104,504	1,153,520	1,214,985
65 - 74	48.6%	1,041,519	1,215,092	1,345,502	1,478,180
≤75 years	53.3%	867,045	1,023,556	1,271,670	1,521,940
TOTAL		**3,904,306**	**4,390,730**	**4,884,311**	**5,405,799**

As shown in Table 2, all states will experience an increase in the number of people with arthritis from 2015 to 2030. Western Australia will have the largest relative increase (55%) over this time period, while Tasmania is projected to have the smallest increase (20%). New South Wales will have the largest absolute increase, with 385,910 additional people expected to have arthritis by 2030. This will be followed by Victoria, which is projected to have an additional 357,395 people with arthritis by the year 2030.

Table 2. Projected prevalence of arthritis to 2030, by state or territory

State	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
ACT	51,600	58,871	66,068	73,740	22,140	42.9%
NSW	1,225,200	1,351,838	1,478,188	1,611,110	385,910	31.5%
NT	15,100	17,610	19,904	22,453	7,353	48.7%
QLD	608,600	691,463	773,184	861,865	253,265	41.6%
SA	300,600	324,825	347,676	372,164	71,564	23.8%
TAS	118,000	127,154	134,953	142,149	24,149	20.5%
VIC	877,700	989,513	1,104,787	1,235,095	357,395	40.7%
WA	314,700	367,959	424,200	488,888	174,188	55.4%

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3.1.2 Projected prevalence of osteoarthritis to 2030

OA is by far the most common type of arthritis in Australia and people with OA comprised 56% of the total arthritis population in 2015. In 2015, OA affected almost 2.2 million people. As shown in Figure 2, the number of people with OA is expected to increase nationally from almost 2.2 million in 2015 to almost 3.1 million Australians in the year 2030.

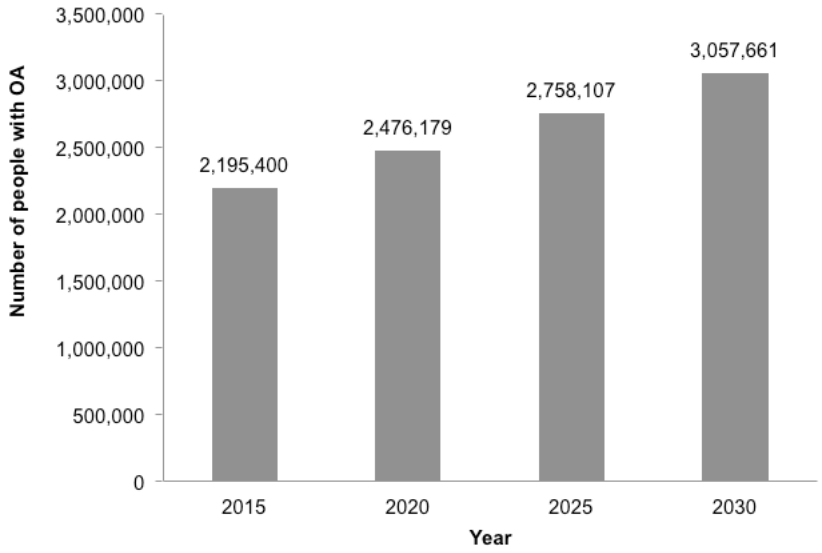

Figure 2. Projected national prevalence of osteoarthritis in Australia, 2015-2030

People aged between 65-74 years represent the largest group with OA in absolute numbers, accounting for 631,345 people in 2015. The number of people with OA in this age group is expected to grow to almost 900,000 Australians by the year 2030 (Table 3).

Table 3. Projected national prevalence of osteoarthritis to 2030, by age group

Age group	OA prevalence	2015	2020	2025	2030
0 - 14	0.0%	0	0	0	0
15 - 24	0.4%	12,528	12,904	13,761	14,961
25 - 34	1.1%	39,099	41,781	42,918	43,822
35 - 44	3.1%	101,356	110,480	124,547	131,818
45 - 54	9.6%	301,608	317,599	331,099	358,809
55 - 64	22.1%	606,672	663,302	692,738	729,651
65 - 74	31.4%	631,345	736,561	815,613	896,039
≤75 years	32.3%	502,792	593,552	737,431	882,561
TOTAL		**2,195,400**	**2,476,179**	**2,758,107**	**3,057,661**

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As shown in Table 4, all states will experience an increase in the number of people with OA from 2015 to 2030. Similar to overall arthritis, Western Australia will experience the largest relative increase over this time period (58%). Tasmania and South Australia will have the smallest relative increase (both with a 25% increase). From 2015 to 2030, New South Wales is expected to have the greatest absolute increase in OA (an additional 250,769 people affected), followed by Victoria and Queensland (an additional 190,984 and 145,855 people with OA, respectively).

Table 4. Projected prevalence of osteoarthritis to 2030, by state or territory

State	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
ACT	27,541	31,773	35,976	40,593	13,052	47.4%
NSW	754,434	836,148	918,077	1,005,203	250,769	33.2%
NT	8,442	9,639	10,724	11,953	3,511	41.6%
QLD	337,222	384,719	431,582	483,077	145,855	43.3%
SA	180,735	196,120	210,713	226,569	45,834	25.4%
TAS	67,013	73,267	78,687	83,811	16,798	25.1%
VIC	454,914	514,388	576,493	645,898	190,984	42.0%
WA	154,535	181,480	210,345	243,765	89,230	57.7%

3 Results

3.1.3 Projected prevalence of rheumatoid arthritis to 2030

RA is the second most prevalent form of arthritis in Australia, and people with RA comprised 10.8% of the total arthritis population in 2015. Between 2015 and 2030, the number of people with RA in Australia is projected to increase from 422,309 people to 579,915 people (Figure 3).

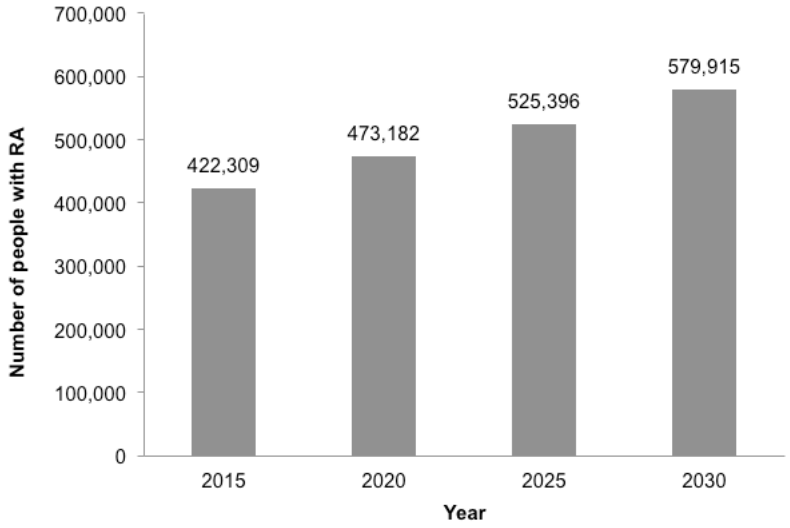

Figure 3. Projected national prevalence of rheumatoid arthritis in Australia, 2015-2030

In 2015, the 65-74 age group had the greatest number of people with RA. With projected population growth, this age group is expected to continue to have the highest number of people with RA in the years 2020, 2025, and 2030 (Table 5).

Table 5. Projected national prevalence of rheumatoid arthritis to 2030, by age group

Age group	RA prevalence	2015	2020	2025	2030
0 - 14	0.0%	0	0	0	0
15 - 24	0.6%	18,792	19,355	20,641	22,442
25 - 34	0.3%	10,664	11,395	11,705	11,952
35 - 44	1.2%	39,235	42,767	48,212	51,027
45 - 54	1.9%	59,694	62,859	65,530	71,015
55 - 64	3.6%	98,825	108,050	112,845	118,858
65 - 74	5.6%	112,597	131,362	145,460	159,804
≤75 years	5.3%	82,502	97,394	121,003	144,817
TOTAL		**422,309**	**473,182**	**525,396**	**579,915**

3 Results

All states will experience an increase in the number of people with RA from 2015 to 2030 (Table 6). The largest absolute increase over this time period will be in Victoria, followed by Queensland (53,645 and 40,004 additional people with RA, respectively).

Table 6. Projected prevalence of rheumatoid arthritis to 2030, by state or territory

State	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
ACT	7,166	7,992	8,779	9,639	2,473	34.5%
NSW	29,633	33,289	37,127	41,125	11,492	38.8%
NT	3,177	3,684	4,158	4,646	1,469	46.2%
QLD	96,786	109,839	122,991	136,790	40,004	41.3%
SA	40,493	43,260	45,783	48,495	8,002	19.8%
TAS	18,879	20,071	20,858	21,731	2,852	15.1%
VIC	133,628	150,448	167,683	187,273	53,645	40.1%
WA	31,428	36,130	40,909	47,132	15,704	50.0%

3 Results

3.1.4 Projected prevalence of juvenile idiopathic arthritis

JIA has been estimated to occur in approximately 0.1% of Australian children,[16] affecting 6006 individuals in 2015. Due to future population growth, the number of children affected by JIA is expected to increase by 22% between the years 2015 and 2030. This equates to an additional 1,328 children and adolescents living with JIA in Australia in 2030 (Figure 4).

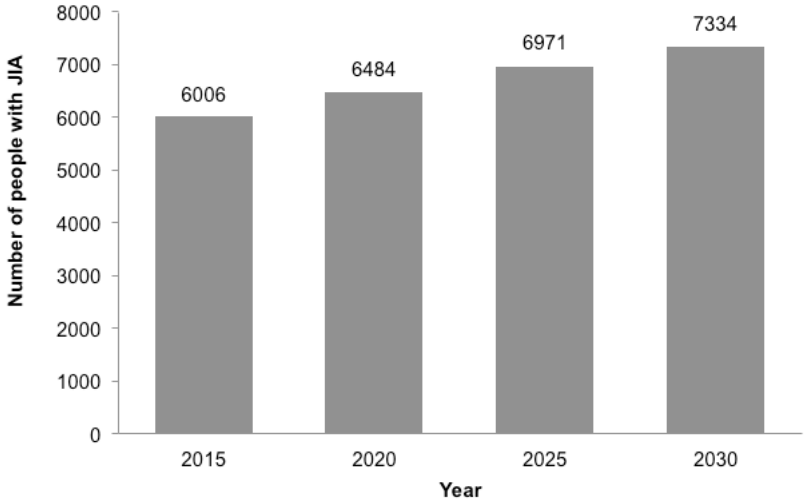

Figure 4. Projected national prevalence of juvenile idiopathic arthritis in Australia, 2015-2030

It is expected that all states and territories will experience an increase in the number of children with JIA between the year 2015 and 2030 (Table 7). Western Australia will experience the largest relative increase (44%), whereas Tasmania will have the smallest increase (1%). The largest absolute increases will be in Queensland followed by Victoria, with an additional 348 and 334 children, respectively.

Table 7. Prevalence of juvenile idiopathic arthritis to 2030, by state or territory

State	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
ACT	99	109	119	125	26	26%
NSW	1,891	1,989	2,087	2,150	259	14%
NT	72	77	83	87	15	21%
QLD	1,280	1,403	1,527	1,628	348	27%
SA	408	426	445	455	47	12%
TAS	128	128	130	129	1	1%
VIC	1,449	1,574	1,696	1,783	334	23%
WA	678	778	884	975	297	44%

3 Results

3.2 Projected healthcare costs

3.2.1 Projected healthcare costs for arthritis and other musculoskeletal conditions to the year 2030

As described earlier (Section 2.3.1), the healthcare costs for arthritis and other musculoskeletal conditions comprised hospital expenses, out-of-hospital medical expenses, and the costs of pharmaceuticals. Combined, the healthcare costs for arthritis and other musculoskeletal conditions were estimated to exceed $5.5 billion in 2015 (Table 8). By the year 2030, these costs are projected to be over $7.6 billion, representing a 38% increase in costs.

In 2015, the highest healthcare costs for arthritis and other musculoskeletal conditions were attributable to the 65-74 age group (over $1.4 billion). By the year 2030, the highest healthcare costs will relate to the 75 years and older group (over $2.1 billion).

Table 8. Projected healthcare costs for arthritis & other musculoskeletal conditions, by age group

Age group	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
0 - 14	0.00	0.00	0.00	0.00	0	0.0%
15 - 24	78.73	81.09	86.48	94.02	15	19.4%
25 - 34	226.96	242.53	249.13	254.37	27	12.1%
35 - 44	376.47	410.36	462.61	489.61	113	30.1%
45 - 54	827.80	871.68	908.74	984.79	157	19.0%
55 - 64	1,399.87	1,530.55	1,598.47	1,683.64	284	20.3%
65 - 74	1,425.79	1,663.41	1,841.93	2,023.56	598	41.9%
≤75 years	1,226.39	1,447.76	1,798.70	2,152.70	926	75.5%
TOTAL	**5,562.01**	**6,247.37**	**6,946.06**	**7,682.69**	**2,121**	**38.1%**

*All costs reported in $000,000

Based on population growth, all states are expected to experience an increase in the healthcare costs associated with arthritis and other musculoskeletal conditions from 2015 to 2030 (Table 9). The greatest absolute increase in costs will be in Victoria (increase of $600 million), followed by New South Wales (increase of $562 million).

Table 9. Projected healthcare costs for arthritis & other musculoskeletal conditions to 2030, by state

State	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
ACT	71.36	81.94	92.39	103.86	33	45.5%
NSW	1,794.92	1,979.40	2,163.59	2,356.60	562	31.3%
NT	35.41	40.75	45.76	50.93	16	43.8%
QLD	1017.51	1,155.06	1,290.70	1,437.53	420	41.3%
SA	484.59	522.90	558.88	597.40	113	23.3%
TAS	162.49	175.99	186.96	197.72	35	21.7%
VIC	1,480.25	1,668.11	1,861.42	2,080.32	600	40.5%
WA	515.48	602.15	693.43	799.05	284	55.0%

*All costs reported in $000,000

3 Results

3.2.2 Projected healthcare costs for osteoarthritis

The healthcare costs for OA alone were estimated to be over $2.1 billion in 2015 and by the year 2030, these are forecast to exceed $2.9 billion (Table 10). In 2015, the highest healthcare costs for OA were related to the 65-74 age group ($612 million) and this is projected to continue until the year 2030 ($869 million). On average, this equates to $970 in healthcare costs for every person with the condition.

Table 10. Projected healthcare costs for osteoarthritis to 2030, by age group

Age group	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
0 - 14	0.00	0.00	0.00	0.00	0	0.0%
15 - 24	12.16	12.52	13.35	14.52	2	19.4%
25 - 34	37.94	40.54	41.65	42.52	5	12.1%
35 - 44	98.35	107.21	120.86	127.91	30	30.1%
45 - 54	292.67	308.19	321.29	348.18	56	19.0%
55 - 64	588.70	643.65	672.22	708.04	119	20.3%
65 - 74	612.64	714.74	791.45	869.50	257	41.9%
≤75 years	487.90	575.97	715.59	856.42	369	75.5%
TOTAL	**2,130.36**	**2,402.82**	**2,676.41**	**2,967.09**	**837**	**39.3%**

*All costs reported in $000,000

As shown in Table 11, all states are expected to see an increase in healthcare costs for OA from 2015 to 2030, with the greatest absolute increase forecast for New South Wales ($269 million).

Table 11. Projected healthcare costs for osteoarthritis to 2030, by state or territory

State	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
ACT	29.56	34.10	38.61	43.57	14	47.4%
NSW	809.75	897.46	985.39	1,078.91	269	33.2%
NT	9.06	10.35	11.51	12.83	4	41.6%
QLD	361.95	412.93	463.23	518.5	157	43.3%
SA	193.99	210.50	226.16	243.18	49	25.4%
TAS	71.93	78.64	84.46	89.96	18	25.1%
VIC	488.27	552.10	618.76	693.26	205	42.0%
WA	165.87	194.79	225.77	261.64	96	57.7%

*All costs reported in $000,000

3 Results

3.2.3 Projected healthcare costs for rheumatoid arthritis

Projected costs of biologics for rheumatoid arthritis

According to PBS expenditure data, the actual benefits paid for bDMARDs in the 2014-2015 financial year was approximately $273 million (Appendix 2). This represents a 104% increase from the costs reported in 2007 of $133.9 million.[94] As shown in Figure 5, the costs of bDMARDs alone are projected to increase to over $375 million by the year 2030, representing a $102 million increase from 2015 costs.

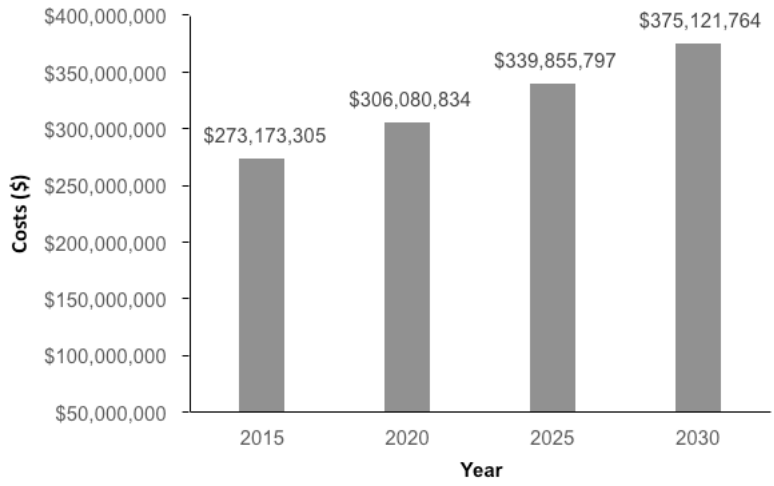

Figure 5. Projected costs of biologic DMARDs for rheumatoid arthritis to 2030

Projected healthcare costs for rheumatoid arthritis

Taking into account the costs for bDMARDs, healthcare costs for RA were estimated to be over $550 million in 2015 (Table 12). This equates to $1,303, on average, for every person with the condition. Healthcare costs for RA are projected to rise to over $755 million by the year 2030. The highest healthcare costs for RA were associated with the 65-74 age group in 2015 ($147 million), and this pattern is projected to continue until the year 2030 ($208 million).

3 Results

Table 12. Projected healthcare costs for rheumatoid arthritis to 2030, by age group

Age group	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
0 - 14	0.00	0.00	0.00	0.00	0	0.0%
15 - 24	24.49	25.22	26.90	29.25	5	19.4%
25 - 34	13.90	14.85	15.25	15.58	2	12.1%
35 - 44	51.13	55.74	62.83	66.50	15	30.1%
45 - 54	77.80	81.92	85.40	92.55	15	19.0%
55 - 64	128.79	140.81	147.06	154.90	26	20.3%
65 - 74	146.74	171.20	189.57	208.26	62	41.9%
≤75 years	107.52	126.93	157.70	188.73	81	75.5%
TOTAL	**550.37**	**616.67**	**684.71**	**755.77**	**205**	**37.3%**

*All costs reported in $000,000

The costs of healthcare for RA are expected to increase in all states, in concert with population growth. As shown in Table 13, the largest absolute increase in healthcare costs for RA is forecast for Victoria (increase of $82 million), followed by Queensland (increase of $61 million).

Table 13. Projected healthcare costs for rheumatoid arthritis to 2030, by state or territory

State	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
ACT	10.92	12.18	13.38	14.69	4	34.5%
NSW	45.15	50.72	56.57	62.66	18	38.8%
NT	4.84	5.61	6.33	7.08	2	46.3%
QLD	147.48	167.37	187.41	208.44	61	41.3%
SA	61.70	65.92	69.76	73.89	12	19.8%
TAS	28.77	30.58	31.78	33.11	4	15.1%
VIC	203.62	229.25	255.51	285.36	82	40.1%
WA	47.89	55.05	62.34	71.82	24	50.0%

*All costs reported in $000,000

3 Results

3.2.4 Projected healthcare costs for other musculoskeletal conditions

The healthcare costs for other musculoskeletal conditions (not including back pain or osteoporosis) are expected to increase from over $2.8 billion in 2015 to over $3.9 billion in 2030. Table 14 provides a breakdown of projected healthcare costs by age group. In 2015, the highest healthcare costs for other musculoskeletal conditions (this includes other forms of inflammatory arthritis) were associated with people aged 55-64 years ($682 million) but by the year 2030, the highest costs are expected to be attributable to people aged 75 years and over ($1.1 billion).

Table 14. Projected healthcare costs for other musculoskeletal conditions to 2030, by age group

Age group	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
0 - 14	0.00	0.00	0.00	0.00	0	0.0%
15 - 24	42.08	43.34	46.22	50.26	8	19.4%
25 - 34	175.12	187.13	192.23	196.27	21	12.1%
35 - 44	226.98	247.41	278.92	295.20	68	30.1%
45 - 54	457.33	481.57	502.04	544.06	87	19.0%
55 - 64	682.38	746.08	779.19	820.70	138	20.3%
65 - 74	666.41	777.47	860.91	945.80	279	41.9%
≤75 years	630.97	744.86	925.42	1,107.55	477	75.5%
TOTAL	**2,881.27**	**3,227.87**	**3,584.93**	**3,959.85**	**1,079**	**37.4%**

*All costs reported in $000,000

The costs of healthcare for other musculoskeletal conditions are expected to rise in all states and territories, as shown in Table 15. The greatest absolute increase is forecast for Victoria (increase of $313 million), followed by New South Wales (increase of $275 million).

Table 15. Projected healthcare costs for other musculoskeletal conditions to 2030, by state

State	2015	2020	2025	2030	Difference (2015-2030)	% change (2015-2030)
ACT	30.88	35.66	40.40	45.60	15	47.7%
NSW	940.01	1,031.22	1,121.62	1,215.03	275	29.3%
NT	21.51	24.79	27.91	31.02	10	44.2%
QLD	508.09	574.76	640.07	710.59	203	39.9%
SA	228.90	246.48	262.95	280.32	51	22.5%
TAS	61.80	66.77	70.73	74.65	13	20.8%
VIC	788.36	886.76	987.15	1101.70	313	39.7%
WA	301.72	352.31	405.33	465.60	164	54.3%

*All costs reported in $000,000

3 Results

3.2.5 Projected healthcare costs of juvenile idiopathic arthritis to 2030: A case study

Projections of healthcare costs for JIA were based on actual costs of service for a cohort of children being treated at the Royal Children's Hospital in Melbourne. There were a total of 111 children with JIA treated in the cohort studied over the period of interest (2012). Table 16 summarises the utilisation frequency, average costs, cost range and aggregate costs for each service category for the cohort. The mean annual cost of management per child was $6,703.84 per annum (SD $6,703.84; range: $78 - $39,968).

Table 16. Costs and services by service category for the JIA cohort, 2012

Service type	Services *(n)*	Patients *(n)*	Average cost per child*	Min	Max	Total cost
Pathology	201	66	$12.65	$0.00	$141.00	$1,417.05
Allied Health	57	16	$13.99	$0.00	$192.36	$1,566.36
Imaging	49	34	$24.68	$0.00	$254.30	$2,765.70
Eye reviews (public hospital)	102	29	$71.93	$0.00	$1,174.20	$7,984.56
Outpatient Rheumatology visit	352	111	$248.23	$78.28	$861.08	$27,554.56
Hospital admissions	102	52	$2,404.83	$0.00	$25,734.69	$269,341.87
Medications	342	83	$3,905.39	$0.00	$23,721.67	$433,498.40
TOTAL	**1205**	**111**	**$6,703.84**	**$78.28**	**$39,968.16**	**$744,126.40**

*Costs have been averaged across all 111 children in the cohort

The largest cost was related to medications, comprising an average annual cost of $3,905.39 per child (SD $7,212.44; range: $0 - $23,721.67). Of the total cost of medications, 94.1% of these costs were due to treatment with a bDMARD (64.7% of all medication costs were due to etanercept alone). Hospital admissions accounted for the next largest expense, averaging $2,426.49 per year per child (SD $3,922.13; range: $0 - $25,734.69). The main reason for admission to hospital was for joint injections (59% of all admissions). Of all service categories, the most frequently-used service was rheumatology outpatient visits, which accounted for 352 services for 111 children. The least frequently used service category was allied health visits, which accounted for 57 services for 16 children.

3 Results

Assuming a 0.1% prevalence of JIA in Australia, or 6,006 children with JIA in 2015 (Figure 4), the total cost to the health system of treating all children with JIA according to a best practice model (at $6,703.84 per child) equates to approximately $40.3 million dollars per year. By the year 2030, with 7,334 children affected by JIA, this equates to a cost of nearly $49.2 million dollars per year (Figure 6).

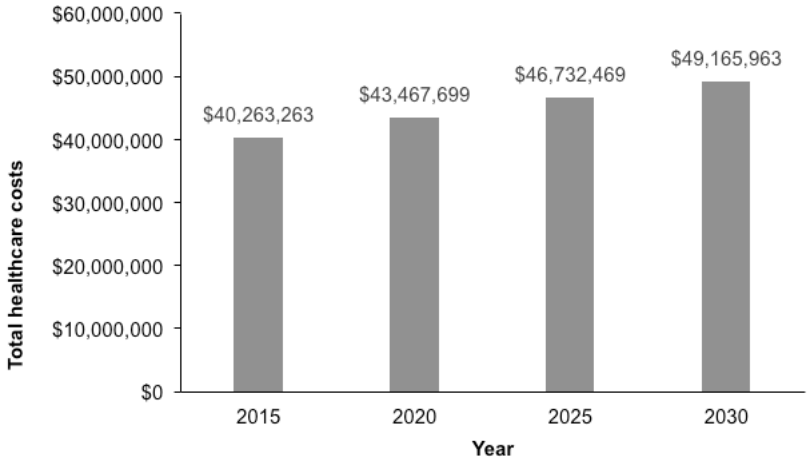

Figure 6. Projected costs of healthcare for JIA to 2030

3 Results

3.3 Benefits of conservative management strategies for knee osteoarthritis

Our findings show that conservative management strategies for people with knee OA could be cost-effective (for mild to moderate knee OA) and result in substantial cost savings for the Australian healthcare system (for severe knee OA), if implemented at a broader population level.

3.3.1 Cost-effective strategies for mild to moderate knee osteoarthritis

Prevalence rates from the National Health Survey and published data were used to estimate the proportion of people with knee OA[44] and subsequently, the proportion of people with mild to moderate knee OA[14] in the Australian population. These calculations indicated that 525,335 people had mild to moderate knee OA in 2015. Based on this figure, we estimated that a combined diet and exercise intervention such as the program trialled by Messier et al[88-90] would result in 42,027 additional QALYs (using an improvement in HRQoL of 0.08 utility units). The cost of providing this program to all people with mild to moderate knee OA in Australia would be $78.9 million in 2015-2016 dollars (based on an intervention cost of $150.19 per person). This equates to a cost per QALY of $1,877, which can be considered highly cost-effective. Interventions that cost under $45,000 per QALY gained are generally considered cost-effective in Australia.[95]

3.3.2 Potential cost savings related to severe knee osteoarthritis

Similar to the methods used for the mild to moderate knee OA analyses, the number of people with severe knee OA in the Australian population was estimated using prevalence rates and published data.[14,44] The number of people in Australia with severe knee OA was estimated to be 10,722 people in 2015, increasing to 14,700 people in the year 2030. Our analyses indicate that avoidance of TKR by 74% of people in the year after a comprehensive non-surgical intervention (consisting of exercise, education, dietary advice, use of insoles and pain medication)[48] would result in substantial costs savings to the health system for that year (Table 17). Based on average DRG costs for TKR (updated to 2015 dollars) and OA prevalence, this would equate to a saving of over $170 million in hospital costs in 2015. By the year 2030, the estimated savings associated with not having TKR would total more than $233 million. As the cost of providing the non-surgical intervention was not reported, the total net cost to the health system (healthcare costs plus cost of the intervention minus cost savings) could not be calculated. However, the net cost is still likely to result in substantial savings to the health system, as conservative management would be considerably less expensive than the current cost of TKR.

Table 17. Estimated hospital savings for severe knee OA

Year	Estimated population with severe knee OA (n)	Estimated population not having surgery (n)	Cost savings*
2015	10,722	7,934	$170,509,594
2020	12,050	8,917	$191,635,247
2025	13,330	9,865	$212,008,715
2030	14,700	10,878	$233,779,098

*Hospital costs avoided due to not having surgery in the first year after intervention

4 Summary of key findings and discussion

This section provides a summary of the key findings and an overview of relevant contextual issues. The strengths and limitations are also presented, and future directions for research are highlighted.

4.1 Key findings - projected prevalence of arthritis

- The number of people with arthritis is expected to increase nationally by 38% from 2015 to 2030, from 3.9 million to 5.4 million Australians.
- By 2030, people aged 75 and older will represent the largest group with arthritis in absolute terms, comprising over 1.5 million people.
- The number of people with OA is expected to increase nationally from almost 2.2 million in 2015 to almost 3.1 million Australians in 2030.
- People with RA comprised 10.8% of the total arthritis population in 2015. Between 2015 and 2030, the number of people with RA is projected to increase from 422,309 people in 2015 to 579,915 people affected in 2030.
- With future population growth, the number of children affected by JIA is expected to increase by 22% between the years 2015 and 2030. This equates to an additional 1,328 children and adolescents living with JIA in Australia in 2030.

4.2 Key findings - projected healthcare costs for arthritis

- The healthcare costs for arthritis and other musculoskeletal conditions were estimated to exceed $5.5 billion in 2015. By the year 2030, these costs are projected to exceed $7.6 billion.
- The healthcare costs for OA alone were estimated to be over $2.1 billion in 2015 and by the year 2030, these are forecast to exceed $2.9 billion. This is equivalent to $970, on average, for every person with the condition.
- The costs of biologics (bDMARDs) for RA are projected to increase to $375 million by the year 2030, representing a $102 million increase from 2015 costs.
- Taking into account the costs for bDMARDs, healthcare costs for RA were estimated to be over $550 million in 2015 (approximately $1,300 for every person with the condition, on average). Healthcare costs for RA are projected to rise to over $755 million by the year 2030.
- The total cost to the health system of treating all children with JIA according to a best practice model of care equates to approximately $40.3 million dollars per year. By the year 2030 (with 7,334 children affected by JIA), this equates to a cost of nearly $49.2 million dollars per year.

4.3 Key findings - potential benefits of conservative management programs

- A combined diet and exercise intervention program would result in 42,027 additional QALYs and the cost of providing this program to all people with mild to moderate knee OA in Australia would be $78.9 million. This equates to a cost per QALY of $1,877, which can be considered highly cost-effective.
- Avoidance of TKR by 74% of people with severe knee OA in the year after undergoing a conservative management program would translate into substantial costs savings to the health system of over $170 million in 2015 and over $233 million in 2030.

4.4 Important points to consider

The findings presented in this report should be considered within the current context of the Australian health system and factors that may influence the future prevalence and healthcare costs associated with arthritis. A brief summary of pertinent factors is provided in the sections below.

4.4.1 Rising rates of obesity

Recent research has shown that obesity rates are increasing in Australia, and this may manifest in greater than anticipated growth in the prevalence of OA and associated healthcare costs (related to more people with the condition, greater difficulty in managing OA in people who are obese, and the additional costs of co-morbidities related to obesity). Australia is currently

experiencing an obesity epidemic. The 2014-2015 National Health Survey showed that over 63% of Australian adults are overweight or obese (36% are overweight and 28% are obese).[10] Using data from the national, population-based Australian Diabetes, Obesity and Lifestyle (AusDiab) Study, researchers predicted that the prevalence of obesity among adults will rise to 34% by the year 2025.[96]

4.4.2 Rising rates of sports injuries

The future prevalence of OA and in particular, knee OA, may be also be impacted by rising rates of sports-related joint injuries in Australia. A Victorian population-based study has shown a significant increase in sports injuries between the years 2004 and 2010, even after accounting for growth in sports participation.[97] Lower limb sports-related injuries rose by 26% over the 7-year period and were associated with over $110 million in direct hospital costs. Given the link between injury and subsequent development of OA, the researchers warned that the growth in sport-related lower injuries may signal a 'future epidemic of OA'. To determine the longer-term impact of sports injuries, new research to investigate the risk and costs of THR and TKR surgery after injury is currently underway.

4.4.3 Biologics and the use of biosimilar drugs

While the advent of bDMARDs has changed the management of inflammatory arthritis, biologics are costly, as evidenced by our calculation of the pharmaceutical costs for people with RA and JIA. In 2012-2013, the Australian government paid $6.39 million in pharmaceutical benefits for biologics used to treat JIA.[16] For the JIA cohort described in this report (which represents approximately 2% of all children in Australia with JIA), expenditure on bDMARDs was $433,498 in 2012, accounting for 6.8% of national cost estimates for these biologics. It should be noted that previous national estimates of medication costs based on PBS data alone may underestimate actual biologic costs for this patient group, as 21% of medication costs in our JIA cohort were funded through clinical trials or hospital-based supplies.

The development of biosimilar drugs (generic drugs that are designed to exert the same pharmacodynamics effects as other drugs) should lead to a decrease in the treatment costs for RA and JIA.[98] While generic medicines can typically offer an 80-90% reduction in costs from the originator drug, biosimilars are unlikely to decrease by this much due to the high cost of manufacturing. The introduction of biosimilars will result in an initial statutory reduction in cost of 16% in Australia,[99] but this may reduce further over time through the PBS price disclosure program. Nevertheless, given the considerable expense of original biologics, future use of biosimilars will still represent a significant cost saving, often in the double digits per dose.[98]

4.4.4 MBS review of surgical procedures for osteoarthritis

A recent systematic review and meta-analysis found that arthroscopic surgery is not an effective treatment for knee OA and in some cases, can be harmful.[100] Arthroscopic surgery is not recommended as part of OA clinical guidelines.[37] However, there were 33,682 knee arthroscopies performed in Australia in 2012-2013, and many of these procedures will have been performed for people with degenerative joint disease.[101] For every 100,000 Australians over the age of 55 years, there were 560 hospital admissions for knee arthroscopy. Unwarranted variation in clinical practice was also identified in the recently-published Australian Atlas of Healthcare Variation.[101] Rates of knee arthroscopy tended to be higher in regional areas than in major cities, and there was substantial between-state variation in the utilisation of this procedure. Geographic variation in utilisation of knee arthroscopy has also been shown previously.[102]

At the time of preparing this report, the MBS Review Taskforce was reviewing health practices and procedures that are funded by the MBS, with a view to ceasing funding for MBS items that have little or no clinical benefit, or lack a supporting evidence base.[103] Arthroscopic surgery for knee OA has previously been flagged as a 'low-value procedure' among services that are funded by the MBS.[104] Based on the lack of evidence for effectiveness, the Australian Commission on Safety and Quality in Health Care has recently recommended to the MBS Review Taskforce that MBS funding be ceased for knee arthroscopy performed for OA.[101] This could result in significant costs savings for the healthcare system, although it is not known whether the savings would be diverted to other components of OA care.

4 Summary of key findings and discussion

4.4.5 Optimal care and delays in access to care for inflammatory arthritis

The data presented in this report represent optimal care of JIA,[9] as all children in the cohort were accessing the care of a paediatric rheumatologist within a tertiary hospital setting. The model of care is 'child-centred and family-focused' and uses a multidisciplinary approach including medical management, allied health services including physiotherapy, education and self-management support, psychosocial support and community liaison. A lack of nationwide data on JIA makes it difficult to quantify how many children with JIA are receiving optimal care in Australia.

Early diagnosis and commencement of treatment are essential for optimising patient outcomes for both JIA and RA. This ensures that the 'window for opportunity' for pharmaceutical treatment is not missed, while controlling patient symptoms and minimising the risk of joint damage. Unfortunately, long delays in diagnosis and commencing treatment for RA and JIA are common in Australia, so that patients can miss this opportune window. Irreversible joint damage can occur within 12 weeks of RA symptom onset, but the average time to treatment initiation for RA in Australia is approximately 23 weeks.[105] The majority of this delay (98 days) relates to the time between symptom onset and referral to a rheumatologist.[105] It is also considered that many children with JIA wait too long for diagnosis and treatment. This may relate to limited public awareness of arthritis affecting children (leading to delays in seeking medical advice) and limited awareness of JIA among clinicians.[9] In Queensland, 47% of children with JIA wait more than 6 months from symptom onset to diagnosis,[106] and families living in regional and remote areas reported particular difficulty in accessing specialist care and ancillary services.[107] Suboptimal care or delayed access to care could lead to long-term health consequences for people with inflammatory arthritis, as well as increased healthcare costs and productivity loss.

4.4.6 Health workforce issues and role re-design

A key barrier to early diagnosis and early treatment for JIA is the shortage of paediatric rheumatologists and appropriately-trained multidisciplinary teams in many parts of Australia. In 2012, there were 13 paediatric rheumatologists Australia-wide.[9] Most states only have 1-2 paediatric rheumatologists, and there are none in the Northern Territory or Tasmania.[108] The re-design of health practitioner roles and models of care for people with arthritis may improve future access to care and have implications for healthcare costs. Specialised nurse practitioner roles are also being considered for paediatric rheumatology settings.[9] This extended scope of practice could include clinical assessment and disease management, including prescription of medications and referral for imaging and other tests, and would be particularly relevant for regions that are currently under-serviced.

In recent years, physiotherapist-led clinics (such as the Osteoarthritis Hip and Knee Service in Victoria and post-arthroplasty review clinics) have been developed and implemented in a number of Australian public hospitals, with the overarching aim of reducing waiting times for surgeon consultation and surgery and optimising conservative management. These innovative models of care are improving patient access to care (by reducing waiting lists for specialist medical and surgical consultation through appropriate triage) and could reduce out-of-hospital medical expenses, by utilising appropriately-trained non-medical staff for routine patient assessment, monitoring and disease management.

4.5 Strengths of the research

This research has utilised the most up-to-date data on national arthritis prevalence and direct healthcare expenditure to provide contemporary estimates of the future prevalence and associated costs of managing arthritis in Australia. In planning our analyses, we searched the peer-reviewed and grey literature and online resources, and identified and assembled a comprehensive set of national government data sources and published reports including national health survey data, national healthcare expenditure data, national population projections and costs data from both the MBS and PBS. In particular, we were able to incorporate recently-released data from the 2014-2015 National Health Survey (national data were made available in December 2015, and state-based data for long-term conditions including arthritis were released in March 2016).

4 Summary of key findings and discussion

For our analysis of healthcare costs, we updated all costs to 2015 Australian dollars, to avoid underestimating the burden of arthritis when using expenditure data obtained from previous years. Additionally, we specifically estimated government expenditure on biologics for RA using current PBS data on benefits paid for individual bDMARDs. As pharmaceutical management comprises the backbone of RA treatment (nearly 80% of the total medical costs associated with RA in 2008-2009 were spent on prescription medications, equating to $275 million49), this approach enabled us to more accurately quantify the true costs of healthcare for the disease and for overall 'arthritis'. Another key strength of this research was our use of patient-level health service utilisation and medication data to estimate the healthcare costs associated with JIA. To our knowledge, this represents the first empirical evaluation of the broader costs of healthcare (comprising hospital admissions, specialist rheumatologist consultations, allied health, medications and investigations) in a cohort of children and adolescents with JIA in Australia.

Lastly, this research was undertaken by a multidisciplinary team with expertise in biostatistics, epidemiology, health economics, clinical pharmacology and musculoskeletal physiotherapy. We also sought expert clinical input from experienced rheumatologists (including specialist paediatric rheumatologists) and clinical pharmacists, who provided valuable clinical perspectives.

4.6 Limitations

We acknowledge the main limitations associated with currently available data sources, including the National Health Survey.[10] This survey only included people living in private dwellings and did not include people living in nursing homes or other aged care facilities. This could lead to an underestimation of long-term health conditions (such as OA) that predominantly affect older people. Very remote areas of Australia and discrete Aboriginal and Torres Strait Islander communities were also not sampled. As acknowledged by the ABS, this is unlikely to have affected national estimates but may have impacted on estimates for areas such as the Northern Territory, where almost one-quarter of the population live in very remote areas. The National Health Survey arthritis module captures doctor-diagnosed arthritis and this may underestimate true arthritis prevalence, by excluding people in the early stages of disease and/or those who have not yet been diagnosed. We also acknowledge that there may be instances of double-counting in the National Health Survey data, as a person with OA and RA would be included in the prevalence rates for both of these conditions.

Another limitation of this data source is the large standard errors reported for some age groups and conditions. This likely relates to sampling issues, where small numbers of people are reporting health conditions so that confident estimates for those populations cannot be obtained. As data on the specific prevalence of OA, RA, and other arthritis by state were not available from the 2014-2015 National Health Survey, we used state-based prevalence rates from the 2011-2012 Survey and assumed that the prevalence of these conditions remained constant for each state. As our national prevalence estimates are based on more robust data (2014-2015 data stratified by arthritis type), these are considered as the gold standard for the projected burden analyses.

It is important to note that our prevalence projections accounted for increases in population numbers (relating to migration and birth rates) and population age (mortality rate) but did not factor in potential increases in arthritis prevalence due to changes in factors such as obesity or injury rates. Additionally, ABS population projections do not include assumptions about events that may influence the population of Australia (for example, changes to migration policy, implementation of health interventions or disease outbreaks).

With regard to the projected healthcare costs, we acknowledge that our analyses do not account for potential changes in the costs of treatment over time, for example as medications come 'off patent' or as future innovations in the non-surgical and/or surgical management of arthritis become available. We also note the limitations associated with the AIHW health expenditure dataset, which captures approximately 70% of total direct expenditure.[49] In particular, out-of-hospital medical costs in the AIHW health expenditure dataset were informed by the BEACH survey. This means that the costs of follow-up or recurrent appointments with specialists (including rheumatologists) are missed, as only the initial referral from a GP is recorded. RA and

4 Summary of key findings and discussion

JIA both require close monitoring by a rheumatologist. As people with these conditions are advised to attend specialist rheumatologist reviews approximately 2-3 times per year[50,65] (even if the disease is well-controlled), this limitation would have led to an underestimation of the actual costs of treating inflammatory arthritis in the AIHW report. The costs of allied health services (for example, visits to physiotherapists, occupational therapists and dieticians) are not covered as part of the AIHW's out-of-hospital expenses and these would add to the direct cost burden of arthritis. In addition, the data do not include other significant costs associated with arthritis, such as over-the-counter medications and out-of-pocket costs for medical and surgical care.

As the AIHW dataset was considered to have potentially underestimated expenditure on biologics, we examined PBS expenditure data for bDMARDs that were indicated to treat RA from 2014 to 2015. As the medical condition for which these drugs were prescribed is not included in the PBS dataset, it is possible that these data contain bDMARD prescriptions for other autoimmune conditions. However, as the reported prevalence of many of the other conditions (e.g. systemic lupus erythematosus, Crohn's disease, Sjogren's syndrome, psoriatic arthritis) is lower in the Australian population when compared to RA, we do not consider this has impacted significantly on our analyses.

Modelling the costs savings and QALYs gained following conservative intervention programs for OA assumes adequate delivery and uptake of the programs, and patient compliance with the intervention components. While we assumed cost savings related to TKR for the first year after intervention, it is possible that people could have other forms of surgery within this period (for example, knee arthroscopy). It remains unknown as to how long surgery can be avoided after the conservative management program, and it is possible that the costs of TKR may be simply shifted to a later year. Longer-term outcome data are not available for the Skou et al study,[48] but are currently being collected. We also acknowledge that there may be other changes in costs after the intervention that could not be quantified; for example, post-operative review consultations would not be required but may be offset by more frequent visits to allied health services (for example, to monitor progress with dietary and exercise programs).

With regard to the JIA case study, it is important to note that as a major tertiary paediatric hospital, the RCH provides 'best-practice' care for patients with JIA[9] and that the costs of care at this institution may not be comparable to the costs of care for all patients with JIA across Australia. We also acknowledge that the data were based on treatment provided by one paediatric rheumatologist. The treatment patterns of this clinician may not mirror those of other rheumatologists; specifically, the frequency of joint injections may have inflated hospital admission costs. It is possible that some patients in regional areas may have also been accessing care from general practitioners or paediatricians. Also, the JIA data only included 12 months of treatment and so longer-term patterns of treatment could not be analysed. The unit costs used were based on average estimates rather than patient-level costing data and we assumed that all medications that were prescribed were filled. Data on the specific type of allied health care was not available, so we assumed the unit cost of a physiotherapy consultation for each of these items. This may have underestimated the total cost of allied health (including services such as occupational therapy and dietician visits). The costs of aids and appliances, individual pathology tests, patient and family education, and staff salaries (for hospital-funded rheumatologists and rheumatology nurses) were also not available for analysis. Additionally, the short data capture period meant that costs for rarer interventions (such as cardiology care and surgery) may have been missed. Taken together, we consider that our findings represent a conservative estimate of the actual costs of care for JIA. Finally, data on disease severity or time from symptom onset were not included, so further analyses according to these factors was not within the scope of this study.

4.7 Directions for future research

While this research has produced important projections of the future burden of arthritis in Australia, it has also highlighted important gaps in our current understanding (and gaps in available evidence) and potential avenues for future research in this field.

4 Summary of key findings and discussion

4.7.1 Detailed cost of arthritis studies

In this research, the direct healthcare costs of arthritis have been estimated from the perspective of the Australian health system and do not include any out-of-pocket costs borne by people with arthritis and their families, which are likely to be substantial. A bottom-up costing approach involving population-based samples (as opposed to the top-down method adopted for our analyses, based on AIHW and other national data) would enable the costs of over-the-counter medications and supplements, allied health consultations, and out-of-pocket (non-reimbursed) costs for medical and surgical care to be quantified. This would enable a more complete snapshot of the full costs of arthritis care. The indirect costs of healthcare (for example, time taken off work by patients and/or carers for appointments) could also be evaluated.

4.7.2 Establishing the national prevalence of juvenile idiopathic arthritis

An empirical study to determine the national prevalence of JIA in Australia would assist in planning future healthcare resource allocation and ensuring sufficient health workforce capacity to care for this patient group. The prevalence of JIA is low and therefore difficult to capture within National Health Survey sampling. Prevalence estimates for JIA from the National Health Surveys (reported as arthritis for the 0-15 age group) have had a high degree of standard error, likely reflecting sampling issues and the low prevalence of the condition.

4.7.3 Implementing and evaluating a national conservative management program for osteoarthritis

Conservative management programs could provide cost-saving opportunities if effectively implemented at the population level. Currently, there is no co-ordinated, national approach to the delivery of conservative management for OA in Australia. Non-surgical care including physiotherapy, tailored exercise programs and patient education is commonly provided through public hospital outpatient settings, community health centres, and private practices. Collection of patient outcomes data following OA care is dependent on the setting and the individual practitioner. In recent years, national non-surgical management programs for OA have been introduced in several Scandinavian countries, and clinical outcomes data are being routinely collected to evaluate their success. The programs involve upskilling of health professionals such as physiotherapists who then deliver the structured intervention, which commonly focuses on disease-relevant education and exercise. In Denmark, the Good Life with Arthritis: Denmark (GLA:D) initiative is a nation-wide conservative management program for the treatment of hip and knee OA that has been implemented in over 220 centres across the country.[109] Although a control group was not used, patients attending the program had reduced pain and increased quality of life at 12 months. The proportion of people taking sick leave for their condition reduced from 30.3% in the year before treatment to 19.5% in the year after the program. In Sweden, the Better Management of Patients with Osteoarthritis (BOA) program is a public health initiative that aims to increase and optimise the conservative management of hip and knee OA to reduce healthcare utilisation and rates of sick leave.[110] It focuses on education and exercise, delivered by trained physiotherapists and other allied health professionals. Since the BOA registry was introduced in 2010, the number of registered patients has doubled each year[111] and approximately 1800 physiotherapists have been trained to deliver the program.[110] BOA has over 25,000 people registered and the program is estimated to reach 15% of all Swedish patients with OA over the age of 45 years seeking care for their OA. After three months, participants demonstrated reduced pain and increased quality of life, and high levels of patient satisfaction were also evident. Norway offers a similar program called AktivA (Active living with Osteoarthritis), which incorporates training of physiotherapists, an evidence-based educational and exercise program for patients with hip or knee OA, and a centralised electronic database to capture longitudinal health outcomes data. A similar national model of conservative management for OA could potentially be developed for Australia but this would require appropriate stakeholder engagement and detailed consideration of feasibility and costs.

5 Appendices

The following Appendices contain supplementary information, as referred to in the main body of the report.

5.1 Appendix 1

Table 18. AIHW healthcare expenditure 2008-2009: Summary of included costs, by category

Category	Included costs
Hospital expenses	• Cost of services for patients admitted to public, private and psychiatric hospitals • Costs were only included for patients with a principal diagnosis relating to arthritis and other musculoskeletal conditions

Out-of-hospital medical expenses	• Costs of services provided by registered medical practitioners and funded by:
	  • Medicare Benefits Schedule (MBS)
	  • Department of Veterans Affairs
	  • compulsory motor vehicle third-party insurance
	  • workers' compensation insurance
	  • private health insurance funds
	  • Australian Government premium rebates allocated to medical services
	  • MBS co-payments and other out-of-hospital pocket payments
	  • non-MBS medical services

Pharmaceuticals	• Pharmaceuticals under the Pharmaceutical Benefits Scheme • Pharmaceuticals under the Repatriation Pharmaceutical Benefits Scheme • Under co-payment prescriptions • Private prescriptions

Adapted from: Australian Institute of Health and Welfare. Health-care expenditure on arthritis and other musculoskeletal conditions 2008-09. Canberra: Australian Institute of Health and Welfare; 2014.

5 Appendices

Table 19. AIHW healthcare expenditure 2008-2009: Summary of excluded costs, by category

Category	Included costs
Hospital expenses	• Non-admitted patient hospital services • Highly Specialised Drugs
Out-of-hospital medical expenses	• Medical services provided to patients at outpatient clinics in public hospitals • Residential aged care • Other health practitioner services • Community health services expenditure • Expenditure on public health programs • Health administration, health aids, appliances, patient transport
Pharmaceuticals	• Over-the-counter drugs including pain medications, vitamins, herbal and other complementary medicines

Adapted from: Australian Institute of Health and Welfare. Health-care expenditure on arthritis and other musculoskeletal conditions 2008-09. Canberra: Australian Institute of Health and Welfare; 2014.

5.2 Appendix 2

Table 20. Benefits paid for biological DMARDS from 2014-2015

Generic name	Proprietary name	PBS item code	Benefits paid ($)
Abatecept	Orencia	1220F, 1221G	36,032,909
Adalimumab	Humira	8737W, 8741C, 9099X, 9100Y	121,266,485
Certolizumab	Cimzia	3425G	21,602,103
Etanercept	Enbrel	8637N, 8638P, 9089J, 9090K	39,966,106
Golimumab	Simponi	3426H, 3427J, 3428K, 3429L	33,894,028
Infliximab	Remicade	4284L (RPBS), 6397Q	1,875,964
Rituximab	Rituxan	9544H, 9611W	13,375,402
Tocilizumab	Actemra	9658H, 9672C	5,160,308
			TOTAL $273,173,305

Data obtained from Pharmaceutical Benefits Schedule Item Reports (http://medicarestatistics.humanservices.gov.au/statistics/pbs_item.jsp)

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5.3 Appendix 3

Table 21. Unit costs and services used by the RCH juvenile idiopathic arthritis cohort

Service type	Cost per service ($AUD 2015)	Source
Hospital admissions		
Joint injections under general anaesthetic	$3,075.00	National Hospital Data Cost, Round 16 (2011-12)[a]
Joint injections under sedation	$3,075.00	National Hospital Data Cost, Round 16 (2011-12)[a]
Tocilizumab infusion	$1,352.00	National Hospital Data Cost, Round 16 (2011-12)[b]
Infliximab infusion	$1,352.00	National Hospital Data Cost, Round 16 (2011-12)[b]
Other elective admission	$1,108.00	National Hospital Data Cost, Round 16 (2011-12)[c]
Outpatient Rheumatology visit	$78.28	Medicare Benefits Schemed
Medications		Pharmaceutical Benefits Scheme, 2015
Allied health	$27.48	$63.90 as standard market rates for physiotherapy based on TAC review, May 2013 [112] with assumption that 43% are treated in the public system [72]
Eye reviews (public hospital)	$78.28	Medicare Benefits Scheme[d]
Pathology encounters	$7.05	Medicare Benefits Scheme[e]
Imaging		
X-ray	$32.50	Medicare Benefits Scheme[f]
Ultrasound	$37.85	Medicare Benefits Scheme[g]
Magnetic resonance imaging	$156.80	Medicare Benefits Scheme[h]

a. DRG code Z01B - Other Contacts W Health Services W OR Procedures, Sameday

b. DRG code R63Z - Chemotherapy

c. DRG code Z64B - Other Factors Influencing Health Status, Sameday

d. MBS item 116 and 132 - Consultant Physician attendances

e. MBS item 74990 - Pathology service

f. MBS item 57518 - Diagnostic imaging (FOOT, ANKLE, LEG, KNEE OR FEMUR)

g. MBS item 55834 - Ultrasound scan (LOWER LEG, 1 or both sides)

h. MBS item 63497 - Magnetic resonance Imaging on a patient under anaesthetic

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Table 22. Complete listing of juvenile idiopathic arthritis medications with unit costs

Medication	PBS (DPMQ/DPMA) $AUD 2015	Medication	PBS (DPMQ/DPMA) $AUD 2015
Adalimumab 20 mg/0.4 mL injection, 2 x syringes	$1,763.56	Methotrexate injection, various concentrations, 1 x vial	$45.00
Adalimumab 40 mg/0.8 mL injection, 2 x syringes	$1,763.56	Methylprednisolone Powder for injection 1 g (as sodium succinate)	$54.84
Anakinra 100 mg/0.67 mL injection, 28 x syringes	$1,650.00	Mylanta	not costed (out-of-pocket)
Caltrate	not costed (out-of-pocket)	Naprosyn, 250 mg, 50 x 2 tablets	$19.93
Cetirizine hydrochloride 10 mg, 30 tablets	$27.39	Naprosyn, 500 mg, 50 tablets	$16.91
Complementary Medicine	not costed (out-of-pocket)	Naproxen 250 mg, 50 x 2 tablets	$17.69
Cyclosporin 50 mg, 30 x 2 tablets	$182.21	Naproxen 750 mg, 28 tablets	$15.34
Daivobet (0.005%-0.05%)	$72.35	Naproxen 500 mg, 50 tablets	$15.79
Etanercept 25 mg/1mL injection, 4 x syringes	$1,763.55	Omeprazole 10 mg, 30 tablets	$14.58
Etanercept 50 mg/1mL injection, 4 x syringes	$1,763.57	Omeprazole 20 mg, 30 tablets	$16.31
Folic acid 500 µg, 100 x 2 tablets	$14.71	Piroxicam 10 mg, 50 tablets	$15.45
Folic acid 5 mg, 100 x 2 tablets	$17.03	Piroxicam 20 mg, 25 tablets	$15.20
Hydrocortisone acetate 1% (10 mg/g) cream, 50 g	$12.28	Prednefrin Forte Drops	$27.29
Ibuprofen 400 mg, 30 tablets	$12.83	Prednisolone, 5 mg, 60 tablets	$12.20
Infliximab 100 mg injection, 1 x vial	$671.48	Prednisolone 25 mg, 30 tablets	$13.65
Leflunomide 20 mg, 30 tablets	$67.77	Ranitidine 150 mg, 60 tablets	$15.08
Meloxicam 15 mg, 30 tablets	$16.15	Sulfasalazine 500 mg, 100 x 2 tablets	$49.79
Methotrexate 10 mg, 15 tablets	$22.52	Tocilizumab 200 mg/10 mL injection, 1 x vial	$467.20
Methotrexate 10 mg, 50 tablets	$50.74	Tocilizumab 400 mg/20 mL injection, 1 x vial	$934.40
Methotrexate 2.5 mg, 30 tablets	$16.25		

PBS DPMQ/DPMA = Pharmaceutical Benefits Scheme Dispensed Price per Maximum Quantity/ Dispensed Price per Maximum Amount

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