

Patient Education for Knee Osteoarthritis: Effectiveness, Priorities, and Co-
Design of a Web-Based Toolkit

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List of abbreviations

95% CI	95% confidence interval
ACL	Anterior cruciate ligament
ACR	American college of rheumatology
ADL	Activities of daily living
AHPRA	Australian health practitioner regulation agency
APA	Australian Physiotherapy Association
ASES	Arthritis self-efficacy scale
BMI	Body mass index
CALD	Culturally and linguistically diverse
CSQ	Coping skills questionnaire
DALYs	Disability-adjusted life years
DVT	Deep vein thrombosis
Ex-Th	Exercise therapy
EULAR	European alliance of associations for rheumatology
ES	Effect size
ESCAPE	Enabling self-management and coping with arthritic pain using exercise
GRADE	Grading of recommendations, assessment, development and evaluations
GLA:D	Good living with osteoarthritis Denmark
HONcode	Health on the net foundation code
ICC	Interclass correlation coefficient
Il-6	Interleukin 6
KOOS	Knee osteoarthritis outcome score
MBS	Medibank benefits schedule
MCID	Minimum clinically important difference
MD	Mean difference
MeSH	Medical Subject Headings
MI	Mean improvement
MRI	Magnetic resonance imaging
MSK Australia	Musculoskeletal Australia
NICE	National institute of health and care excellence
NSAIDS	Non-steroidal anti-inflammatories
OA	Osteoarthritis
OACCP	Osteoarthritis chronic care program
OARSI	Osteoarthritis research society international
OR	Odds ratio
PCS	Pain catastrophizing scale
RR	Risk ratio

SD	Standard deviation
SDE	Self-directed education
SMD	Standard mean difference
TFE	Therapist-facilitated education
TIDieR	Template for intervention description and replication
US	United States
VAS	Visual analogue scale
WHO	World health organisation
WOMAC	Western Ontario and McMaster universities osteoarthritis index

Abstract

Knee osteoarthritis is a leading cause of disability worldwide. All major guidelines recommend patient education as first-line care alongside exercise therapy, and weight management when appropriate. However, the term patient education is poorly defined and guidance with respect to ‘what’ education to provide and ‘how’ to provide it is scarce. This may lead to significant variation in content and delivery approaches in research and practice, potentially acting as a barrier to engagement with guideline-recommended first-line care. Digital literacy and access to the internet is growing rapidly around the world. People with chronic conditions such as knee osteoarthritis increasingly seek health information from web-based sources. Despite this, the development and use of web-based resources to facilitate effective patient education and engagement in first-line care for chronic musculoskeletal conditions, including knee osteoarthritis, remain low. Additionally, the accuracy of content, and the credibility and quality of available web-based resources are questionable.

The aims of this thesis were to:

- i) Evaluate the effectiveness of patient education interventions in clinical trials and assess their content, development, and delivery.
- ii) Identify and appraise common publicly-accessed web-based resources for people with knee osteoarthritis.
- iii) Identify the educational priorities of people with knee osteoarthritis and physiotherapists.
- iv) Use co-design methods to create a web-based toolkit to facilitate self-management and informed decision-making for people with knee osteoarthritis.

My systematic review conducted as part of this thesis indicated that patient education provides small short-term improvements in pain and function compared to usual care, and that combining education with exercise therapy provides superior outcomes compared to either intervention alone. However, significant variation in content, development and delivery was noted across the included trials, with very few education interventions using web-based resources. My appraisal of the web-based content about knee osteoarthritis against research evidence and guidelines identified that content was rarely accurate and clear. My mixed-methods concept-mapping studies identified that people with knee osteoarthritis have broad education needs, prioritising education about surgery and exercise. Physiotherapists prioritise providing information about exercise and dispelling misconceptions about radiology. Collectively, these studies indicate that very few educational priorities of people with knee osteoarthritis and physiotherapists are clearly included as education-specific content recommendations in guidelines.

Collectively, my research identified a need for the creation of a web-based resource that addresses the educational priorities of people with knee osteoarthritis and that can be used as a self-directed resource or with the support of a health professional. The final paper of this thesis outlines the co-design process, including three workshops with end-users, employed to create a web-based toolkit to support patient education and self-management for people with knee osteoarthritis – MyKnee.trekeeducation.org. The workshop findings and subsequent toolkit creation provide important knowledge on ‘what’ content may be important to provide for people with knee osteoarthritis and ‘how’ web-based resources might be used to tailor and optimise care.

Summary of chapters

PART A – INTRODUCING KNEE OSTEOARTHRITIS AND EXPLORING PATIENT EDUCATION IN ITS MANAGEMENT

Chapter 1 provides an overview of knee osteoarthritis, including its pathogenesis, diagnosis, risk factors and treatments, and provides an in-depth exploration of the role of patient education for people with knee osteoarthritis.

Chapter 2 comprises a systematic review and meta-analysis investigating the effectiveness of patient education interventions on pain, function and psychosocial outcomes for people with knee osteoarthritis.

Chapter 3 is an ancillary analysis of the systematic review and meta-analysis from Chapter 2; this analysis explores the development, content and delivery of patient education interventions in knee osteoarthritis clinical trials.

Chapter 4 is a systematic appraisal of the comprehensiveness, accuracy, quality, credibility and readability of web-based information about knee osteoarthritis.

PART B – IDENTIFYING THE EDUCATION PRIORITIES OF PEOPLE WITH KNEE OSTEOARTHRITIS AND PHYSIOTHERAPISTS

Chapter 5 explores the perceived educational needs of people with knee osteoarthritis using a concept mapping methodology and matches these against all major clinical practice guidelines for knee osteoarthritis.

Chapter 6 explores physiotherapists' perceived education priorities for people with knee osteoarthritis using concept mapping methodology and matches these against all major clinical practice guidelines for knee osteoarthritis.

PART C – DEVELOPING A CO-DESIGNED EDUCATION AND SELF-MANAGEMENT TOOLKIT FOR PEOPLE WITH KNEE OSTEOARTHRITIS

Chapter 7 provides a detailed overview of the rationale and describes the co-design process, including workshops and related findings, of a web-based toolkit for people with knee osteoarthritis.

PART D – DISCUSSION AND CONCLUSIONS

Chapter 8 summarises the main findings of this thesis including the strengths, limitations, and potential clinical and research implications.

Statement of authorship

I, Anthony James Goff, declare that this thesis includes work by the author that has been published or accepted for publication as described in the text. Except where reference is made in the text of the thesis, this thesis contains no other material published elsewhere or extracted in whole or in part from a thesis accepted for the award of any other degree or diploma. No other person's work has been used without due acknowledgment in the main text of the thesis. This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution.

With regard to the extent of collaboration with another person or persons, although the publications involve joint authorship, I have made a significant and leading contribution to all the work included in this thesis, equivalent to that expected for a traditional thesis. I am the primary author on all publications pertaining to the body of this thesis (2 published, 3 accepted, and 1 in preparation) with confirmation of authorship documentation presented in [Appendix 1A](#). I am a co-author on additional publications obtained concurrently during this thesis, listed on pages 24-26, that are not submitted as a component of completion of this PhD.

All research procedures reported in the thesis were approved by the La Trobe University Human Ethics Committee. This thesis has been professionally proofread and edited for spelling, grammar, punctuation, sentence structure, style, and clarity by Kirsty Balog in accordance with the Guidelines for Editing Research Theses under the Australian Standards for Editing Practices.

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Signed:

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Publications and presentations arising from this thesis

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2. Goff, A.J., De Oliveira Silva, D & Barton, C.J. (2022). Correspondence: Author response to Yuan et al. *Journal of Physiotherapy*. 68 (1), 80-81. DOI: j.jphys.2021.12.008
3. Goff, A.J., De Oliveira Silva, D., Merolli, M., Bell, E.C., Ezzat, A., O'Halloran, P., Crossley, K. & Barton, C.J. Knee osteoarthritis education interventions in published trials are typically unclear, not comprehensive enough, and lack robust development: ancillary analysis of a systematic review. *Journal of Orthopaedic and Sports Physical Therapy*. available online ahead of print. DOI: jospt.2022.10771
4. Goff, A.J., Barton, C.J., Merolli, M., Quah, A.Q.S, Hoe, C.K.C, & De Oliveira Silva, D. Comprehensiveness, accuracy, quality, credibility and readability of online information about knee osteoarthritis. (accepted by *Health Information Management Journal*).
5. Goff, A.J., Donaldson, A., De Oliveira Silva, D., Crossley, K. & Barton, C.J. People with knee osteoarthritis attending physiotherapy have broad education needs, and prioritise information about surgery and exercise: A concept mapping study. (accepted by *Journal of Orthopaedic and Sports Physical Therapy*).

6. Goff, A.J., Donaldson, A., De Oliveira Silva, D., Crossley, K. & Barton, C.J

Physiotherapists prioritise providing education about exercise therapy and to dispel misconceptions about radiology for people with knee osteoarthritis. A concept mapping study. (accepted by Journal of Orthopaedic and Sports Physical Therapy).

Planned submissions

1. Goff, A.J., De Oliveira Silva, D., Ezzat, A.M., Crossley, K. Pazzinatto, M.F., & Barton, C.J. Co-design of a web-based toolkit for people with knee osteoarthritis and clinicians. Target journal = TBC. Expected submission June 2022

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1. Goff, A.J., De Oliveira Silva, D., Ezzat, A.M., Crossley, K. Pazzinatto, M.F., & Barton, C.J. Canadian Arthritis Research Committee (CARC) 2022. Co-development of an online education toolkit for people with knee osteoarthritis. (symposia)
2. Goff, A.J., Donaldson, A., De Oliveira Silva, D., Crossley, K. & Barton, C.J. La Trobe SAHHSS Promoting Progress conference 2022. Perceived education needs of people with knee osteoarthritis: A concept mapping study. (rapid fire presentation)
3. Goff, A.J., De Oliveira Silva, D., Merolli, M., Bell, E.C., Ezzat, A., O'Halloran, P., Crossley, K. & Barton, C.J. Sports Medicine Australia (SMA) 2021. Most knee osteoarthritis education interventions in published trials lack clarity, comprehensiveness, and robust development: ancillary analysis of a systematic review (poster presentation)
4. Goff, A.J., Donaldson, A., De Oliveira Silva, D., Crossley, K. & Barton, C.J. Sports Medicine Australia (SMA) 2021. What do physiotherapists believe is important to

educate people with knee osteoarthritis about? A concept mapping study (poster presentation)

5. Goff, A.J., De Oliveira Silva, D., Merolli, M., Bell, E.C., Crossley, K. & Barton, C.J. World Physiotherapy Congress 2021. Patient education for knee osteoarthritis: A systematic review and meta-analysis. (platform presentation).
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Confirmation of authorship for all published, accepted or submitted manuscripts can be found in [Appendix 1A](#). Copyright approval for published or accepted manuscripts can be found in [Appendix 1B](#).

Additional publications and presentations during candidature

Publications

Published

1. Goff, A.J., Elkins, M. (2021). Knee Osteoarthritis. Editorial. Journal of Physiotherapy. 67 (4), 240-241. ([Appendix 1C](#))
2. Barton, C.J., King, M.G., Dascombe, B., Taylor, N.F., De Oliveira Silva, D, Holden, S., Goff, A.J., Takarangi, K. & Shields, N. (2020) Many physiotherapists lack preparedness to prescribe physical activity and exercise to people with musculoskeletal pain: A multi-national survey. Physical Therapy in Sport.
3. Lo, C.N., Choi, J.Y.M., Goff, A.J., Soon, B.T.C., Abdelkader, T., Suresh, K., & Cea Carpio, G. (2020) Teaching physiotherapy students physical exam skills by utilizing photogrammetry: A randomized control trial of 3D versus 2D images. Simulation in healthcare.

Conferences (as presenter)

1. Goff, A.J. Singapore International Physiotherapy Congress 2021. Outcomes for patient education. (oral presentation)
2. Goff, A.J. Singapore International Physiotherapy Congress, 2021. Using clinical outcome measures to drive therapy decision making. (symposium host)

Conferences (not as presenter)

1. Quak, A.L.X., Lau, M.S.E., Soh, I.G.Y., Goff, A.J. & Dancza, K.M. Applied learning conference, 2022. An Appreciative Inquiry investigation into changes in undergraduate health science education since COVID-19. (oral presentation)
2. Bell, E.C., Wallis, J., Goff, A.J., & Barton, C.J. Sports Medicine Australia, 2021. Does exercise therapy increase physical activity in people with knee osteoarthritis? A systematic review. (poster presentation)
3. Tan, C.P., Rigby, E. & Goff, A.J. PBL International Conference, 2021. Enhancing the approach for learning clinical reasoning process for beginner physiotherapy students. (oral presentation)
4. Tay, J.A & Goff, A.J. Singapore International Physiotherapy Congress, 2021. Beyond healthcare to health through physical activity. A cross-sectional survey exploring physical activity knowledge and promotion among musculoskeletal physiotherapists in Singapore. (poster presentation)
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object Rotatable 3D Graphics With Traditional 2D Graphics In The Blended Learning
Delivery Of Manual Therapy Skills. (oral presentation).

**PART A - INTRODUCING KNEE OSTEOARTHRITIS AND
EXPLORING PATIENT EDUCATION IN ITS MANAGEMENT**

Chapter 1 : Introduction and background

1.1 Understanding the condition

1.1.1 What is knee osteoarthritis?

Osteoarthritis is the most prevalent arthritic condition and most frequently affects the knee joints¹⁻³. Up to one in four people over the age of 50 years^{2,4} have radiographic knee osteoarthritis, which can affect the tibiofemoral joint, the patellofemoral joint or, most commonly, both^{5,6}. Historically, knee osteoarthritis was viewed as a degenerative condition characterised by progressive loss of articular cartilage due to increased use and loading^{7,8}. However, it is now accepted that the pathogenesis is more complex. It involves mechanical, inflammatory and metabolic processes that create imbalance in the destruction and repair of multiple joint tissues including the articular cartilage, subchondral bone, ligaments, capsule and synovium^{2,9-11}. This can impact local and global musculature^{12,13}, joint function^{14,15}, central processing of information^{16,17}, behaviour of an individual^{18,19} and quality of life²⁰.

Central to the understanding of osteoarthritis is an appreciation of the factors and comorbidities involved in its development and progression⁸. For example, obesity is a risk factor for osteoarthritis development in weight-bearing and non-weight-bearing joints (e.g., the hand)^{7,21,22}, contradicting the traditional biomechanical and degenerative explanations of its development²³. This led to the exploration of systemic and inflammatory processes that are now known to be involved in the pathogenesis of the condition^{7,24}. Further, degenerative features on radiographic imaging are generally poorly correlated with symptoms²⁵⁻²⁹. This, alongside an increased understanding of pain neuroscience, has led to an understanding of knee osteoarthritis as a

whole-person condition that is influenced by many physiological and psychosocial factors, rather than purely a structural condition^{7,30,31}. The Osteoarthritis Research Society International (OARSI) currently defines osteoarthritis as:

“A disorder involving movable joints characterised by cell stress and extracellular matrix degradation initiated by micro- and macro-injury that activates maladaptive repair responses including pro-inflammatory pathways of innate immunity. The disease manifests first as a molecular derangement (abnormal joint tissue metabolism) followed by anatomic and/or physiologic derangements (characterised by cartilage degradation, bone remodelling, osteophyte formation, joint inflammation and loss of normal joint function) that can culminate in illness”³².

1.1.2 How is knee osteoarthritis diagnosed?

Knee osteoarthritis has traditionally been diagnosed through radiographic imaging (i.e., X-ray)³³ and application of qualitative grading scales. For example, the Kellgren-Lawrence scale^{34,35} is commonly cited in literature and assesses structural features on scale from 0 (no features) to 4 (large osteophytes, marked narrowing of the joint space, severe sclerosis and definite deformity of bone ends)³⁵. Previously, stage 2 (definite osteophytes with or without the presence of joint space narrowing) was generally considered the threshold to diagnose knee osteoarthritis^{35,36}.

While the presence of bone marrow lesions and synovitis on magnetic resonance imaging (MRI) may be associated with symptoms^{37,38}, there is generally a poor correlation between radiological features and pain or disability for people with knee osteoarthritis²⁵⁻²⁹. Collectively, research evaluating the relationship between structural features and symptoms highlights the limitations

of the traditional pathoanatomical explanation of osteoarthritis. Subsequently, imaging is now recommended by clinical practice guidelines only in the presence of abnormal symptoms or suspicion of serious pathology³⁹⁻⁴².

Greater understanding of the complexity of the condition, coupled with the weak associations between imaging findings and symptoms and disability²⁵⁻²⁹ has driven the development of alternate diagnostic criteria for osteoarthritis. Knee osteoarthritis clinical practice guidelines now advocate a diagnosis based upon signs and symptoms in most cases. However, variation in diagnostic criteria exists (Table 1.1)³⁹⁻⁴². Diagnosing knee osteoarthritis based on signs and symptoms appears reliable^{43,44} and has many advantages from both a healthcare system and individual perspective – i.e., diagnosis without imaging is more cost- and time-efficient and avoids unnecessary exposure to radiation.

Table 1.1 Clinical diagnostic criteria from major clinical practice guidelines

Clinical practice guideline	A clinical diagnosis of knee osteoarthritis is made if an individual:
ACR ³⁹	Meets one of these three criteria: 1) Crepitus, morning knee stiffness of 30 min or less, and age of 38 years or above. 2) Crepitus, morning stiffness of longer than 30 min, and bony enlargement. 3) No crepitus, but bony enlargement.
EULAR ⁴⁰	Is 40 years or older, AND has movement-related joint pain, AND morning knee stiffness of less than 30 min, AND functional limitations, PLUS has one or more of these examination findings: crepitus, restricted range of motion, and bony enlargement.
NICE ⁴¹	Is 45 years or older, AND has movement-related joint pain, AND either no morning knee stiffness or stiffness of 30 min or less.
RACGP ⁴²	If a person: Is aged 45 years or older Has activity-related joint pain Has morning stiffness that lasts <30 minutes Has crepitus on active motion Has bony enlargement Has no detectable warmth.

ACR = American College of Rheumatology, EULAR = European Alliance of Associations for Rheumatology, NICE = National Institute for Health and Care Excellence, RACGP = Royal Australian College of General Practitioners

1.1.3 What are the risk factors for knee osteoarthritis?

Greater understanding of the complexity of the factors associated with knee osteoarthritis has led to an increasing appreciation of risk factors involved in the development and progression of the condition. Risk factors can be divided into person- and joint-level factors, but there are also complex interactions between the two^{21,45}. Factors associated with osteoarthritis can also be categorised as modifiable or non-modifiable. Identification of modifiable risk factors for knee

osteoarthritis is encouraging and provides opportunities to implement strategies to prevent and improve the management of this condition.

Person-level factors for knee osteoarthritis include age, sex, obesity and physical inactivity^{21,45,46}. Age and sex are non-modifiable. It is widely accepted that increasing age is a significant risk factor for knee osteoarthritis diagnosed radiographically and/or clinically^{2,22,45}. A 2015 review⁴⁵ reported a non-linear relationship between age and knee osteoarthritis incidence, peaking between the ages of 50 and 75 years in men, with limited increases or even a decline from 75-80 years of age. This increasing incidence of osteoarthritis with age is most likely due to repeated exposure to other risk factors in combination with biological, and age-related changes in and around the joint, such as declining bone density and sarcopenia². For women, the incidence of knee osteoarthritis rises sharply around menopause, suggesting female hormones may play a role. However, this relationship is not well understood⁴⁷. In general, women have a higher risk of developing knee osteoarthritis compared to men^{21,22,47} which may be due to one, or a combination of factors including but not restricted to; hormonal differences between the sexes, biomechanics (e.g., Q-angle⁴⁸), smaller cartilage volumes, bone loss, and lower muscle strength^{45,47}.

Obesity, most commonly defined as a body mass index (BMI) of greater than 30 kg/m²⁴⁹, is a modifiable, person-level risk factor for the development of knee osteoarthritis^{21,45}. Obesity can influence the osteoarthritis process via increased mechanical joint loading and systemic inflammatory changes^{7,24,30}, and is commonly associated with physical inactivity for people with knee osteoarthritis⁵⁰. Physical inactivity, defined as a failure to complete 150 minutes of

moderate to vigorous physical activity across five or more days for adults and older adults (i.e. over 65 years)⁵¹, is a proposed modifiable, person-level risk factor for the development of knee osteoarthritis, but there is insufficient evidence to conclusively support this^{52,53}. Physical inactivity is, however, a modifiable person-level risk factor for the progression of knee osteoarthritis⁴⁶. Physical inactivity is associated with thinner cartilage, lower proteoglycan content, and weaker muscles that may be less capable of evenly distributing joint loads, potentially predisposing an individual to the development of knee osteoarthritis and accelerating the progression of the condition⁵³.

Joint-level risk factors include previous injury, valgus or varus malalignment, and abnormal joint loading^{21,22}. Each of these risk factors is potentially modifiable. Previous traumatic knee injuries are estimated to account for at least 12% of the total burden of knee osteoarthritis⁵⁴. Anterior cruciate ligament (ACL) injuries, meniscal tears and intra-articular fractures are strongly associated with the development of early-onset knee osteoarthritis^{55,56}. ACL injuries are more common amongst women than men in those who play team sports⁵⁷, with evidence indicating that reductions in ACL injury rates are possible through the implementation of exercise programs that include strength, plyometric, agility, proprioception and landing mechanic training⁵⁸.

Knee malalignment has long been considered a risk factor for knee osteoarthritis due to traditional biomechanical beliefs about the causation of the condition; however, conflicting evidence exists^{59,60}. Valgus malalignment appears most relevant to the progression, rather than the development, of the condition^{21,61}. Varus malalignment appears to be linked to the development and progression of knee osteoarthritis, but it may be most relevant for obese people

with knee osteoarthritis^{59,62}. Malalignment has also been suggested to pre-dispose an individual to serious knee injuries, and therefore, knee osteoarthritis. However, this association is still not clear^{63,64}. Abnormal loading is poorly defined in research but has been reported to be associated with the development and progression of knee osteoarthritis^{21,22}. Abnormal loading may be a consequence of increased weight/obesity, malalignment and/or occupational roles, including high frequency squatting, kneeling and lifting^{21,22,65,66}. If abnormal loading is related to increased weight or occupational tasks, these are modifiable through appropriate weight management interventions⁶⁷ or modifications to the work environment⁶⁶. If abnormal loading is related to malalignment, then invasive (i.e., surgery⁶⁸) or conservative (i.e., orthoses⁶⁹) options exist to modify lower limb mechanics.

1.1.4 The personal burden of knee osteoarthritis

Up to one in ten people over the age of 60 have symptomatic knee osteoarthritis^{70,71}. Pain is the primary symptom associated with knee osteoarthritis^{2,72}. Early in the lived experience, pain is typically reported as activity-related and intermittent, but can become more persistent and severe over time⁷³. Other frequent clinical signs and symptoms include reduced range of movement, crepitus, joint instability, swelling and muscle weakness⁷⁴. These, combined with pain, can lead to reduced function^{14,15} and social participation⁷⁵, along with impaired emotional and mental health^{17,76} and quality of life²⁰.

Whilst nociceptive pain mechanisms will play a part in the pain experience of people with knee osteoarthritis, the lack of correlation between imaging and symptoms²⁵⁻²⁹ suggests that other mechanisms (i.e., neuropathic and central) are also involved^{11,16,17,74,77}. Beliefs and

misconceptions frequently reported by people with knee osteoarthritis have the potential to influence pain perception when viewed from a biopsychosocial perspective⁷⁸. For example, people with knee osteoarthritis commonly have the misconception that pain is a consequence of damage to joint structures^{75,79-81}. Such beliefs may contribute towards pain catastrophisation^{82,83} and lead to fear avoidance behaviours (i.e., reducing engagement with exercise therapy or social activities in an attempt to avoid creating further ‘damage’ to the knee joint)^{75,79-81,84}. Such misconceptions plus subsequent heightened pain responses and avoidance behaviours may contribute towards up to 87% of people with knee osteoarthritis failing to meet physical activity guideline recommendations¹⁸, common beliefs that surgery is inevitable^{79,85}, and being over four times more likely to report severe pain compared to those without knee osteoarthritis⁸⁶. Misconceptions about the cause and treatment of the condition may be a consequence of receiving contrasting, and sometimes inaccurate, information from different health professionals⁷⁵, or web-based sources⁸⁷⁻⁸⁹.

Knee osteoarthritis is associated with a high prevalence of comorbidities⁹⁰⁻⁹². Up to two-thirds of people with the condition report at least one comorbidity⁹⁰⁻⁹², which is approximately 20% higher compared with age-matched controls⁹⁰. In Australia, the risk of multimorbidity (i.e. presence of two or more conditions) in people with knee osteoarthritis is three times higher than for those without the condition⁹³. Further, having one or more comorbidity is moderately associated with worsening pain and function for people with knee osteoarthritis⁹⁴. Obesity is the most common comorbidity affecting up to 50% of people with knee osteoarthritis⁹⁵. As discussed earlier, obesity is also a risk factor for the development and progression of the condition and has a complex interaction with physical inactivity^{21,45}. Obesity also increases the risk of other

comorbidities, for example cardiovascular disease (which affects up to 40% of people with the condition^{92,96}), that can have a significant impact on an individual's overall health^{30,95}.

Knee osteoarthritis also has the potential to impact an individual's emotional and mental health^{75,97,98}. For example, people with knee osteoarthritis can report feelings of frustration, inadequacy, and fear for the future, or may present with anxiety or depression^{75,98,99}. Anxiety and depression affect up to 25 % of people with the condition⁹⁸ and can be barriers to physical and social activity participation^{78,97,98}, result in higher pain intensities¹⁰⁰ and reduce health-related quality of life⁹⁹.

People with knee osteoarthritis have an increased risk of falling (hazard ratio (HR) 1.26, 95% CI 1.17 to 1.36)¹⁰¹⁻¹⁰³ and hip fracture (HR 2.0, 95% CI 1.18 to 3.37)¹⁰⁴ compared to age-match controls. This greater risk results in up to two in five 45-64-year-olds living with knee osteoarthritis in Australia reporting having had a fall in the previous year¹⁰⁵. Therefore people with knee osteoarthritis likely contribute a large proportion of acute healthcare costs associated with falls that exceed AU\$600 million annually in Australia¹⁰⁶.

1.1.5 Societal burden of knee osteoarthritis in Australia

In 2017-18, approximately 2.2 million people were living with osteoarthritis in Australia¹⁰⁷. Between 2003 and 2018, osteoarthritis moved from 14th in Australia's disease ranking and age-standardised disability-adjusted life-years (DALYs) to 10th¹⁰⁸. Osteoarthritis accounts for over AU\$2 billion of direct healthcare costs annually in Australia, rising to AU\$23 billion when accounting for economic costs such as lost work productivity and loss of well-being¹⁰⁹. A large

proportion of direct healthcare costs related to knee osteoarthritis are attributed to surgical care¹¹⁰. Primary total knee replacements are the most common form of surgery for knee osteoarthritis, with nearly 55,000 performed in Australia in 2018¹¹¹. The frequency of total knee replacements is predicted to rise by 276% between 2019-2030, which will lead to an annual cost of AU\$3.4 billion to the healthcare system¹¹⁰. This increasing health system burden is not unique to Australia and is being driven by ageing populations and increasing levels of obesity globally^{1,112-114}. Encouragingly, the frequency of arthroscopies for knee osteoarthritis in Australia have almost halved from 2011 to 2017¹¹⁵. This decrease is likely driven by guidelines recommending against their use^{41,116-118} following research indicating the limited effectiveness of arthroscopies compared to sham surgery¹¹⁹, and decreased cost-effectiveness compared to first-line care¹²⁰. Nonetheless, over 13,000 knee arthroscopies occurred in 2019, with an estimated cost to the Australian healthcare system of just over AU\$49 million (based upon Medicare Benefits Schedule (MBS) data available at www.mbsonline.gov.au).

Improved understanding of the pathogenesis and treatment of knee osteoarthritis has led to a greater emphasis being placed on exercise-based, diet and lifestyle interventions to manage and prevent osteoarthritis¹²¹. For example, physical inactivity and obesity are modifiable risk factors for knee osteoarthritis development^{22,46}, with physical activity promotion and weight management recommended as first-line care in all clinical practice guidelines^{41,116-118}. It is estimated that reducing population-level obesity by 1-5% in Australia could substantially reduce the number of knee replacements, resulting in up to AU\$170 million saved in direct healthcare costs annually¹¹⁰.

1.1.6 Understanding the condition summary

The pathogenesis of knee osteoarthritis is highly complex and has dual relationships with multiple chronic health conditions and comorbidities. Several factors that are associated with the development and progression of knee osteoarthritis are modifiable, offering hope for interventions to reduce the burden at an individual and societal level. However, the lived experience of knee osteoarthritis is dominated by pain, confusion and misconceptions about the condition which may act as barriers to engagement with treatment.

1.2 Treatments for knee osteoarthritis

Despite slight discrepancies in terminology, clinical practice guidelines usually categorise treatments for knee osteoarthritis into first-line, second-line and third-line care (Figure 1.1)^{41,116-118}. First-line care consists of patient education, lifestyle modifications, self-management, exercise therapy, and weight management as appropriate. These interventions are suitable for all people with knee osteoarthritis, regardless of age, sex, osteoarthritis severity or comorbidities⁴¹. Second-line care includes pharmacotherapies (oral, topical and injections), nutraceuticals, physical therapies, orthoses, footwear and bracing. Third-line care consists of invasive interventions (i.e., surgery). The rest of Section 1.2 provides detailed summaries of each line of care, with Section 1.3 exploring how treatments are currently being provided in ‘real world’ clinical practice for people with knee osteoarthritis. Section 1.4 explores patient education in detail.

Tiers of treatment for knee osteoarthritis

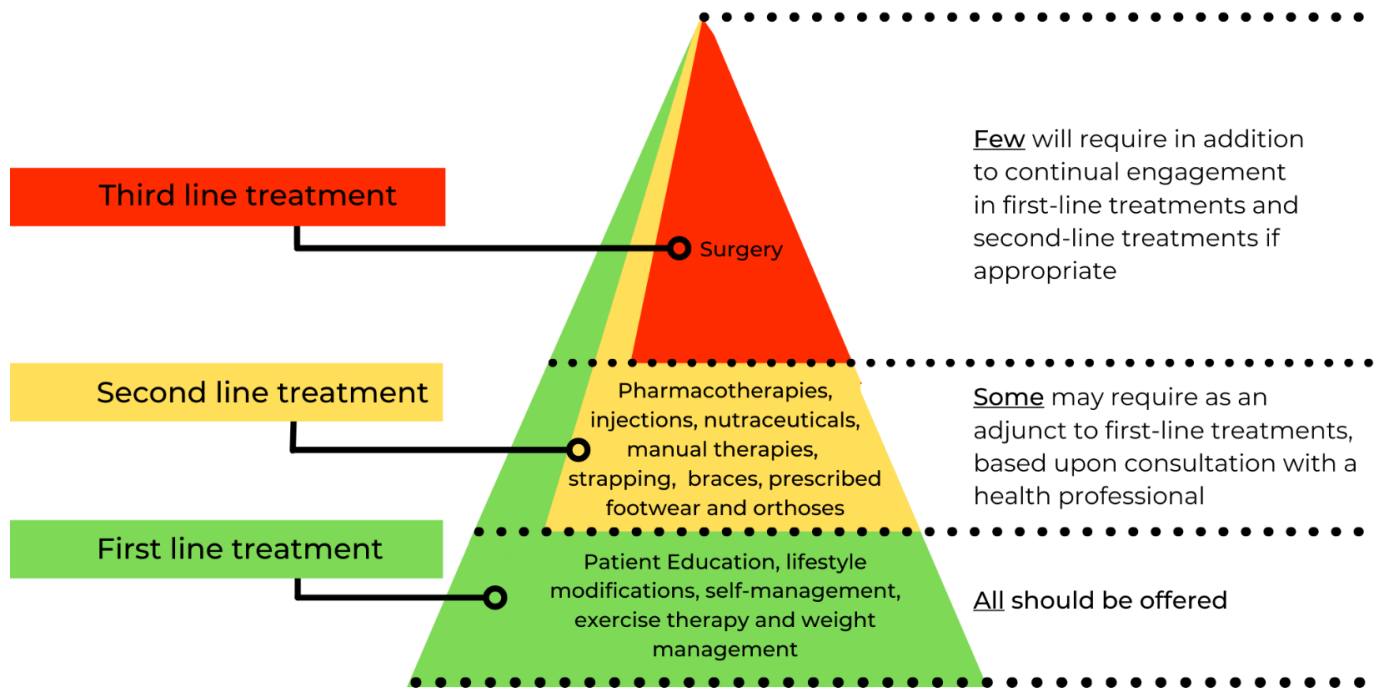


Figure 1.1 First-, second- and third-line care for people with knee osteoarthritis. Adapted from Roos and Jull 2012¹²².

1.2.1 First-line treatments

1.2.1.1 Patient education, lifestyle modifications and self-management

Patient education, lifestyle modifications and self-management are interlinked, with these terms often used interchangeably in research evaluating treatments for chronic health conditions, including osteoarthritis^{41,116-118,123}. Patient education aims to develop or expand the patient's knowledge about the condition and its treatment options. It can also include building coping and self-management skills through behaviour change in order to improve a patient's overall health

and their ability to live with or manage a condition^{123,124}. Patient education is recommended as first-line care in all major clinical practice guidelines^{41,116,118,125}, and an in-depth exploration of patient education is provided in Section 1.4 of this chapter.

1.2.1.2 Exercise therapy

Exercise therapy is a form of physical activity that is planned, structured, repetitive and aims to target one or more components of fitness¹²⁶. All major clinical practice guidelines for people with knee osteoarthritis recommend exercise therapy as a first-line treatment due to its effectiveness for knee osteoarthritis-specific outcomes^{41,116-118}. High-quality meta-analyses¹²⁷⁻¹³¹ consistently conclude that exercise therapy interventions improve pain (Effect Size (ES) 0.50, 95% CI 0.37 to 0.63¹²⁷) and function (ES 0.50, 95% CI 0.38 to 0.63¹³⁰) compared to usual care for people with knee osteoarthritis. Additionally, exercise therapy improves quality of life^{129,132}, self-efficacy and depression¹²⁹ for people with knee osteoarthritis when compared to non-exercise interventions.

There are many variables to consider when prescribing exercise therapy, including type (i.e., aerobic, resistance and aquatic forms of exercise), format (group or individual), level of supervision, commonly manipulated acute program variables (i.e., sets, reps, intensity, etc.) and dose (number of sessions, frequency, program duration)¹³³. Consequently, directly comparing exercise therapy interventions is challenging, especially given the poor reporting of interventions, including acute program variables, in clinical research¹³⁴. Generally, guidelines recommend land-based exercise therapy over aquatic exercise therapy, but do not recommend one form of land-based exercise therapy over another^{41,116-118}. It is common for guidelines to

recommend a combination of resistance and aerobic exercise^{41,116-118}, although Tai Chi, a specific form of balance and resistance exercise, is strongly recommended in the Royal Australian College of General Practitioners (RACGP) guidelines¹³⁵. For resistance exercise, both high-intensity, and low-intensity, variations are effective at reducing pain for people with knee osteoarthritis¹³⁶.

There are very few recommendations in guidelines for how to implement exercise therapy^{41,116-118}. This limitation is consistent with, and has been a criticism of, guidelines for many musculoskeletal conditions^{137,138}. Evidence indicates that 12 or more supervised exercise sessions are more effective than fewer sessions for improving pain (ES 0.46, 95% CI 0.32 to 0.60 vs ES 0.28, 95% CI 0.16 to 0.40) and function (ES 0.45, 95% CI 0.29 to 0.62 vs ES 0.23, 95% CI 0.09 to 0.37) for people with knee osteoarthritis^{128,139}. Expert opinion¹⁴⁰ supports these findings, recommending a minimum of 12 supervised exercise sessions of 30 to 60 minutes per session over a six-week period (i.e., two sessions per week). An additional one to two sessions per week, and extension of the exercise therapy program to 12 weeks or longer may also improve outcomes, especially where increasing muscle strength is a goal¹⁴⁰.

Numerous physiological and psychological mechanisms may explain the positive benefit of exercise for people with knee osteoarthritis¹⁴¹. In people with¹⁴² and without¹⁴³ knee osteoarthritis, exercise usually results in an immediate reduction in pain (hypoalgesia). Reduced pain is thought to occur via a number of mechanisms, including the release of endorphins and opioids, and central changes to pain processing through physiological and psychological mechanisms¹⁴⁴. However, exercise-induced hypoalgesia is often short-lived, lasting

approximately 30 minutes¹⁴³. Therefore, this mechanism cannot fully explain the range of positive outcomes that occur with exercise therapy in people with knee osteoarthritis. Recent research among people with chronic health conditions has focused on the role of exercise in reducing low-grade inflammation which, considering its role in the pathogenesis of the condition, may help explain the improvements in pain for people with knee osteoarthritis^{139,145,146}. Exercise therapy also has the potential to improve psychosocial health, including reducing helplessness and depression and increasing coping, self-efficacy and social function^{129,141}. These factors may also contribute towards the reduction in pain for an individual with knee osteoarthritis when considered from a biopsychosocial perspective^{31,78,147}.

Appropriately targeted exercise therapy is known to improve strength in people with knee osteoarthritis^{131,148}, with improvements in quadriceps strength appearing to be particularly important for improvements in function¹⁴⁹. Functional improvements following exercise therapy are likely due to a combination of factors including improved strength, neuromuscular control, fitness (both muscular and aerobic) and local tissue capacity, alongside reduced pain and fear of movement^{131,140,141}. Targeted exercise therapy can also improve balance and reduce risk of falls^{150,151} for people with knee osteoarthritis and has the potential to improve cartilage health and tissue capacity¹⁵². Cartilage is sensitive to mechanical load¹⁵³, with mechanical load being an essential component to joint homeostasis¹⁵⁴. It is believed that the mechanical loading that occurs as a result of exercise therapy increases proteoglycan synthesis, which improves cartilage health and prevents or decreases joint degeneration¹⁵³.

1.2.1.3 Weight management

As explored in Section 1.1, obesity shares similar inflammatory processes with knee osteoarthritis, and is a key modifiable risk factor for its development and progression³⁰. Weight management refers to either achieving a healthy weight if an individual is overweight or obese and/or maintaining a healthy weight for all people with knee osteoarthritis. For people who are overweight or obese, a 5-10% reduction in body weight can significantly reduce knee osteoarthritis pain (ES 0.33, 95% CI 0.17 to 0.48), plus improve function (ES 0.42, 95% CI 0.25 to 0.59) and quality of life (ES 0.39, 95% CI 0.24 to 0.54)^{67,155,156}. A reduction in body weight is associated a reduced risk of undergoing a total knee replacement¹⁵⁷, along with many positive changes to general physical and mental health, such as increased function and quality of life and reduced depression^{67,147,158,159}.

Weight loss is usually achieved through dietary and exercise interventions, with combined interventions being more effective than diet-only interventions^{160,161}. Although meal replacement options exist to support weight loss¹⁶², most weight loss programs focus on patient education, behaviour change techniques and exercise or physical activity to facilitate gradual weight reduction over time¹⁶⁰. Presently, there is insufficient evidence to recommend one diet type over another; although, greater adherence to a Mediterranean diet has been associated with improvements in function and quality of life^{163,164}. Bariatric surgery is another treatment option that may be suitable for some people with knee osteoarthritis, especially younger individuals with no prior knee injury^{165,166}. Bariatric surgery is effective for maintaining an average weight loss of 22.3%, and is associated with a 25% improvement in pain at five-year follow-up¹⁶⁶. Despite the effectiveness of surgery, clinical practice guidelines do not provide recommendations

for bariatric surgery, and advocate weight loss through education, exercise therapy and diet^{41,116,118,125}.

Current clinical practice guidelines for the non-surgical management of knee osteoarthritis do not provide detailed recommendations for how to achieve weight loss. However, all guidelines recommend combining weight loss with education and exercise therapy^{41,116-118}. The European Alliance of Associations for Rheumatology¹¹⁶ (EULAR) guidelines provide the most thorough recommendations with examples of information or techniques that may assist with weight loss (see Box 1.1). The National Institute of Health and Care Excellence (NICE) guidelines for people with knee osteoarthritis⁴¹ provide specific guidelines for obesity¹⁶⁷; although, these guidelines are primarily for the prevention of obesity and are not specific to people with knee osteoarthritis.

Box 1.1 EULAR weight loss recommendations

Education on weight loss should incorporate individualised strategies that are recognised to effect successful weight loss and maintenance—for example:

- Regular self-monitoring, recording monthly weight
- Regular support meetings to review/discuss progress
- Increase physical activity
- Follow a structured meal plan that starts with breakfast
- Reduce fat (especially saturated) intake; reduce sugar; limit salt; increase intake of fruit and vegetables (at least ‘5 portions’ a day)
- Limit portion size
- Address eating behaviours and triggers to eating (e.g., stress)
- Nutrition education
- Relapse prediction and management (e.g., with alternative coping strategies)

As weight loss programs for people with knee osteoarthritis often involve exercise or physical activity, it is challenging to determine whether improvements in pain and function are due to weight loss alone, exercise/physical activity alone, or a combination of both^{67,161}. Regardless, the mechanisms by which weight management may help people with knee osteoarthritis are likely

multifactorial^{30,168}. There is insufficient evidence to suggest that a reduction in body weight causes direct changes to the cartilage¹⁶⁹. However, a reduction in body weight lowers peak knee compressive forces which may, in turn, may influence nociception¹⁷⁰. A reduction in adipose tissue associated with reduced body weight may reduce systemic inflammation^{30,158}. In people with knee osteoarthritis, reduced body weight is reported to reduce pro-inflammatory cytokines (i.e., Interleukin 6 [Il-6]), which are known to be involved in the development and progression of the condition^{168,170}. A reduction in body weight is also associated with many positive changes to general physical and mental health that may also contribute to improvements in pain and function for people with knee osteoarthritis when viewed from a biopsychosocial perspective^{31,147,158}.

1.2.2 Second-line treatments

Guideline-recommended second-line treatments for people with knee osteoarthritis include pharmacotherapies (oral, topical and injections), nutraceuticals, physical therapies, prescribed footwear, orthoses and braces^{41,116-118,125}. These treatment options are often referred to as adjuncts and should be used in addition to, and not replace, first-line care^{41,116-118,125}. The remainder of this sub-section provides an overview of the evidence for second-line treatment options for people with knee osteoarthritis.

1.2.1.1 Pharmacotherapies (oral and topical)

Currently, there are no pharmacotherapies with proven effectiveness to directly influence the pathogenesis of osteoarthritis, and most medications are proposed to control symptoms¹⁷¹. Medications are only recommended as a short-term option to support first-line care due to the

limited efficacy and potential complications of use^{41,125}. Although multiple pharmacotherapies are recommended within clinical practice guidelines, recommendations have become more cautious over time and are occasionally conflicting between guidelines¹⁷².

Paracetamol (also known as acetaminophen and Tylenol) was previously recommended as a first-line treatment for knee osteoarthritis, and is the most commonly prescribed analgesia by general practitioners in Australia¹⁷³. However, the latest Cochrane review identified that paracetamol results in a 5% improvement in pain and 3% improvement in function compared to placebo, falling short of the minimum clinically important differences (MCIDs)¹⁷⁴. Conflicting recommendations exist within guidelines. The American College of Rheumatology (ACR) guidelines conditionally recommend the use of paracetamol¹¹⁸, the NICE guidelines recommend paracetamol prior to oral non-steroidal anti-inflammatories (NSAIDs) and the RACGP⁴² guidelines provide a neutral recommendation but state that it may be reasonable to trial paracetamol. However, OARSI¹²⁵ guidelines conditionally recommend against the use of paracetamol for people with knee osteoarthritis due to its limited effectiveness and emerging evidence of safety concerns including hepatotoxicity and gastrointestinal issues^{175,176}.

NSAIDs are reported to reduce pain more than paracetamol (ES 0.24, 95% CI 0.08-0.39 vs ES 0.18, 95% CI 0.11 to 0.25)¹¹⁷. However, NSAIDs are not appropriate or recommended for long-term use in the majority of people with knee osteoarthritis due to comorbidities and risks of adverse events¹⁷⁷. Topical NSAIDs (e.g., diclofenac) are another pharmacological option recommended in multiple guidelines for people with knee osteoarthritis^{41,117,118}. The advantage of topical NSAIDs is that they are associated with fewer adverse events than paracetamol and

oral NSAIDs¹⁷⁸. Additionally, they are moderately effective at reducing pain (ES 0.37, 95% CI 0.240 to 0.49) and improving function (ES 0.35, 95% CI 0.268 to 0.49) compared to placebo at the end of treatment¹⁷⁹, and are more effective than paracetamol at reducing pain at four weeks (ES -0.29, 95% CI -0.52 to -0.06)¹⁷⁸. All guidelines recommend both oral and topical NSAIDs for some people with knee osteoarthritis, however the strength of recommendation varies^{41,118,125}. Additionally, NICE⁴¹ guidelines recommend providing topical NSAIDs before the use of oral NSAIDs due to their lower risk of adverse events.

Opioids are powerful pain killers and are prescribed to over one in six people with knee osteoarthritis in Australia¹⁷³. Despite providing small short-term improvements in pain¹⁸⁰, a recent high-quality network meta-analysis advised against their use due to the harms outweighing any potential benefits for symptoms¹⁷⁷. The harms include increased frequency of dizziness and risks of falls and fractures compared to NSAIDs¹⁸¹, plus the general harms associated with opioids such as addiction, overdose and death¹⁸². Conflicting recommendations exist within the guidelines. The ACR guidelines conditionally recommend the short-term use of tramadol-based opioids for people who may have contraindications to NSAIDs or have no surgical options available, but conditionally recommend against the use of non-tramadol-based opioids due to the modest benefits and increased risk of dependence¹¹⁸. The NICE⁴¹ guidelines recommend considering opioids if there is insufficient pain relief from paracetamol or NSAIDs, but highlight the need to consider the risks versus benefits. The OARSI¹²⁵ and RACGP⁴² guidelines strongly recommend against their use due to concerns about dependency and adverse events.

In summary, various pharmacotherapy options exist that may reduce or help to control symptoms for people with knee osteoarthritis. Guidelines have typically reduced the strength of recommendations for pharmacotherapies over time, and currently offer multiple conflicting recommendations for their use. The exception to this is the consistent recommendation of both oral and topical NSAIDs by all guidelines, with caution or contradictions for those with comorbidities. It is important to note that pharmacotherapies should be used in conjunction with, rather than instead of, first-line care, and the potential harms must be considered alongside any potential benefit when deciding on their use for people with knee osteoarthritis. However, a limitation of this recommendation is that many pharmacotherapy options are available over the counter, and therefore may be being used inappropriately by people with knee osteoarthritis if not guided by health professionals.

1.2.2.2 Pharmacotherapy injections

Numerous pharmacotherapy injection options exist for knee osteoarthritis, including corticosteroids, hyaluronic acid, platelet-rich plasma and stem cells¹⁸³. Corticosteroid injections are powerful anti-inflammatories that have been provided for people with knee osteoarthritis in an attempt to reduce their pain¹⁸⁴. However, in the short-term they only provide moderate improvements in pain compared to placebo injections (ES -0.40, 95% CI -0.58 to -0.22)¹⁸⁵ and are comparable to controls (including hyaluronic acid, saline and intra-articular NSAIDs) for function (ES -1.02, 95% CI -2.14 to 0.10)¹⁸⁶. Further, the improvements in pain only represent a 1cm difference between groups on a 1-10cm Visual Analogue Scale (VAS), failing to reach the MCID¹⁸⁵. At 1 year, corticosteroid injections are inferior to first-line care for improvements in pain, function and stiffness using the Western Ontario and Mac Master Universities osteoarthritis

index (WOMAC)¹⁸⁷. Additionally corticosteroid injections may even accelerate the pathogenesis of osteoarthritis¹⁸⁸ and have been associated with an increased risk of total knee replacement¹⁸⁹. Combined, these findings indicate that corticosteroid injections have limited benefit, and are associated with potential harm. Despite this, the ACR¹¹⁸, NICE⁴¹, OARSI¹²⁵ and RACGP⁴² guidelines conditionally recommend their use for people with knee osteoarthritis who do not have any comorbidities. Health professionals need to consider the moderate effect of corticosteroid injections have on pain alongside this risk and cost when deciding whether this is an appropriate intervention.

Intra-articular injections of hyaluronic acid attempt to restore synovial fluid viscosity and concentration¹⁹⁰, and are proposed to be anti-inflammatory in nature¹⁹¹. Hyaluronic acid injections appear to provide moderate improvements in pain compared to placebo injections at eight weeks (ES 0.46, 95% CI 0.28 0.65). However, improvements reduce significantly at 24 weeks (ES 0.21, 95% CI 0.10 to 0.31)¹⁹². Administration of hyaluronic acid injections is associated with increased risk of non-serious, transient local reactions compared to placebo (risk ratio (RR) 1.21, 95% CI 1.07 to 1.36). Health professionals need to consider the small-moderate effect of hyaluronic acid injections have on pain alongside this risk and cost when deciding whether this is an appropriate intervention. Conflicting recommendations exist in clinical practice guidelines. The ACR¹¹⁸, NICE⁴¹ and RACGP⁴² guidelines conditionally recommend against the use of hyaluronic acid injections, citing a high risk of bias from included studies and comparable longer-term effects relative to placebo. However, the OARSI¹²⁵ guidelines conditionally recommend their use for short-term pain relief for people with knee osteoarthritis.

Platelet-rich plasma injections are proposed to have a regenerative effect on body tissues which may restore homeostasis¹⁹³. However, current evidence indicates these injections have no effect on cartilage volume compared to placebo injections at 12 months (MD -0.20 , 95% CI -1.90 to 1.50)¹⁹⁴. Conflicting evidence exists for their effectiveness on pain and function outcomes for people with knee osteoarthritis. Improvements have been reported for pain at 6 and 12 months (ES 0.38 , 95% CI -2.04 to -0.55 and ES 0.47 , 95% CI -2.52 to -0.69 , respectively), and function at 6 months (ES 0.362 , 95% CI -1.366 to 0.052), compared to hyaluronic acid¹⁹⁵. However, these injections are not superior for pain outcomes compared to a placebo injection at 12 months (Mean Difference (MD) -0.40 , 95% CI -0.90 to 0.20)¹⁹⁴, which fails to reach MCID¹⁹⁶. The ACR¹¹⁸, NICE⁴¹ and OARSI¹²⁵ guidelines are unanimous in recommending against the use of platelet-rich plasma injections, citing low-quality evidence and a lack of standardisation of technique, whereas the RACGP⁴² guidelines conditionally (neutral) recommend their use.

Interest in stem cell injections for people with knee osteoarthritis has grown rapidly over the past decade¹⁹⁷. Some long-term evidence from meta-analyses supports their effectiveness for improving pain, function and cartilage volume either in addition to a high tibial osteotomy or in comparison to hyaluronic acid^{198,199}. However, high risk of bias, heterogeneity and a paucity of randomised-controlled trials reduces the certainty of these findings. Presently, all major clinical practice guidelines recommend against the use of stem cells for people with knee osteoarthritis^{41,42,116-118}. The NICE⁴¹ guidelines recommend against their use as the procedure is not licensed within the United Kingdom. However, other guidelines (e.g., RACGP guidelines in Australia) recommend against providing stem cell injections to people with knee osteoarthritis

due to insufficient high-quality research and cite uncertainty in terms of safety, optimal procedure and technique^{42,116-118}.

In summary, although various pharmacotherapy injection options exist for knee osteoarthritis, there does not appear to be a particular option that clearly outperforms control interventions, especially in the longer term. Clinical practice guidelines offer inconsistent recommendations for their use. This may be based upon best available evidence at the time of their development or the bias of panels developing the guidelines.

1.2.2.3 Nutraceuticals

There is a lack of international consensus on the definition of what constitutes a ‘nutraceutical’ intervention, and the term often gets used interchangeably with ‘dietary supplements’^{200,201}.

Broadly speaking, nutraceuticals are substances that may be considered foods, or parts of foods, that are taken by an individual for medical or health benefits²⁰². The most commonly investigated nutraceutical options for people with knee osteoarthritis include glucosamine and chondroitin²⁰¹. These are compounds extracted from animal products that are considered to improve cartilage synthesis²⁰³. Analyses of pre-clinical studies indicate that they have little effect upon osteoarthritis development²⁰⁴. Many randomised controlled trials report improvements in pain and/or function in the short-, medium- and long-term, but improvements fail to reach MCIDs²⁰¹. Consequently, the latest ACR¹¹⁸, NICE⁴¹ and OARSI¹²⁵ guidelines for people with knee osteoarthritis recommend against their use.

Omega-3 supplements are reported to be used by up to one-third of people with knee osteoarthritis in Australia²⁰⁵. These nutraceuticals are proposed to be anti-inflammatory in nature and may reduce the progression of knee osteoarthritis²⁰⁶. Despite their widespread use, Omega-3 nutraceuticals are conditionally recommended against, and strongly recommended against, in the most recent ACR¹¹⁸ and OARSI¹²⁵ guidelines, respectively. Guidelines state insufficient evidence to support the use of Omega-3 nutraceuticals as the rationale for these recommendations, as opposed to specific safety concerns^{118,125}. Other relatively common nutraceutical options for people with knee osteoarthritis include *Boswellia serrata* extract, Pycnogenol and curcumin²⁰¹. Broadly speaking, these nutraceuticals are proposed to target inflammatory responses within the body in an attempt to control symptoms²⁰⁷⁻²⁰⁹. Randomised controlled trials have identified that *Boswellia serrata* extract, Pycnogenol and curcumin result in larger and clinically important short-term improvements in pain and function when compared to placebo²⁰¹. However, these findings are based on low-certainty evidence from studies that are often sponsored by pharmaceutical companies, leading to inconclusive recommendations within the clinical practice guidelines^{41,116-118,125}.

In summary, the most widely researched and used nutraceuticals for people with knee osteoarthritis, including glucosamine and chondroitin, have little effect on pain or function compared to placebo. Less common nutraceuticals such as *Boswellia serrata* extract, Pycnogenol and curcumin show promise for improving pain or function, however further research is required.

1.2.2.4 Manual therapies

Manual therapies, including massage, mobilisation and manipulation, are commonly provided by physiotherapists and other allied health professionals in Australia^{210,211}. Manual therapies are beneficial for improvements in pain (ES -0.61, 95% CI -0.95 to -0.28) and stiffness (ES -0.58, 95% CI -0.95 – -0.21) compared to controls (including acupuncture, usual care and pharmacological interventions)²¹². However, the mechanisms for improvements are complex and still not fully understood, and may include local, central and placebo phenomena that influence an individual's perception of pain²¹³⁻²¹⁷. Manual therapies have been proposed to enhance self-efficacy for movement, and/or to help build a strong therapeutic alliance in which to encourage first-line care^{213,215}. Current evidence indicates that combining manual therapies with exercise therapy is superior for improvements in total WOMAC score at one year compared to exercise therapy alone (MD, -37.5, 95% CI: -69.7 to -5.5)²¹⁸. However, manual therapies are less cost-effective over a two year period when compared to usual care²¹⁹.

Guidelines provide inconsistent recommendations related to the use of manual therapies for people with knee osteoarthritis. The NICE⁴¹, RACGP⁴² and OARSI¹²⁵ guidelines advocate the use of manual therapies as second-line treatment options for people with knee osteoarthritis, although the OARSI guidelines strongly recommend against the use of massage stating a lack of evidence. The ACR¹¹⁸ guidelines conditionally recommend against the use of manual therapies due to their limited effect compared to exercise therapy, while the EULAR¹¹⁶ guidelines do not provide any recommendations due to insufficient evidence. In summary, manual therapies may help to improve pain and function for people with knee osteoarthritis and may be a useful adjunct

to first-line care in the short-term, although mechanisms underlying changes to symptoms are not well understood.

1.2.2.5 Taping

Taping is another passive treatment modality that can be used by health professionals²²⁰. Broadly speaking, there is a choice of rigid taping (e.g. Leukotape)^{221,222} or elastic taping (e.g., Kinesio taping)²²³. Rigid taping is often used in an attempt to alter alignment of the patellofemoral joint to unload tissues and to improve pain and function²²¹. The rationale for use of elastic taping is somewhat more complex with proposed mechanisms spanning from ‘Gate control of pain’, improved lymphatic drainage and improved circulation²²⁴. Rigid tape appears to provide superior improvements in pain (WOMAC pain subscale MD 2.1, 95% CI 0.5 to 3.6) and function (WOMAC function subscale MD 4.7, 95 % CI 0.6 to 8.9) at 6 weeks compared to no tape, but does not outperform sham tape for improvements in pain (WOMAC pain subscale MD 0.0, 95% CI –2.0 to 1.8) or function (WOMAC function subscale MD –2.0, 95% CI –6.7 to 2.8) at 6 weeks²²². Elastic taping can improve pain upon activity at 4 weeks compared to sham taping (VAS MD –1.72, 95% CI –2.94, –0.51), but produces similar outcomes for overall WOMAC score including pain, stiffness and function (WOMAC total MD 0.67, 95% CI –1.99, 3.35).

Conflicting recommendations exist within guidelines. ACR¹¹⁸ guidelines conditionally recommend the use of elastic taping for people with knee osteoarthritis but do not provide a recommendation for rigid taping. RACGP guidelines⁴² conditionally recommend against the use of elastic taping citing no benefit to pain or function and provide a neutral recommendation for rigid taping. OARSI¹²⁵ guidelines recommend against the use of both rigid and elastic taping

stating no efficacy, and EULAR¹¹⁶ and NICE⁴¹ guidelines offer no recommendations for or against use of either type of taping. Challenges associated with trials involving taping include the varying styles and type of application which may be an influencing factor in the inconsistent guideline recommendations²²⁵.

1.2.2.6 Bracing

Rigid tibiofemoral²²⁶⁻²²⁸ and patellofemoral²²⁹ braces are adjunct treatment options for people with knee osteoarthritis. Tibiofemoral braces (for example valgus unloader braces) attempt to improve pain and function for people with knee osteoarthritis by altering mechanics at the knee joint and redistribute loads away from the medial compartment^{227,230}. Tibiofemoral braces are reported to produce large improvements in pain (ES 0.56, 95% CI 0.03 to 1.09) and moderate improvements in function (ES 0.48, 95% CI 0.02 to 0.95) compared to no braces, with these differences exceeding MCIDs²²⁶. However, when compared against sham braces, tibiofemoral knee braces result in moderate, clinically insignificant improvements in pain (ES 0.33, 95% CI 0.08 to 0.58) and no difference in function (SMD 0.19, 95% CI -0.03 to 0.42)²²⁶.

Patellofemoral braces are believed to press the patella into the trochlear groove, creating a greater contact area at the patellofemoral joint in which to re-distribute loads^{229,231}. The latest pooled analysis for patellofemoral braces for people with patellofemoral osteoarthritis identified no overall benefit compared to controls for pain (ES -0.18, 95% CI -0.67 to 0.32)²³². However, one of the trials included in the meta-analysis demonstrated that patellofemoral braces improve short-term pain (knee osteoarthritis outcome score [KOOS] pain subscale MD 5.7, 95% CI 0.6 to 10.8) and function (KOOS activities of daily living [ADL] subscale MD 4.5, 95% CI 0.5 to 8.5)

compared to no brace²²⁹. Whereas the second included trial identified that patellofemoral braces produced similar outcomes compared to a sham brace for improvements in WOMAC pain (ES -0.11, 95%CI -0.66 to 0.88) or function (-0.02, 95% CI: -2.83 to 2.79)²³³.

Soft braces (knee sleeves) are also a treatment option for people with knee osteoarthritis with evidence indicating immediate improvements in pain (ES 0.52, 95% CI 0.14 to 0.89) compared to no brace and prolonged improvements in pain (ES 0.61, 95% CI 0.33 to 0.89) and function (ES 0.39, 95% CI 0.11 to 0.67) compared to usual care²³⁴. However, inherent issues with all trials investigating different types of braces for people with knee osteoarthritis include lack of blinding and heterogeneity in how they are used (e.g., how long they are used for). Additionally, further research is warranted to investigate how braces are best incorporated into multimodal treatments plans rather than being used as a stand-alone modality.

Guidelines provide inconsistent recommendations about the use of braces for people with knee osteoarthritis. The ACR¹¹⁸ guidelines strongly and conditionally recommend the use of bracing depending on whether the osteoarthritis is primarily located at the tibiofemoral or patellofemoral joints, respectively. The NICE⁴¹ guidelines recommend use of braces if an individual has biomechanical knee pain or reports instability, however they do not specify which type of brace. The OARSI¹²⁵ and RACGP⁴² guidelines recommend against the use of both fixed and soft braces for people with knee osteoarthritis stating no efficacy and low-quality evidence. The conflicting evidence and guideline recommendations may be a consequence of the differing types of braces available and their inconsistent use in trials.

1.2.2.7 Prescribed footwear and orthoses

Different footwear types and orthoses can alter knee mechanics, for example knee adduction angles^{235,236}. As with tibiofemoral joint braces, prescribed footwear and orthoses attempt to redistribute loads away from the medial compartment of the knee²³⁷. However, it is not clear whether prescribed footwear or orthoses lead to meaningful changes in pain or function compared to other interventions for people with knee osteoarthritis^{238,239}. For example, although medium-term improvements are noted with the use of unloading (i.e., laterally wedged), improvements in pain (numerical rating score [NRS] MD 0.00 95% CI -0.90 to 0.80) and function (WOMAC function subscale, MD 0.30, 95% CI -3.20 to 3.70) are comparable to prescribed neutral footwear²⁴⁰. Similarly, lateral wedge insoles produce comparable improvements in pain (KOOS pain subscale MD -1.84, 95% CI -6.31 to 2.62) and function (KOOS ADL subscale MD -1.28 95% CI -5.19 to 2.62) compared to sham (neutral) insoles at 24 weeks²⁴¹.

Guidelines provide inconsistent recommendations. OARSI¹²⁵ guidelines recommending against prescribed footwear and ACR¹¹⁸ guidelines conditionally recommending against prescribed footwear and insoles stating no efficacy and low-quality evidence. The NICE⁴¹ and EULAR¹¹⁶ guidelines recommend wearing comfortable, supportive, shock-absorbing shoes but do not provide any recommendations about prescribed footwear or insoles^{41,116}. Considering three out of four people with knee osteoarthritis believe their symptoms are influenced by footwear²⁴², future studies are warranted to investigate effectiveness further, and efforts are needed to improve the consistency of guideline recommendations.

1.2.3 Third-line treatments

Surgical options for knee osteoarthritis are considered third-line treatments, and can include total knee replacement, partial knee replacement, high tibial osteotomy and knee arthroscopy. Clinical practice guidelines for people with knee osteoarthritis recommend considering surgical options only after first- and second-line interventions have been exhausted^{41,116-118}. Local (RACGP⁴²) and international (NICE⁴¹) guidelines state that surgery should only be considered if there is also a significant decline in function in people with end-stage knee osteoarthritis. In this instance, significant decline in function is characterised as significant joint pain, swelling and deformity that disrupts normal sleep patterns, causes a severe reduction in walking distance such that the individual becomes housebound and avoids ambulation outside, and results in marked restriction of activities of daily living (e.g., rising from a chair or toilet seat, difficulty with climbing stairs)²⁴³.

Beyond the broad guidance stated above, no criteria exists for who, or when, an individual with knee osteoarthritis may be a suitable candidate for surgery²⁴⁴. This may be, in part, due to the importance placed upon shared decision-making in the guidelines for people with knee osteoarthritis^{41,42,116-118,245}. For example, both the NICE⁴¹ and American Academy of Orthopaedic Surgeons (AAOS)²⁴⁵ guidelines advocate providing information about the benefits and risks of surgery to people with knee osteoarthritis, emphasising that the decision regarding surgery should be a collaborative one between the patient and health professional. Therefore, it is important that people with knee osteoarthritis who are considering surgery be provided with enough information to make an informed decision. However, there is no clear guidance as to

‘what’ information should be provided, or ‘how’ it should be provided, to facilitate informed decision-making.

1.2.3.1 Total knee replacement

Total knee replacements are the most common surgical intervention for knee osteoarthritis, with over 55,000 performed in Australia in 2018¹¹⁰. This procedure can significantly improve pain and function outcomes above the MCID, in addition to improving quality of life compared to non-surgical multimodal programs²⁴⁶⁻²⁴⁸. However, approximately 20% of people who receive a knee replacement report ongoing pain and dissatisfaction with their outcome²⁴⁹. Skou et al.²⁴⁷ performed a high-quality randomised controlled trial comparing a knee replacement in addition to first-line care to first-line care alone. Both groups demonstrated clinically important improvements in pain and function at 12 months measured by the KOOS. However, combining surgery with first-line care was associated with greater improvements in pain (Mean improvement (MI) 16.0, 95% CI 10.1 to 21.9 vs 32.5, 95% CI 26.6 to 38.3) and function (MI 17.6, 95% CI 11.4 to 23.9 vs 30.0, 95% CI 22.7 to 37.2) compared to first-line care alone. It is important to consider that combining total knee replacement surgery with first-line care is less cost-effective for people with mild to moderate osteoarthritis at 2 years compared to first-line care alone^{248,250}, and that up to 47% of people undergoing a total knee replacement experience at least one adverse event within 90 days²⁵¹. Most commonly, adverse events include prolonged pain or swelling, revision, infection neuralgia and deep vein thrombosis (DVT)²⁵¹.

1.2.3.2 Partial knee replacement

Partial knee replacement surgery is another treatment option for people with knee osteoarthritis^{244,252}, accounting for 6.1% of all knee replacements in Australia in 2019¹¹¹. There is much debate about when to choose a partial or total knee replacement. The decision appears to be most influenced by surgeon preference and/or the presence of perceived end-stage osteoarthritis in only one compartment of the knee, typically medial^{252,253}. The proposed benefits of partial knee replacements are that they are reported to produce greater improvements in pain and function, and are less invasive, associated with a shorter hospital stay, and more cost-effective compared to total knee replacements^{244,254,255}. However, 5-year outcomes indicate that partial knee replacements result in comparable improvements in pain (ES 1.04 95% CI -0.42 to 2.50) and function (ES 0.37, 95% CI -3.81 to 4.55)²⁵⁶, and are associated with an increased risk of revision surgery²⁵⁴, compared to total knee replacements²⁵⁴. Therefore, partial knee replacements may not be a viable long-term solution for people with knee osteoarthritis.

1.2.3.3 High tibial osteotomy

High tibial osteotomy is another surgical option for unicompartmental osteoarthritis that is generally viewed as most appropriate for younger people who have an angular deformity of the knee^{253,257}. The proposed primary advantages of high tibial osteotomy over partial knee replacement are that it can transfer load to the relatively unaffected compartment using a less invasive procedure, and that it can delay the need for a knee replacement²⁵⁸. High tibial osteotomy surgery is associated with superior outcomes for range of movement compared to partial knee replacement (ES -0.85, 95% CI -1.43 to -0.27), but it has similar function outcomes (MD -4.03, 95% CI -9.91 to 1.85) and an increased revision rate (odds ratio (OR) 0.52, 95% CI

0.30-0.90)²⁵⁹. The latest AAOS guidelines for non-replacement surgery²⁴⁵ advocate considering high tibial osteotomy to improve pain and function, but cite that generally low certainty of evidence informs this recommendation.

1.2.3.4 Arthroscopy

Knee arthroscopy was a common form of surgery for people with knee osteoarthritis, peaking at over 70,000 procedures per year in Australia in 2011^{115,260}. This surgery was originally performed in an attempt to improve symptoms by reducing synovitis and eliminating mechanical interference with joint motion²⁶¹. However, these procedures are now only recommended for people with knee osteoarthritis if there is mechanical locking of the knee joint⁴² due to absence of efficacy²⁶². High quality randomised controlled trials indicate that arthroscopy results in only 1-2% improvements in pain compared to sham surgery at one and two years post-surgery¹¹⁹, and improvements at one year are comparable to receiving physical therapy only (patient education and supervised exercise therapy)²⁶¹. Encouragingly, arthroscopy rates are decreasing worldwide due to comparable effectiveness with first-line care. Importantly, first-line care is more cost-effective and is associated with decreased risk of adverse events compared to knee arthroscopy^{115,120}. Additionally, a knee arthroscopy is associated with a three-fold increase risk of progressing to a total knee replacement compared to people who do not have an arthroscopy following a meniscal tear^{176,263}. Current AAOS guidelines cite moderate-quality evidence against the use of knee arthroscopy (in the absence of meniscal tears) for people with knee osteoarthritis²⁴⁵. However, a recent analysis of consumer-facing information about knee arthroscopy in Australia identified that very few resources clearly recommend against its use²⁶⁴.

This has the potential to influence the beliefs of people with knee osteoarthritis regarding the effectiveness of knee arthroscopy or their willingness to undergo this surgery.

1.2.4 Understanding treatments summary

Patient education, exercise therapy and weight management are considered first-line treatment options in all major clinical practice guidelines for people with knee osteoarthritis^{41,116-118}. They are suitable for, and should be offered to, all people with knee osteoarthritis regardless of age, sex or severity of the condition⁴¹. These first-line interventions offer opportunities for people to achieve improvements in pain, function, a variety of psychological outcomes, and overall health and health behaviours. Mechanisms to explain why first-line interventions improve outcomes for people with knee osteoarthritis are complex, like the pathogenesis of the condition itself. Second-line treatment options include pharmacotherapies (oral, topical and injections), nutraceuticals, physical therapies, orthoses, prescribed footwear and braces, and can be considered for people with knee osteoarthritis as an adjunct to first-line care. Surgery is considered a third-line treatment option that few should require, especially if people with knee osteoarthritis are offered, and engage in, appropriate first-line care.

1.3 Current provision of first-line care to people with knee osteoarthritis

Evidence from around the world suggests that many people with knee osteoarthritis do not receive, or engage in, first-line care²⁶⁵⁻²⁶⁹. This section provides a summary of current healthcare provided to people with knee osteoarthritis, and explores barriers and enablers to providing first-

line care. A detailed overview of the provision of patient education by health professionals, including barriers and enablers is provided in Section 1.4 of this chapter.

In the United States, as many as 90% of people who undergo a total knee replacement do not receive physiotherapy in the five years prior to undergoing surgery^{265,266}. In Sweden²⁶⁸ and Denmark²⁶⁷, one- to two-thirds of people with knee osteoarthritis do not receive physiotherapy prior to an orthopaedic consultation. Similar evidence exists in Australia, where one-third of people awaiting an orthopaedic consultation reporting that they have not received, or engaged in, first-line care²⁶⁹. This finding is not surprising, considering that general medical practitioners in Australia refer nearly three times more people with knee osteoarthritis for an orthopaedic consultation compared to physiotherapy (13% to 5%, respectively)¹⁷³. Referrals of people with knee osteoarthritis to physiotherapists did increase from 3 to 5% from 2005-2010 to 2010-2016, however similar increases in referrals to orthopaedic surgeons also occurred, suggesting no change in relative trends over time¹⁷³. Additionally, less than 1% of people with knee osteoarthritis were referred to a dietician or nutritionist for specialist weight management support between 2010 and 2016¹⁷³.

General practitioners (i.e., first-contact medical professionals) may directly provide first-line care to their patients with knee osteoarthritis, removing the need for referral to a physiotherapist or dietician. However, general practitioners in Australia identify inadequate consultation time as a barrier to facilitating engagement in first-line care, and also report knowledge gaps about osteoarthritis (including the pathogenesis, diagnosis and best practice for treatments) as well as low levels of confidence and perceived capability to facilitate behaviour change²⁷⁰.

Physiotherapists play an important role in the management of people with knee osteoarthritis, being trained to provide education and exercise therapy^{271,272}. However as previously stated, only 1 in 20 people in Australia with knee osteoarthritis are referred to physiotherapy services to receive specialised education and exercise therapy support¹⁷³. Physiotherapists report significantly higher adherence to providing first-line care compared to general practitioners, with certain interventions (i.e., exercise therapy) being provided to over 80% of people with knee osteoarthritis^{271,273}. However, other first-line care interventions are less frequently provided by physiotherapists. For example, weight management discussions are only initiated with approximately 12% of people with knee osteoarthritis²⁷³. A lack of clarity around the scope of practice or a lack of additional training to provide weight management interventions^{272,273}, together with a lack of clinical time²⁷¹, may be potential barriers to the effective provision of first-line care by physiotherapists.

In summary, many people with knee osteoarthritis are failing to receive guideline recommended first-line care. The development of resources that could be used by general practitioners and physiotherapists to implement and facilitate engagement in first-line care is encouraged and has the potential to reduce barriers to its provision and improve patient outcomes. Improving first-line care implementation may also reduce the desire of individuals with knee osteoarthritis to undergo a knee replacement, and subsequently, slow the escalating burden on healthcare systems associated with this procedure.

1.4 Patient education

1.4.1 History of patient education

Many philosophers and academics have attempted to define ‘education’ over the years, but we are no closer to achieving a consensus definition²⁷⁴. Most commonly, education is viewed as a teaching and learning process that occurs within primary, secondary and tertiary educational institutions²⁷⁴. In these settings, there is often a ‘teacher’ and a ‘student’ or a ‘group of students’. The teacher transmits their knowledge to the students in a manner that is structured around learning outcomes aligned to pre-defined curriculums. The learning outcomes are subsequently assessed over time, and thresholds for success (i.e., pass/fail) are applied²⁷⁵. As the student progresses from primary through to tertiary education, the role of the educator typically changes from more of a didactic ‘teacher’ to a ‘facilitator’ of active learning, and students tend to have more ‘choice’ around the content or topics that are of interest or meaningful to them. However, in reality, education is far greater than these explanations and can be considered a never-ending process of development, beginning at birth and continuing throughout life²⁷⁶. Gregory (2002) argued that “*education is concerned with equipping minds to make sense of the physical, social and cultural world*”²⁷⁷. This definition can be applied well to ‘patient education’ and factors related to the complexities of living with chronic conditions from a biopsychosocial perspective.

In the Western world, patient education has strong origins in the field of health promotion²⁷⁸. A key enabler of the health promotion movement was the 1974 Lalonde report²⁷⁹, which acknowledged that biomedical aspects of healthcare are only one aspect of overall health. This came at a time when there was a substantial increase of chronic health conditions²⁸⁰. The

Lalonde report proposed that individuals could improve their health through changing behaviour and lifestyle factors such as diet and exercise²⁷⁹. At this time, patient education was viewed in a very similar manner to early institutional education. The health professional (usually a doctor) would act as the ‘teacher’ and pass on their knowledge in a didactic manner to the patient who acted as a ‘student’. Subsequently, the patient was seen as a passive recipient of information, and would not be expected to ask questions²⁷⁸. In the 1980s changes to legislation in Europe acknowledged an individual’s rights to receive information about their condition and treatment options²⁸⁰. This led to an increased awareness of the importance of patient education to help understand chronic conditions and improve health and self-management. Subsequently, more formalised interventions such as videos and information booklets were developed to facilitate patient education, and emerged in the literature as interventions²⁷⁸. It was in the 1980s that the following definition of patient education was proposed: “*A planned learning experience using a combination of methods such as teaching, counselling and behaviour modification techniques which influence patients’ knowledge and health behaviour*”²⁸¹.

In the 1990s, patients became more engaged with their treatment decision-making and formulation of treatment goals. This naturally led to a greater emphasis on educating patients to be able to make informed decisions²⁸². In 1998, the term ‘therapeutic patient education’ was proposed by the World Health Organisation-Europe (WHO)²⁸³, described as follows:

“Healthcare providers tend to talk to patients about their disease rather than train them in the daily management of their condition. Therapeutic patient education is designed, therefore, to train patients in the skills of self-managing or adapting treatment to their particular chronic

disease, and in coping processes and skills. It should also contribute to reducing the cost of long-term care to patients and to society. It is essential to the efficient self-management and to the quality of care of all long-term diseases or conditions, though acutely ill patients should not be excluded from its benefits. Therapeutic patient education is education managed by healthcare providers trained in the education of patients, and designed to enable a patient (or a group of patients and families) to manage the treatment of their condition and prevent avoidable complications, while maintaining or improving quality of life. Its principal purpose is to produce a therapeutic effect additional to that of all other interventions (pharmacological, physical therapy, etc.).”²⁸³

Patient education again evolved further in the 21st century, with recipients of healthcare becoming even more empowered through a culture shift towards patient-centred care²⁸⁴. Within a patient-centred care model, the individual with the condition has a central role in knowledge sharing, and the health professional becomes less of a ‘teacher’ and more of a ‘facilitator’²⁸⁵. It is now generally accepted that patient-centred education should be considered part of standard care for people with chronic musculoskeletal conditions^{41,42,116-118,125,286}.

1.4.2 Best practice principles for ‘how’ to provide patient education

Compelling evidence indicates that patient education has an effect on multiple physical and psychological outcomes for people with various chronic health conditions and behavioural disorders²⁸⁷. However, to date, there is a lack of consensus about what constitutes best practice, which is reflected by inconsistent recommendations in clinical practice guidelines for people with musculoskeletal conditions^{41,116-118,137,138}. Guidelines frequently recommend individualised

or patient-centred care^{41,116-118}. Patient-centred education should include an assessment of an individual's motivation, beliefs and concerns in order to appropriately tailor content and delivery methods, and to identify and overcome potential barriers to behaviour change or engagement in self-management^{288,289}. Yet, guideline recommendations rarely identify strategies or methods to assist health professionals to provide patient-centred education to people with knee osteoarthritis^{41,116-118}. Table 1.2 summarises the current education recommendations from prominent international guidelines for 'how' and 'what' to provide for people with knee osteoarthritis^{41,116-118}.

Table 1.2 Patient education and self-management recommendations from clinical practice guidelines

Terminology	Recommendations for ‘how’ to provide	Recommendations for ‘what’ to provide
<i>ACR 2019¹¹⁸</i>		
Self-efficacy and self-management programs	These programs use a multidisciplinary group-based format combining sessions on skill-building (goal-setting, problem-solving, positive thinking). Health educators, National Commission for Certification Services–certified fitness instructors, nurses, physiotherapists, occupational therapists, physicians and patient peers may lead the sessions, which can be held in person or online (i.e. web-based).	Education about the disease and about medication effects and side effects, joint protection measures, and fitness and exercise goals and approaches.
*Note no recommendations for patient education directly		
<i>EULAR 2013¹¹⁶</i>		
Information and education	<p>Information and education for the person with knee osteoarthritis should:</p> <ul style="list-style-type: none"> - Be individualised according to the person’s illness perceptions and educational capability - Be included in every aspect of management - Be reinforced and developed at subsequent clinical encounters - Be supported by written and/or other types of information (e.g., DVD, website, group meeting) selected by the individual - Include partners or carers of the individual, if appropriate. 	<p>Specifically address the nature of OA (a repair process triggered by a range of insults), its causes (especially those pertaining to the individual), its consequences and prognosis.</p> <p>Maintenance and pacing of activity</p> <p>Counselling about modifiable work-related factors such as altering work behaviour, changing work tasks or altering work hours, use of assistive technology, workplace modification, commuting to/from work and support from management, colleagues and family towards employment</p>
Exercise education	<p>Exercise education (e.g., individual 1 : 1 sessions, group classes, etc) and use of pools or other facilities should be selected according both to the preference of the person with hip or knee OA and local availability.</p> <p>Offer regular reviews to all people with symptomatic osteoarthritis. Agree the timing of the reviews with the person. Reviews should include:</p>	<p>Important principles of all exercise include:</p> <ul style="list-style-type: none"> - ‘small amounts often’ (pacing, as with other activities) - linking exercise regimens to other daily activities (e.g., just before morning shower or meals) so they become part of - lifestyle rather than additional events

	<ul style="list-style-type: none"> - Discussing the person's knowledge of the condition, any concerns they have, their personal preferences and their ability to access services - Support for self-management - 	<ul style="list-style-type: none"> - starting with levels of exercise that are within the individual's capability, but building up the 'dose' sensibly over several months
Lifestyle changes	For lifestyle changes - Teach and encourage behavioural change strategies through goal setting of physical activity and weight changes, action plans to maintain changes and regular follow-ups.	No additional details provided other than information in 'how'
Weight management education	Individualised strategies that are recognised to effect successful weight loss and maintenance (see Box 1.1)	See box 1.1
<hr/> <i>NICE 2014</i> ^{41,125} <hr/>		
Education	<p>Verbal and written information. Ensure that the information provided can be understood</p> <p>Ensure that information sharing is an ongoing, integral part of the management plan rather than a single event at the time of presentation.</p>	<p>Discuss the risks and benefits of treatment options with the person, taking into account comorbidities.</p> <p>Information to enhance understanding of the condition and its management, and to counter misconceptions, such as that it inevitably progresses and cannot be treated.</p> <p>Offer advice on the following core treatments to all people with clinical OA: access to appropriate information, activity and exercise, and interventions to achieve weight loss if the person is overweight or obese.</p> <p>Advise people with OA to exercise as a core treatment, irrespective of age, comorbidity, pain severity, or disability.</p> <p>Offer advice on appropriate footwear (including shock-absorbing properties) as part of core treatments for people with lower-limb OA.</p>

		<p>When discussing the possibility of joint surgery, check that the person has been offered at least the core treatments for osteoarthritis, and give them information about:</p> <ul style="list-style-type: none"> - The benefits and risks of surgery and the potential consequences of not having surgery - Recovery and rehabilitation after surgery - How having a prosthesis might affect them - How care pathways are organised in their local area
Self-management	Self-management either individually or in groups.	<p>Ensure that self-management programs for people with osteoarthritis emphasize the recommended core treatments, especially exercise.</p> <p>Agree on individualised self-management strategies with the person with OA. Ensure that positive behavioural changes, such as exercise, weight loss, and use of suitable footwear and pacing, are appropriately targeted.</p>
<i>OARSI 2019</i> ¹²⁵		
Self-management and education	As part of standard care	Continually provide their patients with necessary information about osteoarthritis disease progression and self-care techniques and to promote hope, optimism and a positive expectation of benefit from treatment.

ACR = American College of Rheumatology, EULAR = European Alliance of Associations for Rheumatology, NICE = National Institute for Health and Care Excellence, OARSI = Osteoarthritis Research Society International

Guidelines for people with knee osteoarthritis do not recommend specific behaviour change techniques or mention providing theory-based education, although this is a recommendation for people with inflammatory arthritis²⁹⁰. To date, evidence to suggest that theory-based education or interventions are superior to non-theory-based education or interventions is lacking²⁹¹. However, from a pedagogical perspective, the potential importance of theory cannot be ignored. Theory-based educational interventions in clinical trials for people with knee osteoarthritis are mostly grounded in either social learning theory, social cognitive theory or derived from cognitive behavioural therapy (i.e., cognitive behavioural therapy or pain coping skills training)²⁹¹⁻²⁹⁴. These theories and approaches are reported to be effective at improving pain, function and self-efficacy for people with musculoskeletal conditions^{295,296}. However, little is known about what theories may be optimal for patient education. A major similarity between social learning theory, social cognitive theory and cognitive behavioural theory is the focus on enhancing self-efficacy^{297,298}. Enhancing self-efficacy is a key component of motivational interviewing, a technique primarily based upon social determination theory²⁹⁹. Interventions that use motivational interviewing show promise for improving pain and function in people with arthritis³⁰⁰ and reducing weight in people with obesity³⁰¹. Therefore, it is recommended that education programs for people with chronic health conditions like osteoarthritis be underpinned by theory to enhance self-efficacy and improve self-management^{123,302}.

Self-efficacy was defined by Bandura in 1999 as “*beliefs in one’s capabilities to organise and execute the courses of actions required to produce given attainments*”³⁰². Self-efficacy, and enhanced self-efficacy, are associated with improvements in health and health behaviours for people with arthritis^{123,303,304}. Importantly, self-efficacy is task- and situation-specific, meaning it is possible to have high self-efficacy for some tasks and lower self-efficacy for

others. Additionally, past experiences will contribute towards an individual's future judgement/self-efficacy³⁰². There are four over-arching strategies to enhance self-efficacy¹²³:

- (i) Performance mastery: viewed as the strongest predictor of self-efficacy; a major focus of performance mastery is to get individuals to 'take action'. Within the context of patient education, this may relate to the performance and mastery of self-management skills or adherence to a physical activity routine. Suggested ways to facilitate performance mastery include the use of action planning and logs of progress, and to have individuals rate their confidence or capability to achieve certain tasks.
- (ii) Modelling: can be achieved using information or resources that are relatable to the individual. An example of modelling for an educational resource would be the use of images illustrating a behaviour or message related to an exercise or skill. The image should be population appropriate in terms of age, sex or race and can include the use of real-life examples of people with osteoarthritis discussing their lived experiences. This may influence confidence or capability to achieve a task or even willingness to attempt the task, hence improving self-efficacy.
- (iii) Interpretation of symptoms: facilitating reinterpretation of symptoms can help individuals form an alternate explanation for their symptoms. In the case of osteoarthritis patient education, this could address inaccurate biomedical beliefs about the cause of the condition and symptoms with a shift towards targeting modifiable risk factors.
- (iv) Social persuasion: providing group patient education programs may offer benefits to enhance self-efficacy. In this instance, changes to efficacy may be influenced by feedback, encouragement, socialisation and support from health professionals or peers.

In the absence of clearer recommendations from guidelines to support health professionals to provide behavioural change or theory-based patient education, these four strategies to enhance self-efficacy should be considered¹²³. They should also be incorporated into the future development of educational interventions of resources. Some education recommendations within clinical practice guidelines for people with knee osteoarthritis align with principles to enhance self-efficacy^{41,116-118}. For example, action planning, goal setting, reframing symptoms and the use of groups are often recommended (Table 1.2)^{41,116,118}. Providing greater structure and theoretical rationale to patient education recommendations in guidelines may improve the clinical translation and consistency in which these are implemented for people with knee osteoarthritis. Another recommendation that appears in NICE⁴¹ and EULAR¹¹⁶ guidelines is that patient education should be a continual process. This approach aligns with best practice in formalised education and pedagogy, and should be encouraged for patient education for people with knee osteoarthritis^{276,305}.

Andragogy (also known as adult learning theory)³⁰⁵ provides a set of principles and guidelines to facilitate adult learning, and can provide a useful framework for health professionals to implement patient education³⁰⁶. Andragogy makes key assumptions about adult learners, including that they are internally motivated and self-directed, bring life experiences and knowledge to learning experiences, are goal and relevancy orientated, are practical, and like to be respected. There are seven key principles in andragogy:

1. Establish an effective learning climate, where learners feel safe and comfortable expressing themselves.
2. Involve learners in mutual planning of relevant methods and curricular content.

3. Involve learners in diagnosing their own needs, which can help to trigger internal motivation.
4. Encourage learners to formulate their own learning objectives, which can give them more control of their learning.
5. Encourage learners to identify resources and devise strategies for using the resources to achieve their objectives.
6. Support learners in carrying out their learning plans.
7. Involve learners in evaluating their own learning, which can develop their skills of critical reflection.

These principles share many similarities with methods to enhance self-efficacy and align with patient-centred care principles. Therefore, the provision of education that is aligned to principles of andragogy should be encouraged.

Forbes et al. (2018)³⁰⁷ identified 22 core competencies for physiotherapists to provide effective patient education. This Delphi study provides insights into the knowledge, skills and attributes that physiotherapists consider important to providing effective patient education. Included within the competencies are factors such as understanding the role of education; understanding the impact of social, cultural and behavioural variables on patient learning; understanding the principles of andragogy; tailoring content and communication to the needs of patients; ensuring that engagement is maintained through education; identifying when learning needs are met; and continuing to develop patient education skills. These competencies further support the need to have a theoretical underpinning when providing patient education, and share similarities with approaches to enhance self-efficacy and provide patient-centred care.

In terms of the delivery mode of patient education, the NICE⁴¹ and EULAR¹¹⁶ guidelines recommend providing verbal education alongside other modes (i.e., written, DVDs or websites), and suggest that education may be provided via group or individual methods. The ACR¹¹⁸ and OARSI¹²⁵ guidelines provide limited recommendations about delivery mode or method. Within clinical research, over half of education interventions use verbal and written modes of delivery, with a relatively even split of individual, group and mixed (26%, 29% and 32%, respectively) methods²⁹¹. Self-directed education is used less commonly (13%)²⁹¹. There is no evidence for the optimal mode or method of delivery of patient education for people with knee osteoarthritis. However, evidence from exercise therapy interventions suggests that group-based interventions are as effective as individual interventions³⁰⁸. When viewed from a person-centred care and an andragogy lens, people with knee osteoarthritis should be offered a choice of mode and method. However, group-based education sessions may have the additional benefit of enhancing self-efficacy through social persuasion¹²³. Lastly, guidelines recommend that patient education is not a one-off event, and outcomes (i.e., knowledge, skills or behaviours) should be evaluated over time^{41,116}. This aligns with theoretical principles for education²⁷⁷ and accounts for learning that may occur over time through lived experiences and reflection, rather than formal education only.

1.4.3 Best practice for ‘what’ content to provide in patient education

Significant variation exists within guidelines to facilitate ‘what’ educational content to provide to people with knee osteoarthritis (Table 1.2). The recommendations that do exist in guidelines tend to be based upon the views of those involved in the guideline development, expert opinions, or on research that is not unique to knee osteoarthritis (i.e., includes people with osteoarthritis at other joints or other forms of arthritis). The paucity and variation of guideline recommendations may reflect an expectation that health professionals select content

that is patient-centred within standard care^{41,116,118,125}. However, evidence from the lived experiences of people with knee osteoarthritis indicates that patient educational needs are frequently unmet during healthcare consultations^{85,267}. This suggests that the provision of patient-centred education may not be common, and that there may be a mismatch between what is being provided, and what people with knee osteoarthritis want to be educated about.

The ACR, EULAR and NICE guidelines recommend providing information about the condition and/or to counter misconceptions^{41,116,118}. However, they include limited guidance about ‘what’ this should include or ‘how’ to provide it^{41,116-118}. Considering low confidence in knowledge about knee osteoarthritis by general practitioners²⁷⁰, guidelines should consider providing accurate and clear information for health professionals to use to educate patients about the condition and to counter misconceptions. The only specific example is from the NICE guidelines who recommend providing education to counter the misconception that “(*knee osteoarthritis*) inevitably progresses and cannot be treated”⁴¹. People with knee osteoarthritis commonly refer to misconceptions of ‘bone on bone’ or ‘wear and tear’ being the primary cause of their symptoms^{75,80,81,85,210,267,309}. Identifying whether an individual possesses these beliefs and providing education to counter them is warranted, as they can act as a barrier to engagement in exercise therapy through fear of causing damage^{75,80,81,85,210,267,309}.

As previously stated, people with knee osteoarthritis also possess a common misconception that surgery is inevitable^{79,85}. Encouragingly, it is possible to change this belief, and an individual’s willingness to undergo surgery, through education and first-line care^{79,310}. Yet, most guidelines do not prioritise this as an education topic. The NICE guidelines⁴¹ provide the most detailed recommendations about surgery. They recommend providing education about

the benefits and risks, expected recovery, how a prosthesis may affect an individual, and how care pathways are organised in the individual's local area (Table 1.2). Other guidelines should consider prioritising this important education topic and include information that can be used by health professionals to enhance the consistency and quality of education being provided. Providing education about surgery may also assist in reducing the future expected burden of surgical interventions for people with knee osteoarthritis¹¹⁰.

Providing education about the benefits of physical activity is important considering it is a modifiable risk factor for the progression of knee osteoarthritis and most people with knee osteoarthritis fail to meet the physical activity guideline recommendations¹⁸. Providing education about the benefits of exercise therapy should also be encouraged since it is considered first-line care and it has the potential to improve adherence to exercise and patient outcomes^{132,311-313}. Although guidelines often recommend providing education to support first-line care including exercise therapy, 'what' specific education to provide to optimise this is unclear. This, alongside many physiotherapists being unable to identify appropriate exercise or physical activity guidelines³¹⁴, may act as a barrier to the appropriate delivery of content and the overall effectiveness of patient education about physical activity and exercise therapy. The EULAR guidelines¹¹⁶ provide the most practical information to facilitate provision of education about exercise therapy. Inclusion of such recommendations in other guidelines may facilitate improved and longer-term engagement with first-line care.

Weight management is another first-line intervention that health professionals should provide education about. People with knee osteoarthritis report that when weight management education is provided, it often includes general information, rather than specific guidance or support on how to lose weight²¹⁰. Of all the guidelines, only EULAR¹¹⁶ provide detailed

recommendations to facilitate weight management education (Box 1.1). Future clinical practice guidelines should consider providing more detailed recommendations about ‘what’ content related to weight management education to provide to facilitate consistent and accurate messaging for people with knee osteoarthritis.

The ACR¹¹⁸ and OARSI¹²⁵ guidelines recommend providing education to develop self-management skills, and these guidelines also mention the importance of optimism and positive thinking. However, they do not state ‘what’ specific skills may be best to educate about or develop. The skills contained within ‘pain coping skill training’ are encouraged³¹⁵, given that they appear to be effective at improving pain coping and self-efficacy and can reduce psychological distress compared to usual care for people with knee osteoarthritis²⁹²⁻²⁹⁴. Pain coping skill training is grounded in social cognitive theory²⁹⁵ and helps to enhance self-efficacy and self-management by developing both physical and emotional coping strategies³¹⁵.

Currently, knee osteoarthritis guidelines do not recommend providing education about falls or falls prevention³⁷⁻⁴⁰. However, this should be considered by health professionals as a relevant education topic as most people with knee osteoarthritis have poor knowledge about falls prevention and are unaware of their increased risk of falling³¹⁶. Notably, two in five 45-64-year-olds living with knee osteoarthritis in Australia report having had a fall in the previous year¹⁰⁵. A barrier to implementing patient education about falls prevention may be that physiotherapists feel unprepared to provide it³¹⁷. A greater emphasis within clinical practice guidelines about the importance of falls risk and prevention, alongside interventions to support health professionals to provide education and exercise therapy interventions capable of reducing falls incidents is warranted.

In the absence of consistent recommendations within guidelines to facilitate ‘what’ education to provide, health professionals may seek assistance from other sources. Validated outcome measures to test the knowledge of people with knee osteoarthritis exist and provide opportunities to identify and tailor content towards knowledge gaps^{318,319}. Studies synthesising expert opinion also provide more detailed recommendations about what content may be important to provide (Box 1.2)^{320,321}. However, these recommendations are generally targeted towards a didactic delivery of education, which conflicts the principles of patient-centred care²⁸⁹ and andragogy³⁰⁵, and therefore may not be optimal for learning. Finally, the items within DISCERN may provide a useful guide on what to educate people with knee osteoarthritis (Box 1.3). Although this tool does not provide specific information for health professionals to use clinically, it does provide a framework to facilitate informed decisions about treatments.

Box 1.2 Expert opinion recommendations from French et al.³²⁰ and Teo et al.³²¹

French et al.³²⁰

Disease Knowledge

1. Osteoarthritis is not just a disease of the cartilage but affects your whole joint including muscles and ligaments
2. Joint damage on an x-ray does not indicate how much your osteoarthritis will affect you
3. The symptoms of osteoarthritis can vary greatly from person to person
4. Osteoarthritis is not an inevitable part of getting older

Drugs

1. You should avoid the use of non-steroidal anti-inflammatory drugs for your osteoarthritis over the long term
2. You may get some pain relief from your osteoarthritis by using acetaminophen (paracetamol) medications

Principles of Management

1. Non-drug treatments have similar benefits for your osteoarthritis symptoms to pain-relieving drugs, but with very few adverse side effects
2. Actively taking part in self-management programs could benefit your osteoarthritis
3. Treatment interventions and lifestyle changes for your osteoarthritis should be individualised and include long- and short-term goals. These should be reviewed regularly with your health professionals
4. Methods for you to self-manage your osteoarthritis should be discussed and agreed on by you and your health professionals

Surgery

1. Your osteoarthritis symptoms can often be eased significantly without requiring an operation
2. If you cannot achieve pain relief from your osteoarthritis, have undertaken a sustained period of recommended conservative management, and it is very difficult to perform activities of daily living, joint replacement surgery is an option
3. Keyhole surgery (arthroscopy) that involves washout of the joint and joint scraping should not be used to treat your pain unless there is mechanical blocking of your joint

Exercise, Physical Activity and Weight Loss

1. Regular physical activity and individualised exercise programs (including muscle strengthening, cardiovascular activity and flexibility exercises) can reduce your pain, prevent worsening of your osteoarthritis, and improve your daily function
2. If you are overweight and have osteoarthritis, it will be beneficial to lose weight and maintain a healthy weight through an individualised plan involving dietary changes and increased physical activity
3. Living a sedentary life could worsen your osteoarthritis and also increases your risk of other lifestyle-related diseases, such as diabetes and cardiovascular disease
4. Individualised exercise is an integral component of treatment for everyone with osteoarthritis
5. Maintaining sufficient muscle strength around the joints is important in reducing pain and maintaining function, and if you require an operation, will benefit both pre- and post-operative periods of your treatment
6. Linking your individualised exercises to your other daily activities is a useful way to become more active
7. Individualised exercises only work for your osteoarthritis if you do them regularly
8. Small amounts of individualised exercise undertaken frequently can be beneficial for your osteoarthritis

Teo et al.³²¹

1. Discuss and offer a personalised exercise and physical activity program to people with hip and/or knee osteoarthritis according to their needs, preferences, self-motivation and ability to perform the exercises. An appropriate exercise program may include muscle strengthening, aerobic activity, land- or water-based exercise, and a supervised or unsupervised exercise program. The type and dosage of the exercise program should be individually tailored
2. Provide information on opportunities for people to exercise locally at a minimal financial cost
3. Offer accurate verbal and written information to enhance understanding of the pain experience, including the neurobiological basis of pain

Box 1.3 DISCERN items that may facilitate the identification of education topics about treatment options to inform decision-making³²²

A good quality publication will:

1. Have explicit aims
2. Achieve its aims
3. Be relevant to consumers
4. Make sources of information explicit
5. Make date of information explicit
6. Be balanced and unbiased
7. List additional sources of information
8. Refer to areas of uncertainty
9. Describe how treatment works
10. Describe the benefits of treatment
11. Describe the risks of treatment
12. Describe what would happen without treatment
13. Describe the effects of treatment choices on overall quality of life
14. Make it clear there may be more than one possible treatment choice
15. Provide support for shared decision-making

1.4.4 Patient education landscape in relation to knee osteoarthritis

Patient education is poorly defined in the knee osteoarthritis literature and is often used interchangeably with terms such as lifestyle modification and self-management¹²³. However, patient education and/or self-management are consistently recommended as first-line care in all major clinical practice guidelines for people with knee osteoarthritis^{41,116-118}. Self-management interventions in clinical research can frequently include the provision of patient education alongside other interventions such as physical activity promotion and exercise therapy. This creates challenges when attempting to understand if improvements from self-

management programs are due to patient education, exercise therapy or a combination of both. A 2012 Cochrane review³²³ concluded that self-management programs result in small to no benefit in pain and function for people with osteoarthritis of various joints. However, to date, no high-quality systematic reviews have been conducted to identify the effectiveness of patient education, either as a stand-alone intervention or in combination with other interventions, on pain or function outcomes specifically for people with knee osteoarthritis. Nonetheless, other systematic reviews have reported that combining patient education with exercise therapy can effectively improve quality of life, self-efficacy, depression and psychological distress for people with knee osteoarthritis^{132,313,324}.

Current guidelines (Table 1.2)^{41,116-118} demonstrate that patient education is multifaceted and can be provided in a variety of ways. This reflects the design of clinical trials for knee osteoarthritis, where patient education interventions range from knowledge formation via simple, passive provision of information or advice, through to complex problem-solving, skill-development or behaviour change interventions that actively engage the learner^{291,312}. It is important to note that patient education is frequently used as a control condition in clinical trials^{132,313,323}, and no studies have yet determined if this might impact on the quality of content, development or delivery methods for the education interventions tested. Exploration of this is warranted, as these factors may be important to consider when interpreting findings.

Current evidence indicates that the provision of patient education for people with knee osteoarthritis by health professionals in Australia is poor¹⁷³. Despite improving trends from 2005-2010 to 2010-2016, general practitioners still only provide patient education or lifestyle management advice to approximately 23% of patients presenting to them with knee osteoarthritis^{173,273}. This could be due to the low self-reported knowledge about knee

osteoarthritis and confidence to provide behaviour change techniques²⁷⁰. Physiotherapists report more frequent provision of patient education about osteoarthritis, in just over 60% of cases²⁷³. However, the provision of education about certain topics (i.e., physical activity) is reported to be much higher, with up to 83% of physiotherapists reporting the provision of this education all or most of the time²⁷¹. Physiotherapists also generally report higher perceived levels of confidence to provide patient education as compared to general practitioners^{271,272}.

Whilst it is encouraging that physiotherapists appear to be providing patient education to the majority of people with knee osteoarthritis, general practitioners refer just 1 in 20 people to a physiotherapist to assist with care¹⁷³. Additionally, simply reporting that patient education is being provided or having high levels of confidence to provide it does not necessarily equate to the provision quality patient education. For example, in a sample of 1,064 physiotherapists prior to attending a workshop about osteoarthritis in Australia, less than half of them felt adequately trained to provide education to people with knee osteoarthritis²⁷¹. Additionally, evidence from lived experience studies indicates that people with knee osteoarthritis often receive conflicting education and advice from health professionals that can act as both a barrier and enabler to engaging in first-line care^{75,80,81,85,210,309}.

Analysis of the mode of patient education provided by physiotherapists in Australia reveals that very few consistently provide written information or signpost to web-based sources of information to supplement the patient education they provide^{271,272}. Combined, these findings suggest that the primary mode of patient education in physiotherapy practice is through verbal communication, with very little use of theory or resources to facilitate longer-term learning and engagement in self-management. This may limit the retention of education provided and its overall effectiveness.

In Australia, people with knee osteoarthritis report that they are rarely provided with education to develop the knowledge or skills necessary to lose weight²¹⁰. This supports findings from Scandinavia suggesting that people with knee osteoarthritis are less likely to receive lifestyle advice compared to people with other chronic health conditions such as diabetes and hypertension³²⁵. Additionally, only one-third of people with knee osteoarthritis felt informed about the condition, treatment options, how to self-manage their disease, and how to change their lifestyle prior to an orthopaedic consultation²⁶⁷. Research investigating whether the educational priorities of people with knee osteoarthritis align with the perceived educational priorities of health professionals is, therefore, warranted and may inform guideline recommendations.

1.4.5 Patient education summary

The appreciation and use of patient education in the management of chronic health conditions, including knee osteoarthritis, has steadily increased over the past 60 years. What is considered best-practice has evolved from the individual with the condition being the ‘student’ and the health professional being the ‘teacher’ towards a patient-centred approach where the individual with the condition is empowered to share their knowledge and expertise, and the health professional ‘facilitates’ the education process. Patient education is consistently recommended in clinical practice guidelines for people with osteoarthritis as first-line care. However, little guidance about ‘how’ to implement it or ‘what’ it should or could entail in practice is provided. This is consistent with many musculoskeletal conditions and threatens the consistency and potential effectiveness of patient education. Theoretical principles of learning, behaviour change and co-design provide an opportunity to develop more robust interventions and frameworks to optimise the effectiveness of patient education.

1.5 Rationale for thesis

Evidence synthesised in high-quality systematic reviews supports the effectiveness of patient education interventions for various forms of arthritis and other chronic health conditions^{132,287,323}. The effectiveness of patient education interventions specifically for people with knee osteoarthritis is not well understood³²³. There are no published in-depth analyses of the content, development and delivery of education interventions for people with knee osteoarthritis. Considering that people with knee osteoarthritis are increasingly using the internet to retrieve health information³²⁶⁻³²⁸, it is also important to explore the accuracy and comprehensiveness of the web-based information available, and work to fill gaps and address any misinformation. These important considerations may enable the development of more specific and effective patient education recommendations and resources for people with knee osteoarthritis within clinical practice guidelines, research trials, and ultimately, clinical practice.

Implementation of patient-centred care for knee osteoarthritis is strongly encouraged and is important to enhance patient satisfaction and outcomes. Patient-centred care for people with knee osteoarthritis may be improved by identifying and understanding their education priorities (i.e., what they want to know). Combined, this knowledge may assist health professionals to meet the needs and expectations of people with knee osteoarthritis and may facilitate patient-centred education and informed, shared decision-making. It can also be used to inform the development of educational resources and interventions to support people with knee osteoarthritis and the health professionals they consult.

Knowledge gained from this thesis will inform and facilitate the development of a co-designed resource that can either be used in a self-directed manner for people with knee osteoarthritis, or in a blended format in collaboration with a health professional.

The overall aims of this thesis were to:

- i) Evaluate the effectiveness of patient education interventions in clinical trials, and assess their content, development and delivery.
- ii) Identify and appraise common publicly-accessed web-based resources for people with knee osteoarthritis.
- iii) Identify the educational priorities of physiotherapists and people with knee osteoarthritis.
- iv) Use co-design methods to create a web-based toolkit to facilitate self-management and informed decision-making for people with knee osteoarthritis.

Chapter 2 : Patient education improves pain and function in people with knee osteoarthritis with better effects when combined with exercise therapy: A systematic review

2.1 Preface

Chapter 1 provided an overview of knee osteoarthritis, its diagnosis, the associated comorbidities, its impact, and the current clinical practice guideline treatment recommendations. An in-depth overview of the theoretical underpinnings of patient education was also provided, alongside a discussion related to the lack of evidence for its effectiveness, and the limited guidance provided on its implementation, despite consistent guideline recommendations supporting its use. An up-to-date, in-depth synthesis of evidence related to patient education for people with knee osteoarthritis is required to inform future research, guideline recommendations and clinical practice.

I conducted a systematic review and meta-analysis³¹² to identify and critically appraise the current literature on the effectiveness of patient education for people with knee osteoarthritis. The primary aim of the review was to determine the effectiveness of patient education for people with knee osteoarthritis as a standalone intervention, and in combination with other interventions, for improving pain and function. The secondary aims of the review were to evaluate psychological outcomes and compare the modes of patient education delivery. The review was prospectively registered with PROSPERO (CRD42019122004).

The following chapter contains an edited version of the following published paper:

Goff, A.J., De Oliveira Silva, D., Merolli, M., Bell, E.C., Crossley, K.M, & Barton, C.J.

“Patient education improves pain and function in people with knee osteoarthritis with better effects when combined with exercise therapy: A systematic review”

Published in the Journal of Physiotherapy 67(3), 177-189. DOI: j.jphys.2021.06.011

All edits of the published manuscript are grammatical to facilitate alignment with the remainder of this thesis.

Tian and Yuan provided a critique of this work in the form of a letter to the editor of the Journal of Physiotherapy³²⁹. Their letter, plus my response³³⁰ can be found in [Appendix 2A](#).

2.2 Abstract

Question: Is patient education effective as a standalone intervention or combined with other interventions for people with knee osteoarthritis?

Design: A systematic review of randomised controlled trials. MEDLINE, EMBASE, SPORTDiscus, CINAHL and Web of Science were searched from inception to April 2020. The Cochrane Risk of Bias Tool was used for included studies, and Grading of Recommendations, Assessment, Development and Evaluations (GRADE) was used to interpret the certainty of results.

Participants: People with knee osteoarthritis.

Intervention: Any patient education intervention compared with any non-pharmacological comparator.

Outcome measures: The primary outcomes were self-reported pain and function.

Results: Twenty-nine trials involving 4,107 participants were included, informing low to very low certainty evidence. Nineteen of 28 (68%) pooled comparisons were not statistically significant. Patient education was superior to usual care for pain (SMD 20.35, 95% CI 20.56 to 20.14) and function in the short term (20.31, 95% CI 20.62 to 0.00), but inferior to exercise therapy for pain in the short term (0.77, 95% CI 0.07 to 1.47). Combining patient education with exercise therapy produced superior outcomes compared with patient education alone for pain in the short term (0.44, 95% CI 0.19 to 0.69) and function in the short (0.81, 95% CI 0.54 to 1.08) and medium term (0.39, 95% CI 0.15 to 0.62). When using the Western Ontario and McMaster Universities Osteoarthritis Index for these comparisons, clinically important differences indicated that patient education was inferior to exercise therapy for pain in the short term (MD 1.56, 95% CI 0.14 to 2.98) and the combination of patient education and exercise therapy for function in the short term (8.94, 95% CI 6.05 to 11.82).

Conclusion: Although patient education produced statistically superior short-term pain and

function outcomes compared with usual care, differences were small and may not be clinically important. Patient education should not be provided as a standalone treatment and should be combined with exercise therapy to provide statistically superior and clinically important short-term improvements in function compared with education alone.

Registration: PROSPERO registration number CRD42019122004.

2.3 Introduction

Knee osteoarthritis is a leading cause of disability worldwide, affecting up to one in four people over the age of 50 years^{4,72}. The growing healthcare burden related to knee osteoarthritis in many developed countries is considered unsustainable. For example, AU\$905 million was spent in Australia in 2013 on knee replacement surgery alone, a figure expected to rise to AU\$1.38 billion by 2030¹¹⁰. All major clinical practice guidelines recommend patient education, exercise therapy and weight management as first-line interventions for knee osteoarthritis^{116-118,331}. These recommendations are supported by compelling evidence of the effectiveness and cost-effectiveness of exercise therapy^{127,128,332} and weight management^{160,311,333} in people with knee osteoarthritis. However, the inclusion of patient education as a first-line intervention for people with knee osteoarthritis in clinical practice guidelines is often justified by evidence relating to people with various forms of osteoarthritis or chronic pain³³⁴⁻³³⁷.

The most recent published high-quality evidence synthesis evaluating the effectiveness of patient education on pain and function outcomes, including in people with osteoarthritis, was completed in 2012³²³. This Cochrane review³²³ did not distinguish knee osteoarthritis from other arthritic conditions, but reported small to no benefit of patient education programs for pain, function and quality of life compared to providing information only or usual care/no treatment. Other more recent reviews have focused on self-efficacy and quality of life outcomes in people with knee osteoarthritis following education^{132,313}. The review that examined self-efficacy reported no difference when patient education was compared with a combination of patient education and exercise therapy³¹³. The review that examined quality of life reported no difference when self-directed education was compared with a combination of self-directed education and physical activity or therapist-facilitated patient education alone¹³².

No recent comprehensive review specifically evaluating pain and function outcomes in people with knee osteoarthritis exists to guide clinical practice guidelines.

The primary objectives of this review were to estimate the effects of patient education on self-reported pain and function outcomes as a standalone intervention or in combination with other interventions for people with knee osteoarthritis. The secondary aims of this review were to estimate the effect of patient education on psychological outcomes and to estimate the effects of therapist-facilitated education compared with self-directed education on pain and function outcomes for people with knee osteoarthritis.

Therefore, the research question for this systematic review was:

Is patient education effective as a standalone intervention or combined with other interventions for people with knee osteoarthritis?

2.4 Methods

The protocol for this systematic review was prospectively registered in January 2019. The design and reporting of this review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement³³⁸.

2.4.1 Identification and selection of studies

A comprehensive search strategy was devised based upon guidelines provided by the Cochrane Collaboration³³⁹ plus a previous review investigating patient education in patellofemoral pain³⁴⁰. The search strategy was applied to the following databases from inception to April 2020: MEDLINE via OVID; EMBASE via OVID; SPORTDiscus via EBSCO; CINAHL via EBSCO; and Web of Science. The search strategy was developed

using Medical Subject Headings (MeSH) and keywords to identify randomised controlled trials in adults with knee osteoarthritis. The search strategy can be found in [Appendix 2B](#).

All references were imported into reference management software and duplicates were removed. Two reviewers (AJG and DOS) independently reviewed the titles and abstracts, obtaining full-text copies of potentially eligible articles for review. Full texts were then independently reviewed by the same two reviewers to determine eligibility based upon the inclusion criteria shown in Box 2.1. In the case of disagreements, a third reviewer (CJB) was consulted to reach a consensus.

Box 2.1 Inclusion criteria

- Design
- Randomised controlled trials including cluster randomised controlled trials
- Participants
- People with clinical or radiographically diagnosed knee osteoarthritis
- Intervention
- Any form of patient education
- Outcome measures
- Primary outcome measures: self-reported joint-related pain or function scales
 - Secondary outcomes: self-reported psychological outcomes
- Comparisons
- Any other non-pharmacological intervention including usual care or no treatment

Randomised controlled trials, including cluster randomised trials, delivering any form of patient education for people with either clinical or radiographically confirmed knee osteoarthritis^{34,116-118,331}, compared with any non-pharmacological intervention, were considered for inclusion in this review, even if the patient educational intervention was the control intervention. No date, setting or language restrictions were applied. Non-randomised controlled trials, cross-sectional studies, case series and case reports were excluded from this review.

2.4.2 Assessment of the characteristics of studies

Risk of bias was assessed by two independent reviewers (AJG and MM) using the Cochrane Risk of Bias Tool³⁴¹ under the following categories: random sequence generation; allocation concealment; blinding of participants and personnel; blinding of outcome assessment; incomplete outcome data; selective reporting; other bias (imbalances in baseline characteristics and compliance with the intervention). Following consultation and agreement between three people in the research team (AJG, DOS and CJB), trials were classified as low risk of bias when they appropriately reported that they met at least four of these seven criteria, and high risk of bias otherwise.

2.4.3 Data analysis

Participant and study characteristics and means and standard deviations (SDs) for primary and secondary outcomes were extracted by two reviewers independently (AJG and ECB). The primary outcomes were self-reported joint-related pain and function measures, such as the WOMAC³⁴² and the VAS for pain. Secondary outcomes were self-reported psychological measures, such as the arthritis self-efficacy scale³⁰³, pain catastrophising scale³⁴³ and the Coping Strategies Questionnaire³⁴⁴. Authors were contacted a maximum of two times via email to request necessary data when it could not be extracted from a published manuscript (e.g., data were pooled for hip and knee osteoarthritis, or mean changes were reported) before the manuscript was excluded. When a trial reported data that required transformation to a different statistic for meta-analysis, appropriate calculations were made according to the Cochrane handbook³³⁹ and previous research³⁴⁵.

Data analysis of the primary and secondary outcomes was completed using Cochrane

Collaboration software. The data were pooled when trials investigated similar patient education interventions as standalone interventions or in combination with other interventions. An overall estimate of effect was calculated using a random-effects model and reported as the SMD and 95% CI. Based upon consideration of recommendations from Cohen³⁴⁶ and the Cochrane handbook³³⁹, the effect sizes were categorised as small (<0.3), moderate (0.3 to 0.5), large (0.5 to 0.8) or very large (>0.80). Heterogeneity was quantified with the I^2 statistic.

The certainty of evidence for pooled trials was assessed and interpreted using Grading of Recommendations, Assessment, Development and Evaluations (GRADE)^{347,348} and summarised using GRADE Pro Software. Although it was planned to use a modified version of van Tulder's criteria³⁴⁹, it was decided to follow the Cochrane Handbook's recommendation to use GRADE. Full details of the upgrade and downgrade criteria for all categories of GRADE, including heterogeneity, can be found in [Appendix 2C](#).

Data that could not be pooled were presented in table format and pooled data were presented using forest plots and summarised as SMDs and 95% CIs. In addition to this planned analysis, when all trials containing the same intervention type used the same outcome measure, the MD was also calculated using a random-effects model to aid clinical interpretation. Each was subsequently compared against suggested MCIDs in published literature^{350,351}. MCIDs of 1.5 points for pain³⁵⁰ and 6 points for function³⁵¹ were nominated on the respective subsections of the WOMAC outcome measure. When a manuscript presented the mean or MCID in a scaled format, it was converted back into the outcome's original raw form for pooling and interpretation.

Due to large variation in when outcome measures were assessed, subgrouping of results (short

term (<6 months), medium term (6 to 12 months) and long term (>12 months)) was introduced where possible. These timelines are in line with Cochrane reviews investigating patient education in osteoarthritis and exercise therapy in knee osteoarthritis^{129,323}.

A post hoc comparison between therapist-facilitated and self-directed education was deemed important, considering potential differences in healthcare resources and outcomes between the two. Therapist-facilitated education was classified as any educational intervention where the education was actively facilitated by a health professional, regardless of profession (e.g., physiotherapist, dietician, doctor), including one-to-one consultations, group classes, telephone consultations and telerehabilitation. Self-directed education was classified as any educational intervention that did not involve a health professional explanation or opportunity for participants to ask questions related to the educational content (e.g., leaflets, booklets, websites).

Although sensitivity analyses of effect were not planned, they were deemed necessary due to the presence of included trials with: multiple groups with similar interventions, multiple data outcomes within the same pre-specified time point, or multiple outcome measures for the same construct.

A planned mixed-methods analysis including a content evaluation of included trials and a cross-sectional analysis of general web-content will be published elsewhere. Splitting of these further evaluations from this systematic review was considered necessary to improve the clarity and impact of each component.

2.5 Results

2.5.1 Flow of studies through the review

The flow of trials through the review process can be found in Figure 2.1. Following the removal of duplicates, 4,528 records were screened, and 128 full-text articles were assessed for eligibility. This assessment led to the exclusion of 99 articles, primarily due to an ineligible study design ($n = 47$) or inability to acquire the necessary data from the authors ($n = 25$). Full details of all excluded trials can be found in [Appendix 2D](#). Twenty-nine trials involving 4,107 participants were included in the analysis.

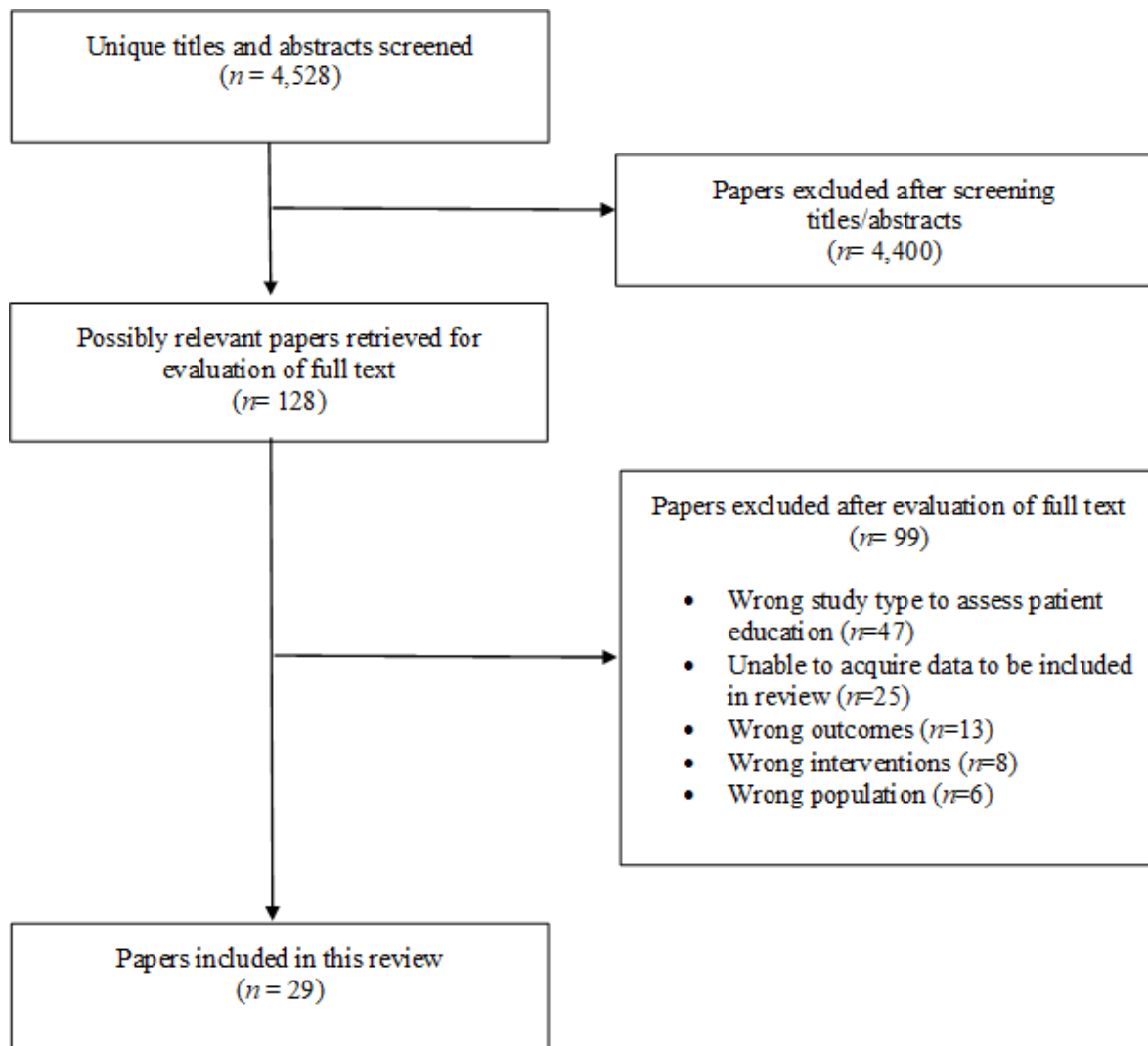





Figure 2.1 Flow of trials through the review.

2.5.2 Characteristics of trials

Characteristics of the 33 included trials are provided in Table 2.1 Twenty-eight trials included evaluation of patient education as a standalone intervention^{292-294,352-376}. When patient education was combined with other interventions, it was always combined with exercise therapy ($n = 10$)^{292,294,356,357,363,365,368,369,373,377}. A total of 41 patient education interventions were identified across the 29 trials. Of the 41 patient education interventions, 14 were provided as a control, all of which were provided as standalone interventions^{352,355-359,361-364,368,369,373,374,376}. More details of the included trials and interventions can be found in Table 2.3 in [Appendix 2E](#).

The results from the risk of bias analysis can be found in Figure 2.2. Before final decisions were made, there was a 91% agreement rate between the two independent reviewers. Eleven trials (38%) were classified as low risk of bias according to the definition of $>4/7$ categories on the Cochrane Risk of Bias Tool^{292,353,355,357,359,360,363,365,367,368,371}, with the remaining 18 (62%) classified as having high risk of bias^{293,294,352,354,356,358,361,362,364,366,369,370,372-377}. All trials were downgraded for performance and detection bias.

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Ackerman et al 2012	+	+	-	-	-	+	-
Allen et al 2010	+	+	-	?	+	+	?
Allen et al 2016	+	?	-	?	+	+	?
Allen et al 2019	+	?	-	?	+	+	?
Ay et al 2013	?	?	-	-	+	+	+
Baker et al 2001	+	+	?	-	+	+	+
Bennell et al 2016	+	+	-	-	?	+	+
Brosseau et al 2016	+	?	-	?	-	+	?
Chen et al 2019	+	+	-	?	?	+	+
Cheung et al 2017	+	-	-	?	+	+	-
Cheung et al 2020	+	+	-	?	+	+	+
Coleman et al 2012	+	+	-	?	+	+	?
De Rezende et al 2016	+	?	-	?	?	-	?
De Rezende et al 2017	+	?	-	-	?	+	?
Dias et al 2017	+	+	-	?	+	+	?
Ettinger et al 1997	+	?	-	?	+	-	+
Farr et al 2010	+	+	-	?	?	+	+
Ganji et al 2018	+	?	-	?	?	+	+
Helminen et al 2015	+	+	-	?	?	+	+
Hinman et al 2020	+	+	?	?	+	+	+
Keefe et al 2004	?	?	-	-	+	+	-
Messier et al 2004	+	?	-	?	+	+	?
Murphy et al 2018	+	-	-	?	?	+	+
O'Brien et al 2018	+	+	?	?	?	+	+
O'Moore et al 2018	+	+	-	?	?	+	?
Oh et al 2020	?	?	-	?	-	+	?
Qingguang et al 2017	+	?	-	?	+	+	?
Taglietti et al 2018	+	+	-	?	?	+	?
Victor et al 2005	-	+	-	?	-	?	+

-  = Low risk of bias
 = Unclear risk of bias
 = High risk of bias

A trial is classified as low risk of bias if $\geq 4/7$ items are denoted low risk of bias. A trial is classified as high risk of bias if $< 4/7$ items are denoted low risk of bias

Figure 2.2 Risk of bias for included trials.

Table 2.1 Characteristics of included trials

Study	Participants		Intervention	
	Eligible population	Participants Age (SD) Sex (%) Male/Female) BMI (SD)	Participants Age (SD) Sex (%) Male/Female) BMI (SD))	Education Comparator
Ackerman et al. (2012) ³⁵²	Orthopaedic or rheumatology patients	63.5 (10.8) 38/62 30 (24-35 IQR)	66.6 (10.9) 42/62 29 (26-35 IQR)	Patient education (therapist-facilitated) (<i>n</i> = 58) Patient education (self-directed) (<i>n</i> = 62)
Allen et al. (2010) ³⁵³	Primary care patients from a veterans medical centre	60.3 (10.3) 92/8 32.0 (7.0)	60.3 (10.8) 93/7 31.6 (6.5)	Patient education (therapist-facilitated) (<i>n</i> = 172) Usual care (<i>n</i> = 172)
Allen et al. (2016) ³⁵⁴	Overweight patients recruited from a veterans medical centre	60.4 (9.4), 87/13 34.3 (6.0)	61.7 (9.0) 95/5 33.4 (5.7)	Patient education (therapist-facilitated) (<i>n</i> = 151) Usual care (<i>n</i> = 149)
Allen et al. (2019) ²⁹³	African Americans recruited from a veterans medical centre	59.2 (9.8) 51/49 35.6 (8.4)	58.9 (10.9) 51/49 34.8 (7.9)	Patient education (therapist-facilitated) (<i>n</i> = 124) Usual care (<i>n</i> = 124)
Ay et al. (2013) ^{a377}	No details provided	59.35 (11.71) 3/17 NR	61.50 (11.05) 25/75 NR	Patient education (therapist-facilitated) + exercise therapy (<i>n</i> = 20) Exercise therapy (<i>n</i> = 20)
Baker et al. (2001) ³⁵⁵	Community dwelling	69 (6) 15/85 31 (4)	68 (6) 83/17 32 (5)	Patient education (therapist-facilitated) (<i>n</i> = 23) Exercise therapy (<i>n</i> = 23)
Bennell et al. (2016) ²⁹²	Community dwelling	63.0 (7.9) 39/61 30.8 (20)	62.7 (7.9) 41/59 31.5 (6)	Patient education (therapist-facilitated) (<i>n</i> = 74) Exercise therapy (<i>n</i> = 75)
			64.6 (8.3) 40/60 31.0 (6)	Patient education (therapist-facilitated) + exercise therapy (<i>n</i> = 73)

Brosseau et al. (2012) ^{a356}	Community dwelling	62.3 (6.8) 37/63 29.9 (5.3)	63.9 (10.3) 30/70 29.4 (5.4)	Patient education (self-directed) (<i>n</i> = 74)	Patient education (self-directed) + exercise therapy (<i>n</i> = 79)
Chen et al. (2019) ³⁵⁷	Community dwelling	68.8 (6.96) 14/86 25.4 (3.51)	68.9 (7.78) 17/83 25 (3.45)	Patient education (therapist-facilitated) (<i>n</i> = 70)	Patient education (therapist-facilitated) + exercise therapy (<i>n</i> = 70)
Cheung et al. (2017) ^{b358}	Community dwelling	71.8 (8.0) NR 27.8 (7.9)	74.4 (7.5) NR 29.2 (7.1)	Patient education (therapist-facilitated) (<i>n</i> = 23)	Exercise therapy (<i>n</i> = 28)
Cheung et al. (2020) ³⁵⁹	Community dwelling	62.83 (5.8) 72/28 22.06 (2.1)	64.41 (6.1) 82/18 22.66 (1.3)	Patient education (therapist-facilitated) (<i>n</i> = 18)	Acupressure (<i>n</i> = 17)
Coleman et al. (2012) ³⁶⁰	Primary care	65 (7.9), 20/80 NR	65 (8.7) 31/69 NR	Patient education (therapist-facilitated) (<i>n</i> = 71)	Usual care (<i>n</i> = 75)
De Rezende et al. (2016) ^{b361}	Trauma and orthopaedic patients	NR NR NR	NR NR NR	Patient education (therapist-facilitated) (1a) (<i>n</i> = 29)	Patient education (self-directed) (group 4b) (<i>n</i> = 29)
De Rezende et al. (2017) ^{b362}	Trauma and orthopaedic patients	NR NR NR	NR NR NR	Patient education (therapist-facilitated) (1a) (<i>n</i> = 29)	Patient education (self-directed) (Group 4b) (<i>n</i> = 29)
Dias et al. (2017) ³⁶³	Community dwelling	71.0 (5.2) 0/100 30.0 (5.2)	70.8 (5.0) 0/100 30.5 (4.3)	Patient education (therapist-facilitated) (<i>n</i> = 32)	Patient education (therapist-facilitated) + exercise therapy (<i>n</i> = 33)
Ettinger et al. (1997) ^{b364}	Community dwelling	69 (6) 36/64 NR	68 (6) 27/73 NR	Patient education (therapist-facilitated) (<i>n</i> = 149)	Exercise therapy (<i>n</i> = 146)
Farr et al. (2010) ³⁶⁵	Community dwelling	55.8 (6.1) 28/72 28 (4.0)	55.5 (7.3) 27/73 27.5 (4.5) 54.2 (7.3) 21/79 27.2 (4.2)	Patient education (therapist-facilitated) (<i>n</i> = 57)	Exercise therapy (<i>n</i> = 52) Patient education (therapist-facilitated) + exercise therapy (<i>n</i> = 62)

Ganji et al. (2018) ³⁶⁶	Patients referred to an elderly care clinic	65.34 (6.2) NR NR	64.58 (4.7) NR NR	Patient education (therapist-facilitated) (<i>n</i> = 42)	Usual care (<i>n</i> = 41)
Helminen et al. (2015) ³⁶⁷	Recruited from primary healthcare	64.5 (7.3) 29/71 30.1 (6)	62.8 (7.2) 32/68 29.9 (6.3)	Patient education (therapist-facilitated) (<i>n</i> = 55)	Usual care (<i>n</i> = 56)
Hinman et al. (2020) ³⁶⁸	Community dwelling	62.5 (8.1) 38/62 31.2 (7.6).	62.4 (9.1) 37/63 31.1 (6.8)	Patient education (therapist-facilitated) (<i>n</i> = 88)	Patient education (therapist-facilitated) + exercise therapy (<i>n</i> = 87)
Keefe et al. (2004) ²⁹⁴	Patients recruited from rheumatology clinics	60 (12.2) 50/50 NR	60.25 (8.7) 66/34 NR	Patient education (therapist-facilitated) (<i>n</i> = 18)	Exercise therapy (<i>n</i> = 16)
			60.20 (9.1) 35/65 NR		Patient education (therapist-facilitated) + exercise therapy (<i>n</i> = 20)
			57.56 (14.3) 39/61 NR		Usual care (<i>n</i> = 18)
Messier et al. (2004) ¹³⁶⁹	Community dwelling	69 (0.1) ^c 32/68 34.2 (0.6) ^c	68 (0.7) ^c 28/22 34.5 (0.6) ^c	Patient education (therapist-facilitated, healthy lifestyle) (<i>n</i> = 78)	Patient education (therapist-facilitated) + exercise therapy (<i>n</i> = 82)
		68 (0.7) ^c 28/72 34.5 (0.6) ^c	69 (0.8) ^c 14/86 34.2 (0.6) ^c	Patient education (therapist-facilitated, weight loss focus) (<i>n</i> = 82)	Exercise therapy (<i>n</i> = 80)
Murphy et al. (2018) ³⁷⁰	Community dwelling	64.8 (8.0) 23/77 32.9 (6.3)	60.7 (8.5) 27/73 29.8 (5.3)	Patient education (therapist-facilitated) (<i>n</i> = 31)	Usual care (<i>n</i> = 15)
O'Brien et al. (2018) ³⁷¹	Patients on orthopaedic consultation waitlist	63.0 (11.1) 34/66 33.4 (3.4)	60.2 (13.9) 42/58 32.1 (3.1)	Patient education (therapist-facilitated) (<i>n</i> = 59)	Usual care (<i>n</i> = 60)
O'Moore et al. (2018) ³⁷²	Recruited from healthcare organisations	63.16 (7.38) 14/86 NR	59.68 (6.01) 32/68 NR	Patient education (self-directed) (<i>n</i> = 44)	Usual care (<i>n</i> = 25)
Oh et al. (2020) ³⁷³	General community	71.06 (5.4) NR	72.44 (6.3) NR	Patient education (therapist-facilitated)	Patient education (therapist-facilitated) + exercise therapy (<i>n</i> = 40)

		25.72 (3.8)	24.57 (2.5)	(n = 20)	
Qingguang et al. (2017) ³⁷⁴	Recruited from community centres	64.5 (3.4) 0/100 25.0 (3.4)	64.6 (3.4) 0/100 25.2 (3.5)	Patient education (therapist-facilitated) (n = 23)	Exercise therapy (n = 23)
Taglietti et al. (2018) ³⁷⁵	Recruited from primary healthcare facility	68.7 (6.7) 38/62 29.2 (0.8)	67.3 (5.9) 26/74 30.4 (0.9)	Patient education (therapist-facilitated) (n = 29)	Exercise therapy (n = 31)
Victor et al. (2005) ³⁷⁶	Patients referred to rheumatology clinics	62 (11) 25/75 NR	65 (11) 32/68 NR	Patient education (therapist-facilitated) (n = 120)	Patient education (self-directed) (n = 73)

BMI = Body mass index, SD = Standard deviation, IQR = Interquartile range, NR = not reported

Age and BMI data are the mean (SD) or median (IQR), except where noted.

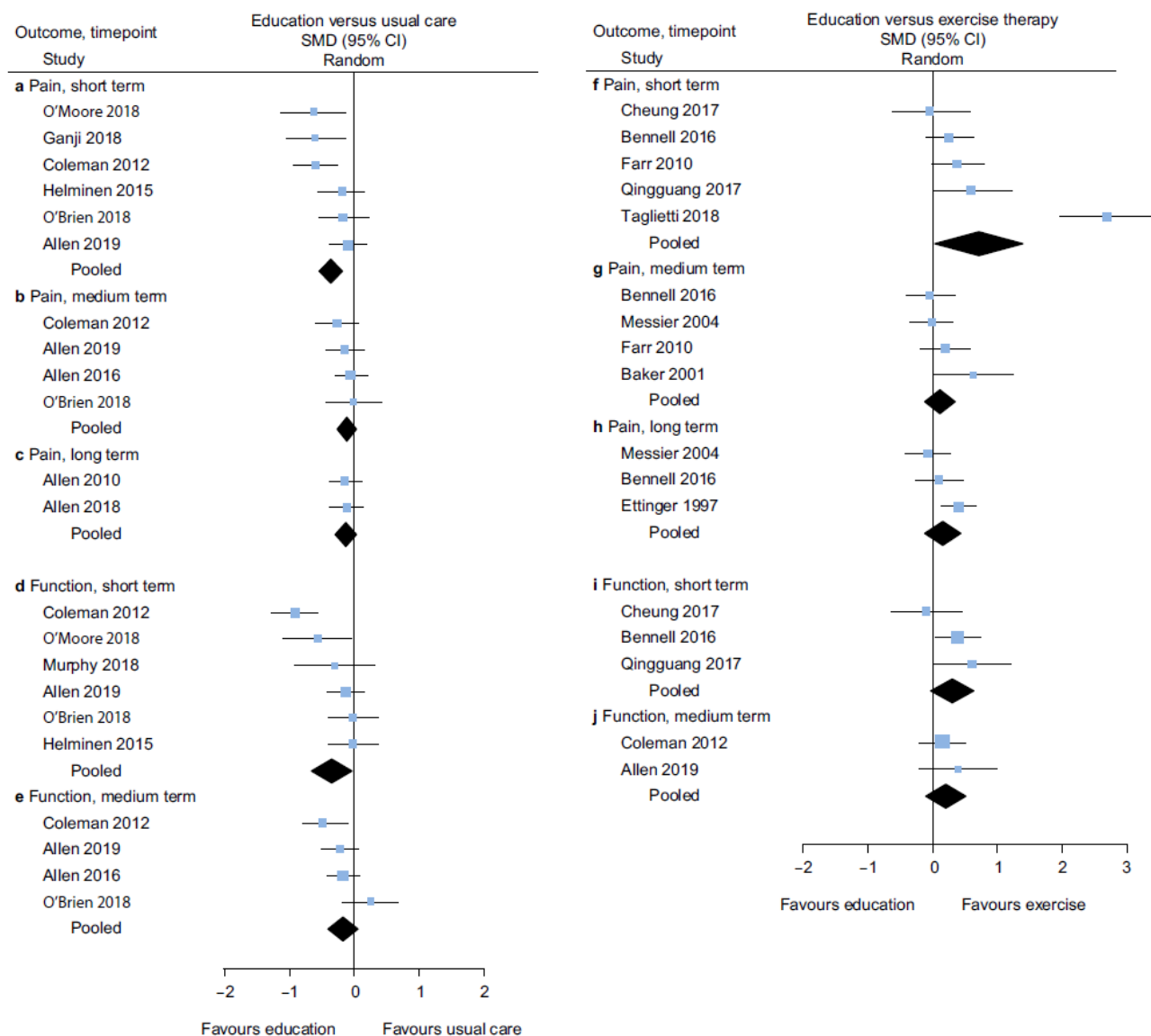
^a - Trial included at least one other intervention group that was not used in the analysis.

^b - Trial included at least one other intervention group that was used for sensitivity analysis only.

^c - standard error.

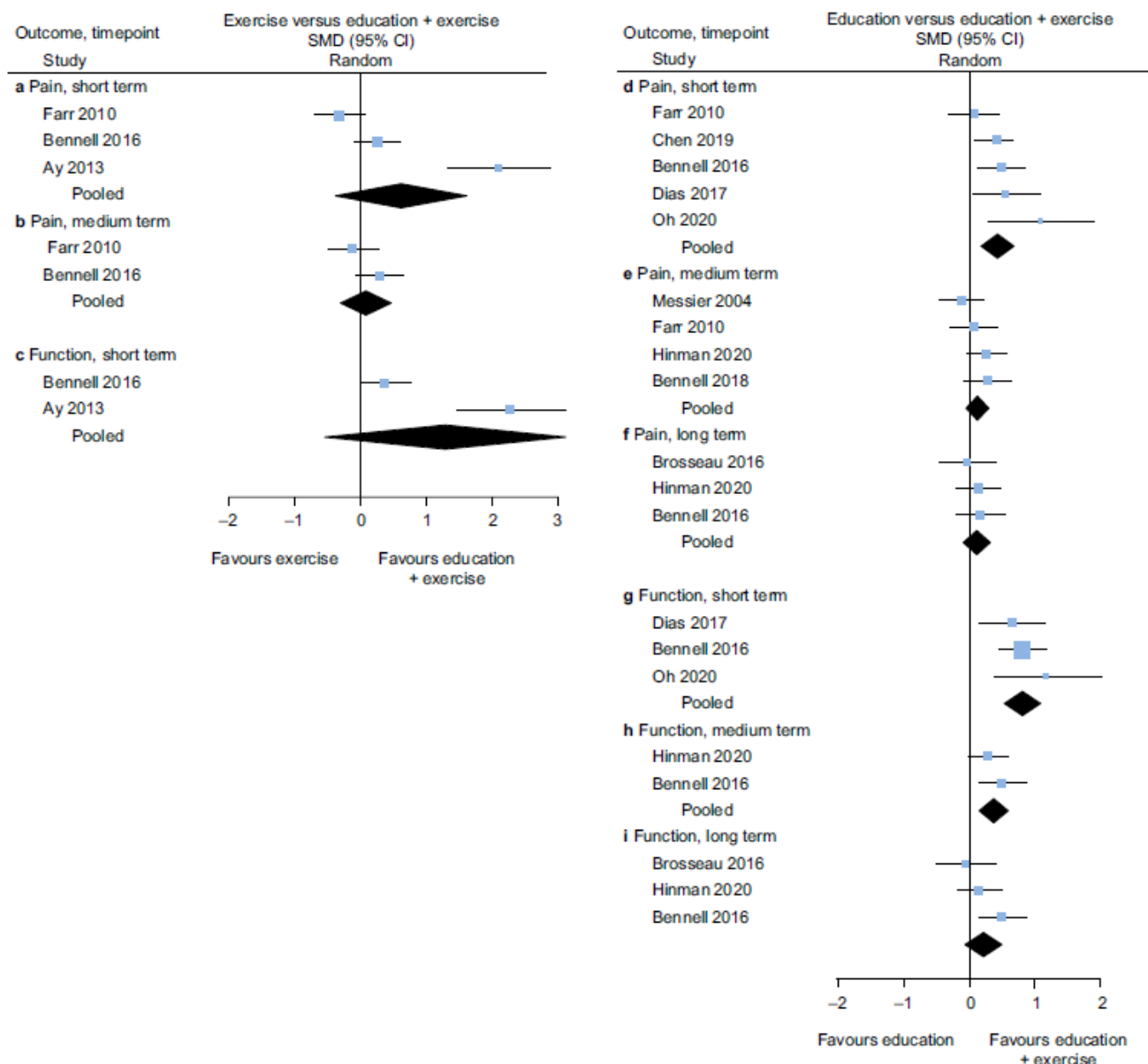
2.5.3 Effect of the intervention

The results of data pooling for the primary outcomes are shown in Figure 2.3 (i.e., the effects of patient education as a standalone intervention) and Figure 2.4 (i.e., the effects of patient education in combination with other interventions). The summarised results of the pooled secondary outcomes can be found in Table 2.2. The results of data pooling for the secondary outcomes can be found in [Appendix 2F](#). The summary GRADE tables for all comparisons are shown in [Appendix 2G](#). The summarised results of the unpooled data are shown in [Appendix 2H](#). The summarised results of the MD analysis for all possible comparisons are shown in Table 2.3. Forest plots for all MD comparisons can be found in [Appendix 2I](#). Note that more detailed forest plots for Figures 2.3 and 2.4 are available as [Appendix 2J](#) and [Appendix 2K](#) respectively.



SMD = Standardised mean difference, 95% CI = 95% confidence interval

Figure 2.3 Effect of patient education relative to usual care on pain in the (a) short, (b) medium and (c) long term and on function in the (d) short and (e) medium term. Effect of patient education relative to exercise on pain in the (f) short, (g) medium and (h) long term and on function in the (i) short and (j) medium term.



SMD = Standardised mean difference, 95% CI = 95% confidence interval

Figure 2.4 Effect of patient education in combination with exercise therapy relative to exercise therapy alone on pain in the (a) short and (b) medium term and on function in the (c) short term. Effect of patient education in combination with exercise therapy relative to education alone on pain in the (d) short, (e) medium and (f) long term and on function in the (g) short, (h) medium and (i) long term.

2.5.4 Patient education as a standalone intervention

Very low certainty evidence indicated that patient education is superior to usual care for pain in the short term (SMD 20.35, 95% CI 20.56 to 20.14) based on six trials^{293,360,366,367,371,372}

(Figure 2.3a). Low certainty evidence indicated that patient education produces similar outcomes to usual care for pain in the medium term (SMD 20.10, 95% CI 20.26 to 0.05; four trials^{293,354,360,371}, Figure 2.3b). Very low certainty evidence indicated that patient education produces similar outcomes to usual care for pain in the long term (SMD 20.12, 95% CI 20.30 to 0.05; two trials^{353,354}, Figure 2.3c). Very low certainty evidence indicated that patient education is superior to usual care for function in the short term (SMD 20.31, 95% CI 20.62 to 0.00; six trials^{293,360,367,370-372}, Figure 2.3d) but produces similar outcomes for function in the medium term (SMD 20.17, 95% CI 20.40 to 0.07; four trials^{293,354,360,371}, Figure 2.3e).

Very low certainty evidence indicated that patient education is inferior to exercise therapy for pain in the short term (SMD 0.77, 95% CI 0.07 to 1.47; five trials^{292,358,365,374,375}, Figure 2.3f) but produces similar results for pain in the medium term (SMD 0.12, 95% CI 20.11 to 0.36; four trials^{292,355,365,369}, Figure 2.3g) and long term (SMD 0.18, 95% CI 20.11 to 0.46; three trials^{292,364,377}, Figure 2.3h). Very low certainty evidence indicated that patient education produces similar outcomes for function in the short term (SMD 0.33, 95% CI 20.02 to 0.69; three trials^{292,358,374}, Figure 2.3i) and medium term (SMD 0.23, 95% CI 20.08 to 0.54; two trials^{292,355}, Figure 2.3j).

2.5.5 Patient education in combination with other interventions

Very low certainty evidence indicated that patient education combined with exercise therapy produces similar outcomes compared with exercise therapy alone for pain in the short term (SMD 0.61, 95% CI 20.40 to 1.62; three trials^{292,365,377}, Figure 2.4a) and medium term (SMD 20.10, 95% CI 20.30 to 0.50; two trials^{292,365}, Figure 2.4b), and for function in the short term (SMD 1.32, 95% CI 20.57 to 3.20; two trials^{292,377}, Figure 2.4c).

Very low certainty evidence indicated that patient education combined with exercise therapy is superior to patient education alone for pain in the short term (SMD 0.44, 95% CI 0.19 to 0.69; five trials^{292,357,363,365,373}, Figure 2.4d). Low certainty evidence indicated that patient education combined with exercise therapy produces similar outcomes to patient education alone for pain in the medium term (SMD 0.14, 95% CI 0.04 to 0.32; four trials^{292,365,368,369}, Figure 2.4e). Low certainty evidence indicated that patient education combined with exercise therapy produces similar outcomes to patient education alone for pain in the long term (SMD 0.17, 95% CI 0.13 to 0.33; two trials^{292,368}, Figure 2.4f). Low certainty evidence indicated that patient education combined with exercise therapy produces superior outcomes compared with patient education alone for function in the short term (SMD 0.81, 95% CI 0.54 to 1.08; three trials^{292,363,373}, Figure 2.4g) and medium term (SMD 0.39, 95% CI 0.15 to 0.62; two trials^{292,368}, Figure 2.4h). Very low certainty evidence indicated that patient education combined with exercise therapy produces similar outcomes compared with patient education alone for function in the long term (SMD 0.24, 95% CI 0.06 to 0.54; two trials^{292,368}, Figure 2.4i).

2.5.6 Secondary outcomes

Full details of all comparisons can be found in Table 2.2. Detailed forest plots are presented in [Appendix 2L](#). Very low certainty evidence indicated that patient education combined with exercise therapy is superior to patient education alone in the short term for self-efficacy (SMD 0.46, 95% CI 0.02 to 0.89; two trials^{292,294}). Very low certainty evidence indicated that patient education is superior for pain coping compared with usual care (SMD 20.71, 95% CI 21.32 to 20.01) and exercise therapy (SMD 20.96, 95% CI 21.42 to 20.49; two trials^{292,294}) in the short term.

Table 2.2 Summary of secondary outcomes (SMD) for all pooled data (Forest plots are found in [Appendix 2L](#))

Comparison	Outcome	Time-point	<i>n</i>	SMD (95%CI)	Certainty
Patient education versus usual care	Self-efficacy	Short-term	2	-0.41 (-0.82 to 0.01)	Very low
	Pain catastrophising	Short-term	3	-0.02 (-0.45 to 0.42)	Very low
	Pain coping	Short-term	2	-0.71 (-1.32 to -0.01)	Very low
Patient education versus exercise therapy	Self-efficacy	Short-term	2	0.09 (-0.82 to 0.65)	Very low
	Pain catastrophising	Short-term	2	-0.16 (-0.62 to 0.30)	Very low
	Pain coping	Short-term	2	-0.96 (-1.42 to -0.49)	Very low
Patient education versus patient education + exercise therapy	Self-efficacy	Short-term	2	0.46 (0.02 to 0.89)	Very low
	Pain catastrophising	Short-term	2	0.15 (-0.15 to 0.46)	Very low
	Pain coping	Short-term	2	0.04 (-0.34 to 0.26)	Very low
Therapist-facilitated education versus self-directed education	Pain	Short-term	3	0.03 (-0.29 to 0.23)	Very low
		Long-term	3	-0.04 (-0.48 to 0.39)	Very low
	Function	Short-term	2	0.09 (-0.21 to 0.40)	Very low
		Long-term	2	-0.05 (0.53 to 0.62)	Very low

n = number of trials, SMD = standardised mean difference, 95% CI = 95% confidence interval.

Table 2.3 Mean difference (MD) for all possible comparisons (See [Appendix 2I](#) for forest plots)

Comparison	n	Outcome	Time-point	MD (95% CI)	MD in relation to MCID
Pain					
Patient education vs usual care	4	WOMAC pain subsection	Medium-term	-0.40 (-0.94 to 0.14)	Not clinically important
Patient education vs exercise therapy	5	WOMAC pain subsection	Short-term	1.56 (0.14 to 2.98)	Clinically important
Patient education vs exercise therapy	4	WOMAC pain subsection	Medium-term	0.42 (-0.39 to 1.23)	Not clinically important
Exercise therapy vs patient education + exercise therapy	3	WOMAC pain subsection	Short-term	2.01 (-1.16 to 5.18)	Clinically important
Exercise therapy vs patient education + exercise therapy	2	WOMAC pain subsection	Medium-term	0.31 (-0.97 to 1.59)	Not clinically important
Patient education vs patient education + exercise therapy	5	WOMAC pain subsection	Short-term	1.48 (0.48 to 2.49)	Not clinically important
Patient education vs patient education + exercise therapy	4	WOMAC pain subsection	Medium-term	0.49 (-0.07 to 1.06)	Not clinically important
Patient education vs patient education + exercise therapy	3	WOMAC pain subsection	Long-term	0.45 (-0.22 to 1.13)	Not clinically important
Therapist-facilitated education vs self-directed education	3	WOMAC pain subsection	Short-term	-0.15 (-0.99 to 0.68)	Not clinically important
Therapist-facilitated education vs self-directed education	3	WOMAC pain subsection	Long-term	-0.13 (-2.00 to 1.74)	Not clinically important
Function					
Patient education vs usual care	6	WOMAC function subsection	Short-term	-2.43 (-4.71 to -0.16)	Not clinically important
Patient education vs usual care	4	WOMAC function subsection	Medium-term	-2.12 (-4.55 to 0.31)	Not clinically important
Patient education vs exercise therapy	3	WOMAC function subsection	Short-term	3.36 (-1.00 to 7.71)	Not clinically important
Patient education vs exercise therapy	2	WOMAC function subsection	Medium-term	2.78 (-1.11 to 6.67)	Not clinically important
Exercise therapy vs patient education + exercise therapy	2	WOMAC function subsection	Short-term	13.08 (-5.44 to 31.60)	Clinically important
Patient education vs patient education + exercise therapy	3	WOMAC function subsection	Short-term	8.94 (6.05 to 11.82)	Clinically important

Patient education vs patient education + exercise therapy	2	WOMAC function subsection	Medium-term	4.61 (1.88 to 7.33)	Not clinically important
Patient education vs patient education + exercise therapy	3	WOMAC function subsection	Long-term	2.69 (-0.26 to 5.65)	Not clinically important
Therapist-facilitated education vs self-directed education*	2	WOMAC function subsection	Short-term	1.02 (-2.91 to 4.94)	Not clinically important
Therapist-facilitated education vs self-directed education	2	WOMAC function subsection	Long-term	0.71 (-7.98 to 9.40)	Not clinically important

Pain coping

Patient education vs usual care	2	Coping strategies questionnaire	Short-term	-19.24 (-31.29 to -7.18)	N.A.
Patient education vs exercise therapy	2	Coping strategies questionnaire	Short-term	-25.11 (-33.27 to -16.96)	N.A.
Patient education vs patient education + exercise therapy	2	Coping strategies questionnaire	Short-term	-1.09 (-9.00 to 6.81)	N.A.

MD = Mean difference, MCID = Minimal clinically important difference, MCID values are 1.5 for pain and 6 for function. 95% CI = 95% confidence interval, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.

Negative MD = supports first listed intervention in comparison, Positive MD = supports second listed intervention in comparison.

* Assumed a typo in manuscript by Victor et al. (2005) – Mean (SD) of 21 (7) for control, 21 (10) for intervention rather than 2.1 (7) and 2.1 (10), respectively, for the WOMAC function section at 1 month that is reported in the manuscript.

2.5.7 Sensitivity analyses

Multiple sensitivity analyses were performed during data analysis. There were five instances where performing a sensitivity analysis for alternate options would have changed the outcome or size of the effect. The details can be found in [Appendix 2M](#). The selection of comparisons used in this review was always based upon similarity of outcome, time points and interventions across pooled trials.

2.6 Discussion

This review provides a comprehensive synthesis of evidence related to patient education for knee osteoarthritis, which can inform guidelines, clinical practice and future research. It is important to note that recommendations are informed primarily by very low credibility evidence. Pooling of 19 comparisons was possible; however, only six (32%) produced statistically significant findings. Of these six comparisons, two were clinically important for pain (i.e., >1.5 points)³⁵¹ or function (i.e., >6 points)¹²⁹ using the respective subsections of the WOMAC. Exercise therapy produced statistically superior and clinically important improvements in pain compared with patient education alone, and combining patient education with exercise therapy resulted in statistically superior and clinically important short-term improvements in function compared with education alone. It is, therefore, recommended that patient education be provided in combination with exercise therapy whenever possible.

Very low certainty evidence indicated that patient education produces a moderate beneficial effect at reducing pain and improving function in the short term compared with usual care. However, improvements may not be clinically important for either pain or function using the

WOMAC, questioning the value of patient education in isolation. It is worth noting that as patient education is a guideline-recommended first-line intervention for people with knee osteoarthritis^{116-118,331}, education provided as part of usual care is unknown. Further research is warranted to investigate the effectiveness of patient education versus a wait-and-see approach.

Very low certainty evidence indicated that patient education combined with exercise therapy produces moderate, statistically significant short-term improvements in pain, and very large, statistically and clinically important short-term improvements in function compared with patient education alone. Low certainty evidence indicated that functional improvements are maintained in the medium term; however, the differences are not clinically important. Although not statistically significant, very low certainty evidence indicated that patient education combined with exercise therapy produces clinically important improvements in short-term pain and function compared with exercise therapy alone. Further research is warranted to explore the benefits of combining patient education with exercise therapy. A possible explanation for these enhanced outcomes may be that providing patient education alongside exercise therapy improves exercise therapy adherence in people with knee osteoarthritis^{311,378}. Additionally, research across a number of musculoskeletal conditions suggests that patient education may improve illness perceptions³⁷⁹, self-efficacy³⁸⁰ and fear-avoidance behaviours³⁸¹, and can create positive attitudes towards³⁸² and a safer environment in which to attempt exercise therapy. One way to potentially sustain improvements in the medium to long term could be providing additional face-to-face education sessions following the immediate treatment period, which, unlike exercise therapy, does not appear to have been explored. Booster exercise therapy sessions have been found to improve adherence to treatment in people with osteoarthritis and low back pain³⁸³.

Very low certainty evidence indicated that patient education is inferior to exercise therapy for pain outcomes, with a large and clinically important difference in the short term; however, this difference was not sustained in the medium or long term. Very low certainty evidence indicated that patient education produces similar outcomes compared with exercise therapy for function in the short and medium term. These findings are in contrast to a recent review which found that patient education produces similar pain and function outcomes compared with exercise therapy in younger people with knee pain³⁰³. The lack of improvement in pain in younger people with knee pain may reflect a reduced need for exercise therapy in less chronic conditions. Additionally, it may also highlight the greater role of exercise therapy for people with knee osteoarthritis due to the associated high rates of comorbidities⁹² and systemic inflammation³⁸⁴.

Very low certainty evidence indicated that patient education has a moderate effect at improving short-term pain coping compared with usual care, and with a very large effect compared with exercise therapy. This is likely due to the highly targeted nature of education interventions to specifically develop pain coping skills in the trials included in this comparison^{292,294,353}.

Combining patient education with exercise therapy did not appear to improve pain coping compared with patient education alone in the short term. However, very low certainty evidence indicated that a combination of patient education and exercise therapy is superior to patient education alone, with a large effect for self-efficacy in the short term. These findings are in contrast to a previous review³¹³ which reported that patient education programs combined with exercise therapy produce similar outcomes to patient education programs alone for self-efficacy outcomes in people with knee osteoarthritis. These contrasting findings may be explained by the

inclusion of different trials in the analysis of the total arthritis self-efficacy scale³⁰³ score in this review, rather than the pain, function and other subsections used in Brand et al.'s review³¹³. The current findings combined with Brand et al.'s¹⁹ findings suggest that patient education with or without exercise therapy has the potential to impact different domains of self-efficacy for people with knee osteoarthritis; however, the relationship is not well understood and requires further investigation. Enhanced pain coping and self-efficacy are desirable due to known associations with improvements in pain, function and physical activity^{380,385,386}, which, in turn, have the potential to enhance quality of life and reduce healthcare utilisation for people with knee osteoarthritis. The psychological benefits of patient education identified in this review highlight the importance of considering outcomes beyond pain and function when guiding treatment recommendations based on available evidence.

Very low certainty evidence indicated that therapist-facilitated education produces similar short-term and long-term pain and function outcomes compared with self-directed education. An important consideration in interpreting these findings is the approaches used in therapist-facilitated education and the content of each education intervention. Participants in De Rezendes's^{361,362} self-directed education intervention received DVD recordings of the face-to-face therapist-facilitated education lectures and workshops. Therefore, the delivery method was different between groups; however, the content was the same. In comparison, both Ackerman et al.'s³⁵² and Victor et al.'s³⁷⁶ delivery methods and contents differed between the therapist-facilitated education and self-directed education interventions. The varied interventions used in these trials makes it challenging to draw any clear conclusions regarding how to provide patient education for people with knee osteoarthritis.

The delivery of therapist-facilitated education interventions in this review varied from singular lectures³⁷⁷ and intensive group-based sessions over a number of sessions^{292,352} to the provision of self-directed education materials with follow-up telephone calls^{293,353,354,357-359} or home visits^{352,355}. The content of patient education interventions was equally varied, ranging from interventions targeting basic knowledge acquisition^{357,360,363,377} to more complex psychologically informed self-management skill development²⁹²⁻²⁹⁴. Combined, these variations reflect the lack of recommendations for delivery method and content in clinical practice guidelines^{116-118,331} and the lack of studies identifying how people with knee osteoarthritis learn best. With the growing emphasis placed on patient-centred care for people with knee osteoarthritis^{116-118,121,331} and other musculoskeletal conditions²⁸⁶, further research evaluating ways to match delivery methods and/or content to someone with knee osteoarthritis's individual needs or preferences is warranted. This could include consideration of blended learning approaches used for other chronic conditions^{387,388}, as well as in tertiary medical³⁸⁹ and healthcare³⁹⁰ education for people with knee osteoarthritis. Identifying the optimal mode and content of patient education will influence how healthcare providers develop educational interventions and prioritise resources for people with knee osteoarthritis.

2.6.1 Limitations

It is important to consider that the results of this review were informed by all patient education interventions. Education interventions were included regardless of the intervention development process (co-design, based on learning theory, etc.) or whether they were used as a control. The decision to include all patient education interventions was made in order to reduce selection bias

and appropriately assess all patient education interventions for people with knee osteoarthritis in the published literature. Further analysis of interventions based on the development process or whether the intervention was designed as a control or not may impact these results. The certainty of the findings is limited due to the low and very low categorisation of evidence using GRADE, and the findings may change in the future with updated reviews on this topic. The variation and nature of patient education interventions, combined with the self-reported outcome measures assessed in this review significantly impacted the risk of bias assessment and the indirectness and imprecision measures of GRADE. The large heterogeneity between the included trials also impacted the imprecision measure of GRADE. Assessment of publication bias was not possible for any comparison due to the small number of trials included within each comparison. Caution should be adopted when applying the recommendations to younger people with knee osteoarthritis (e.g., post-traumatic knee osteoarthritis), as the typical mean age of participants in this review was in the 60s. Lastly, clinical interpretation of the results was not possible for all comparisons, and significant variation exists in the MCID values for the WOMAC pain and function subsections in knee osteoarthritis³⁹¹. The clinical interpretation of these results may change depending upon the comparative MCID chosen and the inclusion of future research.

2.7 Conclusion

Although patient education produced statistically superior short-term pain and function outcomes compared with usual care, the differences were small and may not be clinically important. Patient education should not be provided as a standalone treatment and should be combined with exercise therapy to provide statistically superior and clinically important short-term improvements in function compared with education alone.

Chapter 3 : Knee osteoarthritis education interventions in published trials are typically unclear, not comprehensive enough, and lack robust development: Ancillary analysis of a systematic review

3.1 Preface

Chapter 2 provided evidence for the effectiveness of patient education both as a standalone intervention and in combination with exercise therapy for people with knee osteoarthritis. I identified that patient education produced statistically superior short-term pain and function outcomes compared with usual care, but the differences were small and may not be clinically important³¹². I also identified that patient education was inferior compared to exercise therapy for short-term pain outcomes. Subsequently, the review concluded that patient education should be provided in combination with exercise therapy whenever possible, due to statistically significant and clinically important improvements in function.

As part of my systematic review and meta-analysis³¹², significant variation in terms of ‘what’ patient education was provided and ‘how’ it was delivered to people with knee osteoarthritis were identified. An ancillary analysis of the systematic review investigated this variation further. The primary aims of the ancillary analysis were to summarise i) the content of patient education interventions reported in clinical trials, ii) how patient education interventions were reportedly developed, and iii) how patient education interventions were delivered to people with knee osteoarthritis. The secondary aims were to summarise the differences in content, development

and delivery when patient education was provided as an intervention or a control condition within trials.

The following chapter contains an edited version of the following published paper:

Goff, A.J., De Oliveira Silva, D., Merolli, M., Bell, E.C., Ezzat, A., O'Halloran, P., Crossley,
K.M., & Barton, C.J.

“Knee osteoarthritis education interventions in published trials are typically unclear, not
comprehensive enough, and lack robust development: Ancillary analysis of a systematic review”

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All edits of the published manuscript are grammatical to facilitate alignment with the remainder
of this thesis.

3.2 Abstract

Objective: To summarise the content, development and delivery of education interventions in clinical trials for people with knee osteoarthritis.

Design: Ancillary analysis of a systematic review.

Literature search: MEDLINE, EMBASE, SPORTDiscus, CINAHL and Web of Science were searched from inception to April 2020.

Study selection criteria: randomised controlled trials involving patient education for people with knee osteoarthritis.

Data Synthesis: The content of education interventions was matched against a pre-defined topic list ($n = 14$) and categorised as: accurate and clear, partially accurate/lacks clarity or not reported. I examined whether education interventions included skill development or stated learning objectives, and if they were developed based on theory, previous research or co-design principles. The delivery methods and mode(s) were also identified. Data were summarised descriptively.

Results: Thirty-eight education interventions (30 trials) were included. Interventions lacked comprehensiveness (median topics per intervention = 3/14, range = 0-11). Few topics were accurately and clearly described (10%, 13/136). Sixty-one percent ($n = 23/38$) of interventions targeted skill development and 34% ($n = 13/38$) identified learning objectives. Forty-two percent ($n = 16/38$) were based on theory, 45% ($n = 17/38$) were based on research for chronic conditions, including 32% ($n = 12/38$) based on osteoarthritis. Eleven percent of interventions ($n = 4/38$) were co-designed. Education was typically facilitated through face-to-face sessions (median = 9, range = 0-55) supplemented with telephone calls and/or written materials.

Conclusion: Education interventions for people with knee osteoarthritis lacked comprehensiveness plus accurate and clear descriptions of topics covered. Most interventions failed to identify learning objectives and were not based on theory, previous research, or co-design principles.

Trial registration: PROSPERO registration number CRD42019122004.

3.3 Introduction

Education is recommended as first-line care for most musculoskeletal conditions^{116-118,286,331}. Yet, evidence supporting these guideline recommendations is conflicting and of low certainty^{312,392,393}. Clinical practice guidelines for musculoskeletal conditions generally provide broad education-specific content recommendations, typically referring to ‘information about the condition’ and/or ‘self-management strategies’^{116-118,331}. Further guidance about how to implement recommendations is scarce, possibly due to incomplete reporting of trials informing them^{116-118,137,138,286,331}, and this may undermine implementation of such interventions in clinical practice. Recent systematic reviews on patient education for musculoskeletal conditions^{312,323,340,394} do not provide clear guidance on the value of face-to-face group or individual interventions as compared with self-directed interventions.

Developing patient education interventions based on previous research and/or theoretical frameworks may improve compliance, satisfaction and patient outcomes^{123,290,306,395-397}. Actively involving patients in the learning process to identify their learning objectives, develop skills and encourage behaviour change is considered important to change behaviour^{123,398-400}. Developing interventions through co-design with people with a lived experience of a chronic condition is increasingly employed by healthcare organisations to tailor interventions and improve patient satisfaction⁴⁰¹⁻⁴⁰³. However, little is known about whether these development considerations are implemented and reported within clinical trials evaluating the efficacy and effectiveness of patient education for musculoskeletal conditions.

Knee osteoarthritis is a leading cause of disability worldwide^{4,72}, and is a key example where

patient education is uniformly recommended by guidelines^{116-118,331}. The findings of my recent systematic review³¹² of interventions for people with knee osteoarthritis indicated that: i) patient education is superior to usual care for pain and function in the short term, but differences may not be clinically important, ii) patient education as a standalone intervention is inferior, with a large and clinically important difference, compared to exercise therapy for pain in the short term, and iii) combining patient education with exercise therapy results in clinically important short-term differences in pain and/or function compared to either intervention alone. The previous review did not include a detailed evaluation of the content, development and delivery approaches for patient education interventions of included trials. Further exploration is warranted to add context to the findings and to inform clinical practice.

This study is an ancillary analysis of my previous systematic review and meta-analysis³¹². The primary aims were to summarise i) the content of patient education interventions reported in clinical trials, ii) how patient education interventions were reportedly developed, and iii) how patient education interventions were delivered to people with knee osteoarthritis. The secondary aims were to summarise the differences in content, development or delivery when patient education was provided as an intervention or a control condition within trials.

3.4 Methods

The primary systematic review and meta-analysis³¹² was prospectively registered on the International Prospective Register for Systematic Reviews website (CRD42019122004) in January 2019. Full details of the search strategy, screening and risk of bias assessment can be found in the previous publication³¹².

3.4.1 Deviations from protocol

A meta-analysis for the effectiveness of patient education, with sub-analysis of education content, plus a cross-sectional analysis of general web-based content for knee osteoarthritis was planned. This ancillary analysis was separated from the primary systematic review and web-based content analysis to improve the clarity and impact of each component. The other deviations from the pre-registered protocol were:

- (i) Omission of the planned analysis to determine the effectiveness of education topics on patient outcomes and the associations between the two, due to widespread, incomplete trial reporting.
- (ii) Extraction and reporting of descriptive data, including content comprehensiveness, accuracy and clarity of patient education topics provided, intervention development and delivery method/mode(s), due to their importance for effective translation of interventions to clinical practice.
- (iii) Addition of a comparison of the content, development and delivery of patient education provided as an intervention compared to control conditions—an important consideration when assessing the effectiveness of patient education.

3.4.2 Data extraction – Previously published

Patient-reported outcomes of pain and function

The data extraction and analysis of patient-reported outcomes are presented in my primary systematic review and meta-analysis³¹².

3.4.3 Data extraction – Ancillary analysis

Content: Four members of the research team (AJG, DOS, AME and CJB) identified overarching themes from the recommendations in clinical practice guidelines^{116-118,331}, expert opinion³²⁰ and clinical research^{4,22,34,72,404-408}. Specific content topics were then created based upon the researchers' interpretations of the themes:

- i) general information about the condition (7 topics),
- ii) information to inform and support first-line care (4 topics), and
- iii) information about other treatment options (3 topics).

A transparent, criterion-based scoring rubric was developed to determine when topic descriptions were: i) accurate and clear, ii) partially accurate/lacks clarity, iii) inaccurate, iv) not reported ([Appendix 3A](#)). For example, for exercise therapy, a clear and accurate description was “Advise people with osteoarthritis to exercise as a core treatment irrespective of age, comorbidity, pain severity or disability. Exercise should include local muscle/neuromuscular strengthening and general aerobic fitness”³³¹. An inaccurate description included information indicating that exercise is unsafe or harmful for people with knee osteoarthritis^{41,408}.

Topic descriptions from included trial manuscripts, supplementary materials and/or published protocols were extracted and matched against the scoring rubric by two independent researchers involved in creating the rubric (AJG and AME). An alignment meeting was held prior to extraction to ensure consistent interpretation. A third researcher (CJB) was available to facilitate final agreement, if required. Comprehensiveness, accuracy and clarity of content for patient education interventions was then determined using this information.

Two researchers (AJG and AME) identified whether interventions emphasised one or more pain coping skills as originally identified by Keefe and colleagues³¹⁵. Pain coping skills were chosen due to their frequent use and known effectiveness for people with osteoarthritis^{409,410}, and were recorded as ‘yes’ or ‘not reported’. A third researcher (CJB) was available to facilitate final agreement, if required.

Development: Two researchers (AJG and ECB) independently extracted details about the development of each patient education intervention, including whether it was based on:

- i) learning/behaviour change theory (i.e., theory-based),
- ii) previous research in chronic conditions and/or osteoarthritis, or
- iii) co-designed.

These items were considered by the research team to be important in the development of patient education interventions, and were categorised as either ‘yes’ or ‘not reported’.

An intervention was classified as theory-based if the trial stated a recognised learning or behaviour change theory upon which it was developed. The effectiveness of theories was not considered as judging this was beyond the scope of this ancillary analysis.

An intervention was classified as based on previous research if the trial reported and provided a reference for the same or related published, peer-reviewed intervention for people with chronic conditions, including osteoarthritis⁴¹¹. An intervention was classified as co-designed when a trial or reference that the intervention was based upon explicitly stated that people with a lived experience of the condition were involved in the development process. A third researcher (CJB)

was available to facilitate final agreement, if required.

Delivery: Two researchers (AJG and AME) independently extracted information relating to the number of sessions, delivery method (group, one-to-one, mixed or self-directed) and delivery mode(s) (written, audio, audio-visual, telephone, face-to-face or web-based) for all interventions. Two researchers (AJG and ECB) independently screened trial manuscripts to identify whether learning objectives were stated. A learning objective was defined as a statement about the larger goals of the course or program⁴¹². Apart from the number of sessions, the delivery items were categorised as ‘yes’ or ‘not reported’. A third researcher (CJB) was available to facilitate final agreement, if required.

Secondary aims: For the secondary aims, two researchers (AJG and AME) independently extracted information from included trials relating to whether each patient education intervention was provided as an intervention or control condition within the respective trial. To be considered a control condition, trials had to either explicitly state that the intervention was being used as a control or was classified as a control based on identical education components provided in both arms of a comparison (e.g., education vs the same education + exercise therapy).

3.4.4 Data analysis for primary aims

If two trials reported the same intervention (e.g., one trial reported short-term outcomes and another long-term outcomes of the same trial), they were pooled and only reported once to avoid duplication. If an identical patient education intervention was provided in two arms of a trial, they were pooled and classified as a control to avoid duplication.

Content comprehensiveness, accuracy and clarity: For comprehensiveness, we calculated the number of the 14 content topics provided in each education intervention regardless of accuracy and clarity, and calculated the median and range. For accuracy and clarity, we calculated the frequency and proportion (percentage (%)) of topic descriptors that matched each of our scoring rubrics categories (accurate and clear, partially accurate/lacks clarity, inaccurate or not reported) [Appendix 3A](#).

Development: the frequency and proportion of interventions reporting ‘yes’ to the four pre-defined development items were calculated.

Delivery: the reported number of sessions for each intervention was identified and pooled to present the mean, median and range. The frequency and proportion of the method (group, one-to-one, mixed or self-directed) of interventions were calculated and the mode(s) of delivery were identified (written, audio, audio-visual, telephone, face-to-face or web-based).

3.4.5 Data analysis for secondary aims

The frequency and proportion of content, development and delivery items were compared between interventions when patient education was used as an intervention or control condition.

3.5 Results

Full details of the inclusion/exclusion of trials, risk of bias appraisal, characteristics of all patient education and comparator interventions, and effectiveness of these interventions for pain and

function have been previously published³¹².

3.5.1 Ancillary analysis

Thirty-eight unique patient education interventions were identified and analysed across 30 included trials^{292-294,352-377,413-415}. Fifteen patient education interventions were used as a control condition^{352,356-359,361-364,368,369,373,374,376}.

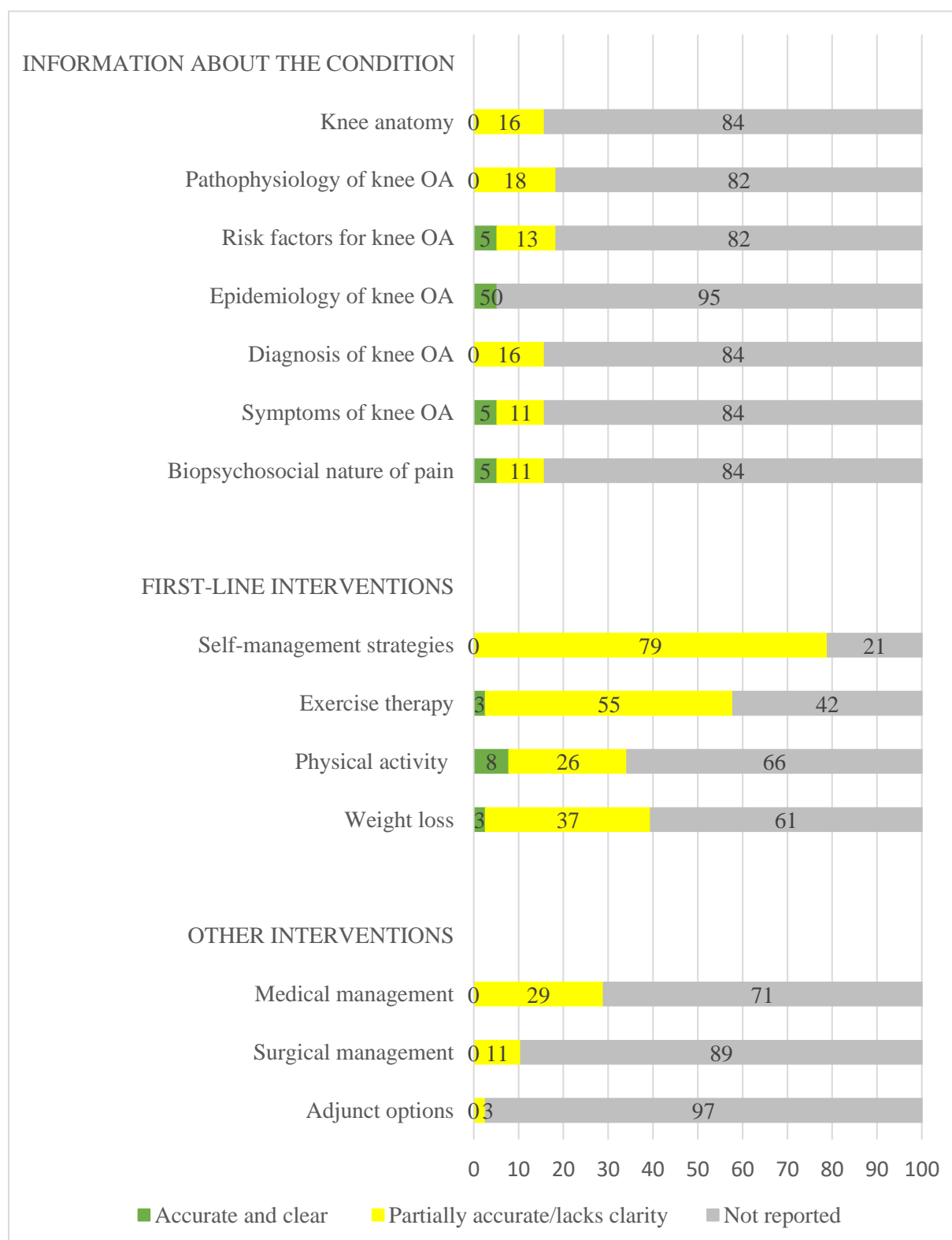
3.5.2 Patient education content

Full details of comprehensiveness, accuracy and clarity by intervention can be found in Figure 3.1. Pooled summaries of comprehensiveness for all interventions, and when patient education was used as an intervention or control condition, can be found in [Appendix 3B](#). The median number of topics provided for all patient education interventions was 3/14 of the pre-defined topics (range 0-11). Pooled summaries of accuracy and clarity for all interventions, and when patient education was used as an intervention or control condition, can be found in Figures 3.2, 3.3 and 3.4, respectively. No content topics were classified as having an ‘inaccurate’ description for any patient education intervention. Refer to [Appendix 3C](#) for a breakdown of the skill emphasis results by intervention. Sixty-one percent ($n = 23/38$) of all interventions emphasised at least one pain coping skill^{292-294,352-354,360-362,365,367,368,371-373,375,376}. When patient education was provided as an intervention, 83% ($n = 19/23$) emphasised developing at least one pain coping skill^{292-294,352-354,360-362,365,367-369,371,372,375,376}. When patient education was provided as a control, 27% ($n = 4/15$) emphasised at least one pain coping skill^{352,361,362,373}.

Author	Intervention name	Number of sessions	Information about the condition							First-line interventions				Other interventions		Comprehensiveness/14	
			Knee anatomy	Pathophysiology of knee OA	Risk factors for knee OA	Epidemiology of knee OA	Diagnosis of knee OA	Symptoms of knee OA	Biopsychosocial nature of	Self-management strategies	Exercise therapy	Physical activity	Weight loss	Medical management	Surgical management		Adjunct options
Ackerman 2012	Intervention group	6															5
	†Control group	N.A															3
Allen 2010	OASMP	12															6
Allen 2016	Intervention group	18															4
Allen 2019	PCST group	11															3
Ay 2013	Group 1	2															7
Baker 2001	†Control	7															1
Bennell 2016	PCST only	13															2
	PCST + Ex-Th	13															3
Brosseau 2016*	†Control	N.A															1
	AND Walking intervention																
Chen 2019	†Control	9															11

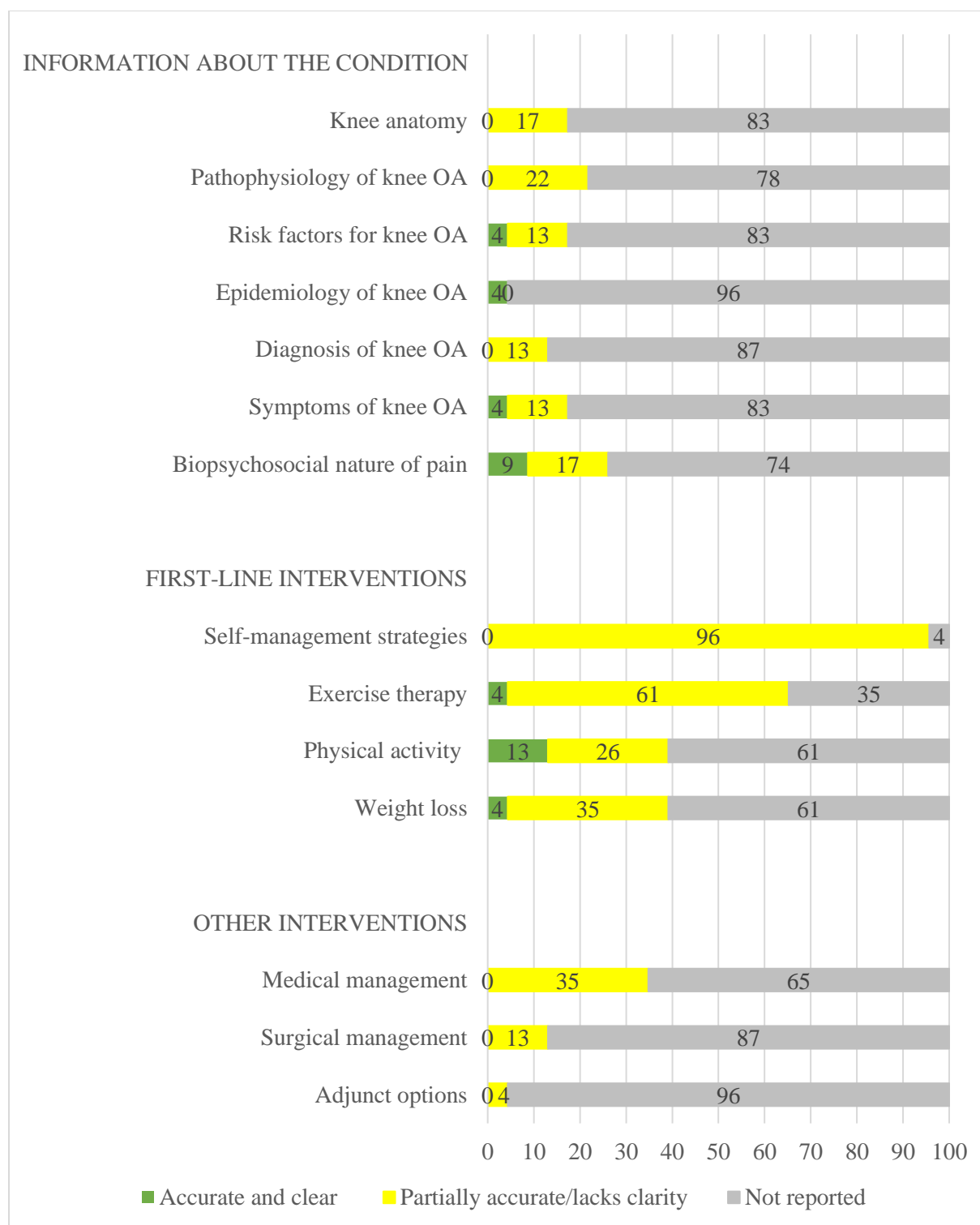
	Education + Ex-Th	9		11
Cheung 2017	!Control	8		3
Cheung 2020	!Control	14		1
Coleman 2012	OAK	6		8
De Rezende 2016 & 2017	Group 1a	2		6
	!Group 4b	N.A		6
Dias 2017	Hydrotherapy	1		3
	!Control	7		3
Ettinger 1997	!Control	16		2
Farr 2010	Self-management	36		4
	Self-management + Ex-Th	13		4
Ganji 2018	Intervention	6		0
Helminen 2015	Intervention	6		3
Hinman 2020	!Control	1		1
	Intervention	6		4
Keefe 2004	SA PCST	12		2
	SA PCST + Ex-Th	12		2
Messier 2004*	!Healthy lifestyle control	12		3
	!Diet	55		1

[illegible]



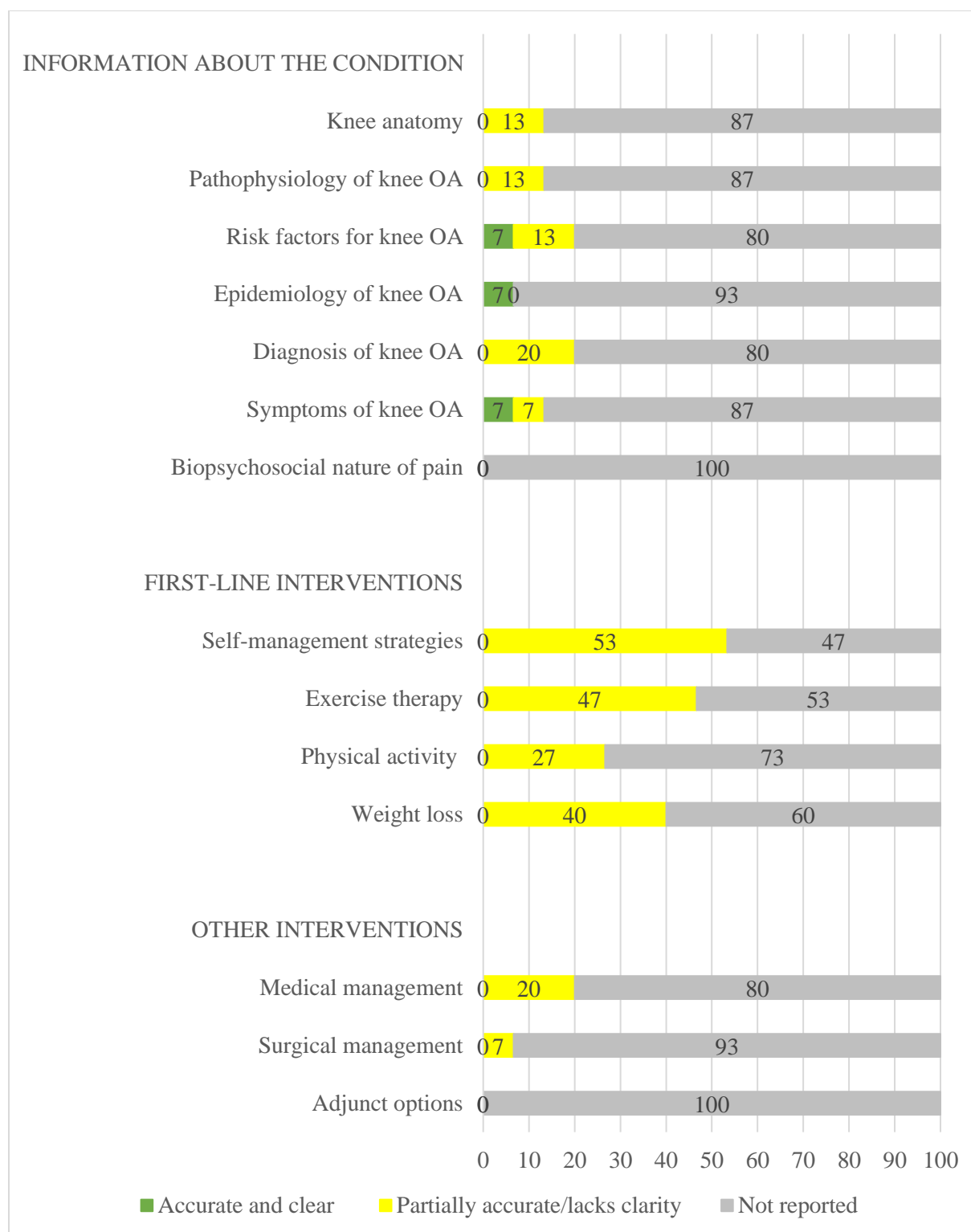
OA = Osteoarthritis

Figure 3.2 Accuracy and clarity (%) of content for all patient education interventions ($n = 38$).



OA = Osteoarthritis

Figure 3.3 Accuracy and clarity (%) of content for patient education used as an intervention ($n = 23$).



OA = osteoarthritis

Figure 3.4 Accuracy and clarity (%) of content for patient education used as a control condition ($n = 15$).

3.6.3 Patient education development

A summary of the development characteristics of the patient education interventions can be found in Figure 3.5. Refer to [Appendix 3D](#) for a breakdown by intervention.

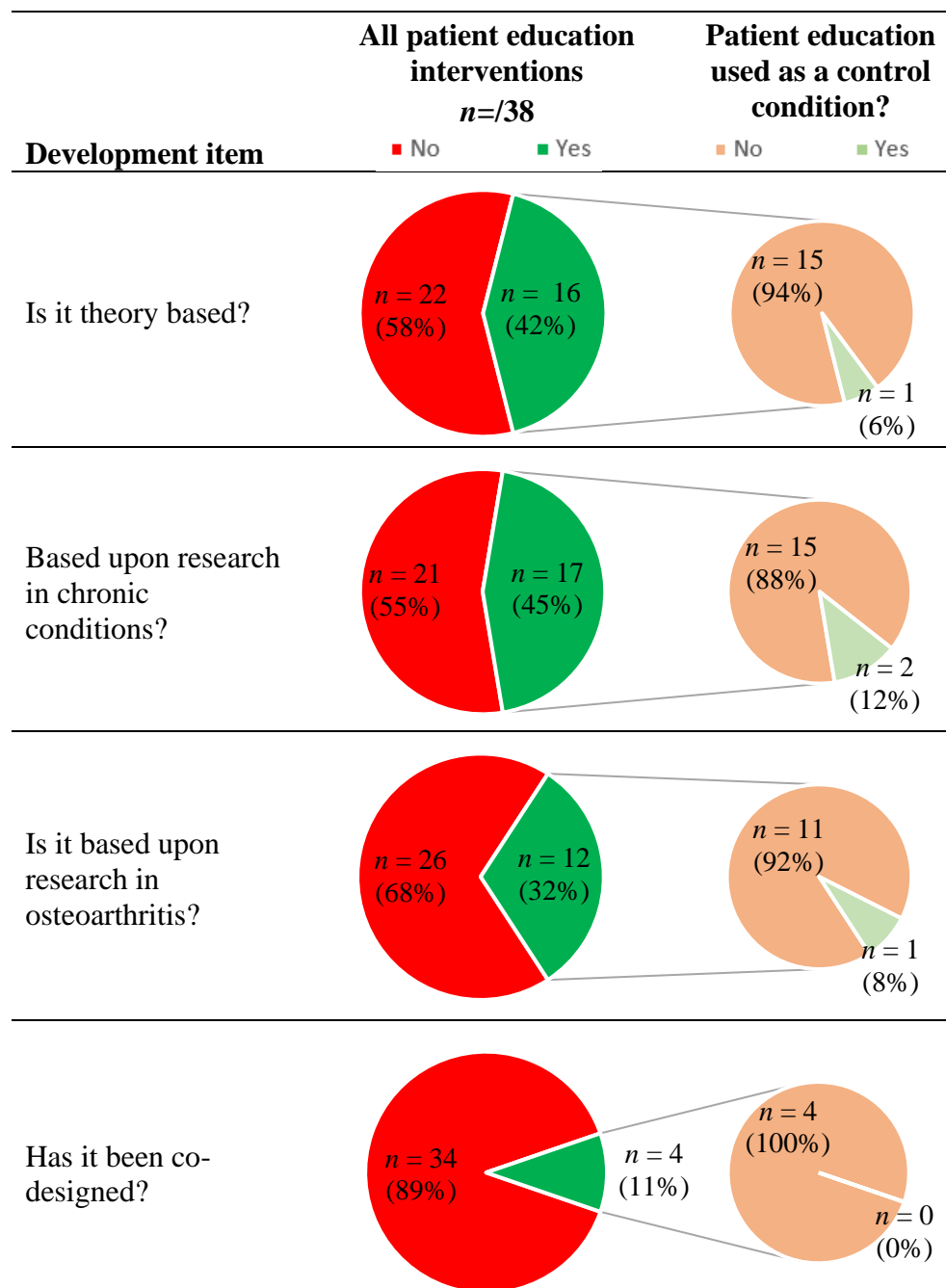


Figure 3.5 Summarised development characteristics of the patient education interventions.

3.6.4 Patient education delivery

Summarised patient education delivery characteristics are reported in Figure 3.6 and Figure 3.7.

Refer to [Appendix 3C](#) for a breakdown of the learning objective results by intervention. Learning objectives were identified in 34% ($n = 13/38$) of all included interventions in this ancillary analysis^{292,294,353,360,365,367-369,371,376}. When patient education was provided as an intervention, 52% ($n = 12/23$) identified learning objectives^{292,294,353,360,365,367,368,371,376}. When patient education was used as a control, 7% ($n = 1/15$) identified learning objectives³⁶⁹.

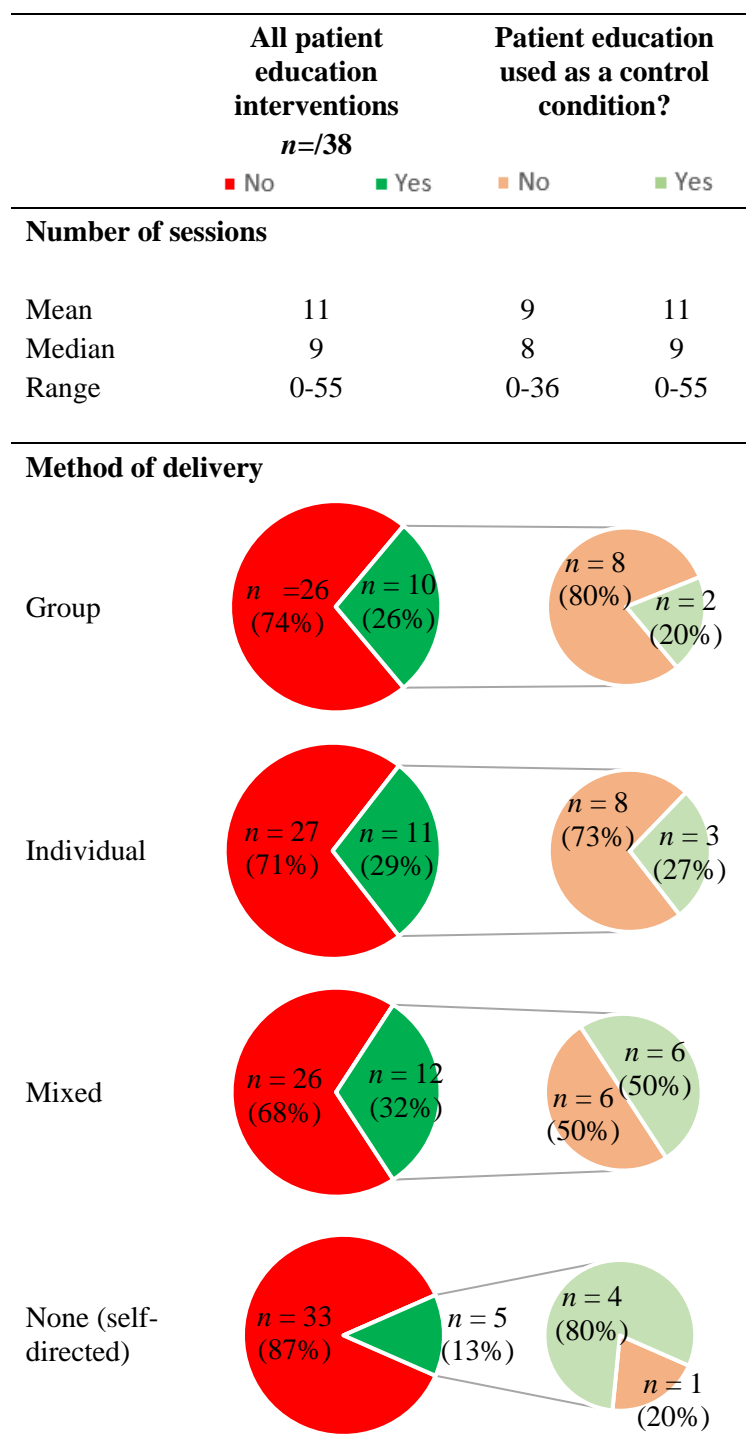
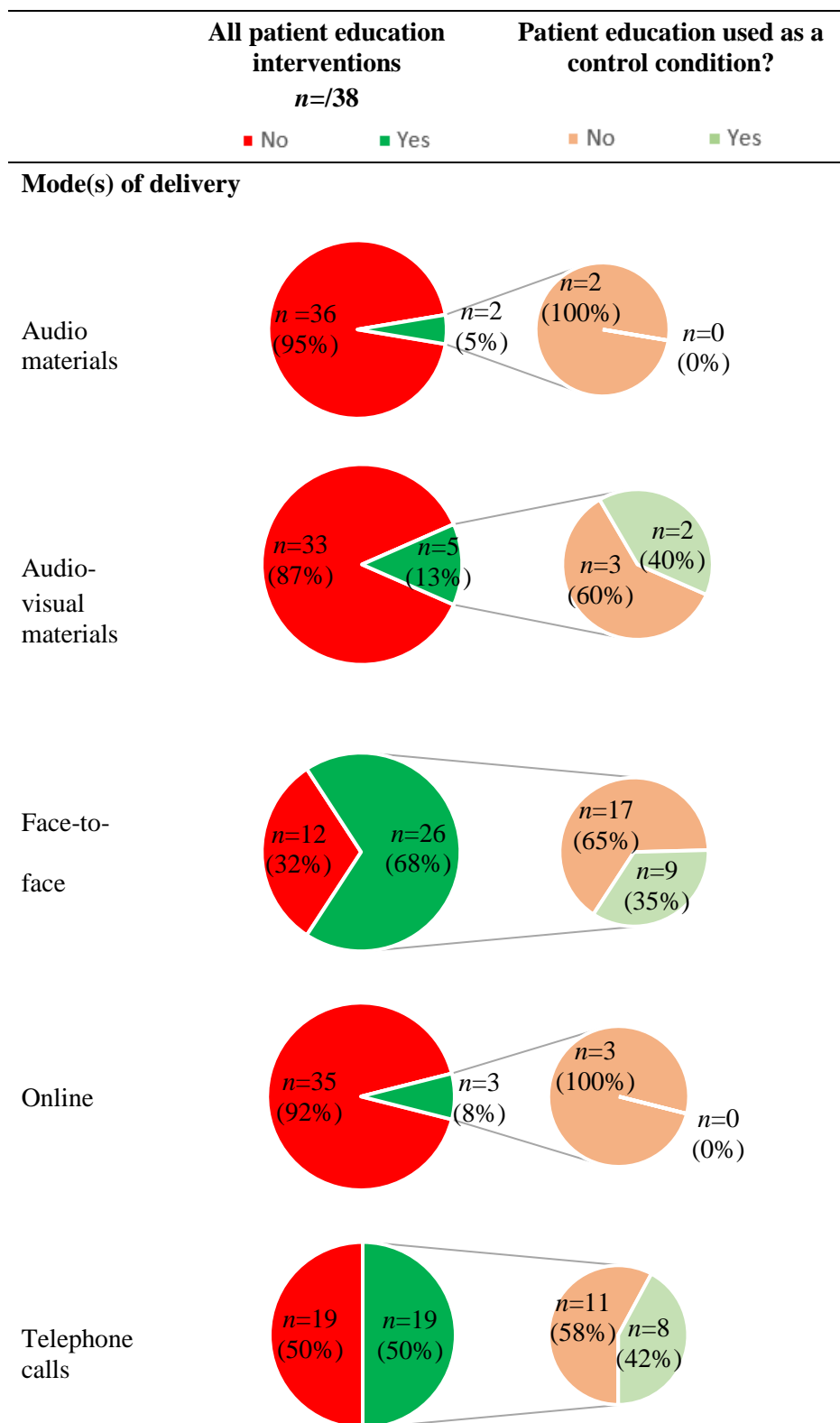


Figure 3.6 Delivery characteristics (number of sessions and method) of patient education interventions.



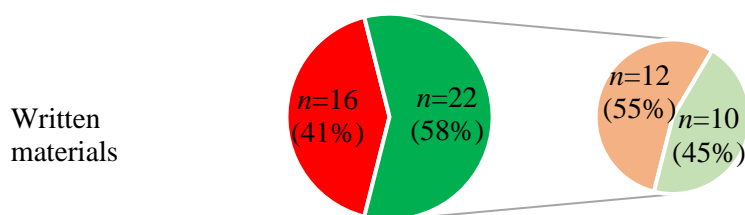


Figure 3.7 Delivery characteristics (mode) of patient education interventions.

3.7 Discussion

This ancillary analysis provides detailed information about the content, development and delivery of patient education interventions reported in published clinical trials for people with knee osteoarthritis. This analysis identified that inadequate reporting prevents guidelines from providing specific recommendations on implementation and inhibits clinicians from understanding what effective patient education for people with knee osteoarthritis looks like. The topics covered were broad, inconsistent and frequently lacked clear and accurate descriptions. Less than half of the interventions evaluated stated learning objectives or were developed based on theory, previous research or co-design.

The poor accuracy and clarity of patient education content descriptions identified in this ancillary analysis is consistent with published trials evaluating patient education for low back pain²⁹⁶. Information about self-management was provided by the majority (79%) of interventions evaluated, with 61% emphasising at least one pain coping skill. However, the descriptions in these interventions were always only partially accurate/lacked clarity, limiting their clinical applicability. Information about other first-line treatments for knee osteoarthritis (exercise therapy, physical activity and weight loss) was typically either not provided or partially accurate/lacked clarity, limiting the ability of the education interventions evaluated to facilitate effective self-management and key health behaviour changes^{116-118,331}. Future trials evaluating patient education interventions for people with knee osteoarthritis are encouraged

to improve the clarity and transparency of content so as to enhance clinical applicability, and have a greater focus on developing self-management skills aligned with guideline-recommended first-line care^{116-118,331}.

Few interventions identified learning objectives or were theory-based. This finding is consistent with trials of patient education related to asthma⁴¹⁶ and physical activity and diet within the general population⁴¹⁷. The use of learning objectives and theory is encouraged in future patient education research given that these characteristics are considered fundamental for effective patient education and communication^{290,307,396,418}. Interventions based upon cognitive behavioural theory are effective for improving psychological outcomes in people with knee osteoarthritis¹³² and for pain and disability in other musculoskeletal conditions²⁹⁶. Illustrating this potential in knee osteoarthritis, my primary systematic review indicated that trials that evaluated interventions informed by cognitive behavioural theory^{292,294} resulted in superior short-term outcomes for pain coping and self-efficacy compared to exercise therapy³¹². Further investigation of the importance of theory-based patient education interventions for pain and function outcomes is warranted to facilitate specific recommendations within clinical practice guidelines.

Few interventions were developed based upon previous research or co-design, which may help to explain the broad and inconsistent range of topics provided. Basing interventions on previous research or co-design may assist in tailoring content topics towards those that are valued by people with knee osteoarthritis and have the potential to improve health outcomes^{400,401}.

Consistent with other chronic conditions^{290,296}, patient education interventions for people with

knee osteoarthritis were typically facilitated by health professionals in face-to-face group sessions and supplemented by written materials or telephone calls. The total number of sessions and delivery method and mode varied substantially across interventions. Web-based resources were rarely used to deliver education, which is consistent with clinical trends in the delivery of patient education in Australia and Canada for people with knee osteoarthritis²⁷². Considering the increasing use of web-based health information^{326,419} and the known effectiveness of blended learning in other contexts^{388,389}, research to determine how best to use web-based resources to deliver patient education is encouraged.

Education interventions used as a control condition were rarely developed based on theoretical or co-design principles and often failed to identify learning objectives or develop self-management skills. Collectively, these limitations may mask the true effectiveness of patient education and inflate the effectiveness of comparators for people with knee osteoarthritis^{132,312,313,323}. I recommend that when patient education is used as a control condition within future clinical trials, it is developed and delivered with the same rigour as when provided as an intervention.

3.7.1 Limitations

This ancillary analysis was restricted to trials included in my published systematic review, which focused on pain and function outcomes³¹². Additionally, authors of trials were not contacted to retrieve additional information about aspects related to interventions that were not reported in manuscripts, supplementary materials or published protocols. Therefore, the results may not represent all patient education interventions for people with knee osteoarthritis or reflect the full scope of interventions provided in trials.

The number of self-management skills included, or the extent to which skills were developed or evaluated within interventions was not identified in this study. The scoring rubric developed to assess content comprehensiveness accuracy and clarity was based upon the research team's interpretation of clinical practice guidelines and clinical research. Further research to determine its validity and reliability is warranted and may alter the criterion descriptors. Lastly, I could not investigate whether inclusion of certain content topics or development features were associated with improved patient outcomes. This should be a focus of future research.

3.7.2 A call to action

Reporting of content, development and delivery may be improved by reporting standards for patient education interventions. The development of a tool that is equivalent to the Consensus on Exercise Reporting Template (CERT)⁴²⁰ for exercise therapy or the Workgroup for Intervention Development and Evaluation Research (WIDER) checklist⁴²¹ for behaviour change interventions is encouraged to assist reporting. This could help to i) identify whether certain content topics are associated with improved patient outcomes, ii) facilitate more efficient clinical translation, and iii) inform the development of future high-quality patient education interventions or resources. In the absence of such a tool, the features identified in this ancillary analysis may provide a guide for reporting and/or assessing the development of high-quality patient education interventions in the future.

Guidelines recommend that patient education be provided alongside other first-line interventions for people with knee osteoarthritis^{116-118,331}. This ancillary analysis highlights the variation and disparity in content, development and delivery of patient education interventions in clinical research. Careful consideration of these factors is required when developing future

recommendations based upon findings from meta-analyses, especially when patient education is used as a control condition.

This ancillary analysis cannot provide specific recommendations for ‘what’ and ‘how’ to provide patient education for people with knee osteoarthritis. Subsequently, I recommend that clinicians adhere to theoretically-driven principles for patient education and behaviour change to first identify patient-centred learning objectives and then tailor content towards developing self-management skills. When developing future resources, clinicians should ensure that they are based upon theory, previous research and/or co-design principles.

3.8 Conclusion

Education interventions for knee osteoarthritis described in published clinical trials lack comprehensiveness, accuracy and clarity. Most interventions fail to identify learning objectives and are not based on theory, previous research or co-design principles.

Chapter 4 : Comprehensiveness, accuracy, quality, credibility and readability of web-based information about knee osteoarthritis

4.1 Preface

Globally, the proportion of people with knee osteoarthritis who participate and engage with education interventions in clinical trials will be small. It is therefore important to investigate other ways in which people with knee osteoarthritis learn about their condition. Investigating web-based information about knee osteoarthritis is warranted as people with chronic conditions are increasingly seeking health information from web-based sources. The information they are exposed to may impact their knowledge, attitudes, beliefs and behaviours. In this chapter I performed a systematic appraisal of freely available websites commonly accessed in Australia⁸⁷ to summarise the comprehensiveness, accuracy, clarity, quality of information about treatment choices, credibility and readability of web-based information about knee osteoarthritis.

The following chapter contains an edited version of the following paper that is accepted for publication in Health Information Management Journal:

Goff, A.J., Merolli, M., Barton, C.J., Quah, A., Hoe, C., & De Oliveira Silva, D.
“Comprehensiveness, accuracy, quality, credibility and readability of online information about knee osteoarthritis”.

All edits of the accepted manuscript are grammatical to facilitate alignment with the remainder of this thesis.

4.2 Abstract

Background: People increasingly use the internet to retrieve health information about chronic musculoskeletal conditions, including osteoarthritis. However, this information can be inaccurate and of variable quality.

Objective: Summarise the i) comprehensiveness, ii) accuracy and clarity, iii) quality of information about treatment choices, iv) credibility, and v) readability of web-based information about knee osteoarthritis.

Method: A systematic search and appraisal of website content. Searches for “knee osteoarthritis” and “knee arthritis” were performed using Google and Bing (October 2020). The top 20 URLs of each search were screened for eligibility. The comprehensiveness and accuracy/clarity of website content was matched against 14 pre-defined topic descriptors. Quality of information about treatment choices and the credibility of websites were assessed using DISCERN and Health On the Net Foundation (HONcode) certification criteria, respectively. Flesch Reading Ease and Flesch-Kincaid Grade Level tests were used to assess readability. The data were summarised descriptively.

Results: Searches identified 35 unique websites. Websites were generally comprehensive (median, range = 12, 0-14/14) with descriptors available for 67% ($n = 330/490$) of topics across all websites; however, only 35% ($n = 116/330$) were accurate/clear. The quality of the information about treatment choices was generally low (median DISCERN score, range = 40, 16-56/80). Credibility descriptors were present for 65% ($n = 181/280$) of all items, with 81% ($n = 146/181$) of descriptors being clear. The median Flesch Reading Ease was 53 (range = 21-74), and the Flesch-Kincaid Grade Level was 8 (range = 5-11).

Conclusions: Few included websites provided accurate and clear content aligned to key research evidence or clinical practice guideline recommendations for knee osteoarthritis. The overall quality of information about treatment choices was poor, with large variation in the

comprehensiveness, credibility and readability of websites. Careful consideration is required by clinicians to identify what web-based information people with knee osteoarthritis have been exposed to and address any misinformed beliefs.

Trial registration: PROSPERO registration number CRD42019122004.

Keywords: health information, knee, co-design, patient education, self-management

4.3 Introduction

People often seek and retrieve health information web-based^{327,328}, with searches related to common musculoskeletal conditions increasing up to five-fold over the past decade³²⁶.

Consequently, health professionals are increasingly collaborating with patients to identify, interpret and analyse web-based health information in order to inform shared decision-making⁴²². Recent evaluations indicate that the credibility of websites for common musculoskeletal conditions is poor, and that content frequently lacks comprehensiveness and accuracy compared to local and international clinical practice guidelines⁴²³⁻⁴²⁵. Web-based health information can positively or negatively impact decision-making and self-management behaviours of people with musculoskeletal conditions. For example, inaccurate web-based information promoting bed rest for people with low back pain⁴²⁴ or inappropriate information about the cause of osteoarthritis⁸¹ may act as barriers to engagement in first-line care. Conversely, accurate web-based health information, consistent with guidelines, can improve self-management and reduce the burden to healthcare systems⁴²⁶.

Knee osteoarthritis is a leading musculoskeletal cause of disability worldwide¹, with patient education and self-management supported by evidence³¹² and recommended as first-line care in all clinical practice guidelines^{116-118,331}. People with knee osteoarthritis often source information about their condition and its management from multiple sources, including the Internet^{85,419,427}. Previous analyses of websites for knee osteoarthritis identified that quality and credibility vary significantly⁸⁹, and may be inadequate to help people with symptomatic knee osteoarthritis make informed decisions about surgery^{88,264}. The comprehensiveness, accuracy and readability of information about knee osteoarthritis are yet to be investigated. These are important considering that inaccurate biomedical beliefs about the condition are known to impact treatment choices^{81,85}.

The aims of this study were to summarise the i) comprehensiveness of content (i.e., the total number of pre-defined topics presented), ii) accuracy and clarity of content (alignment with clinical practice guidelines and key research evidence), iii) quality of information about treatment choices (measured by DISCERN), iv) credibility of websites (using Health On the Net Foundation code (HONcode) certification criteria), and iv) readability of websites (measured by the Flesch Reading Ease and Flesch-Kincaid Grade Level) about knee osteoarthritis.

4.4 Methods

4.4.1 Ethics approval

Not required.

4.4.2 Deviations from protocol

A systematic review with a web-content appraisal was planned and prospectively registered on the International Prospective Register for Systematic Reviews website in January 2019 (PROSPERO registration #: CRD42019122004). The decision was made to report this appraisal of web-content separate to the primary systematic review³¹² to improve the clarity and impact of each component. This study intended to assess whether web-based health information reflects recommendations of clinical practice guidelines and/or expert opinion but the PROSPERO record did not state how this would be assessed. This study assessed website content comprehensiveness, accuracy and clarity using a pre-defined rubric that has been used to assess patient education interventions for people with knee osteoarthritis in clinical trials²⁹¹. Comprehensiveness, accuracy and clarity were chosen as outcomes based upon similar web-content analyses for people with patellofemoral pain and low back pain^{424,425}. Readability was

not stated in the pre-registered protocol but has been assessed in this study as it can act as a barrier or facilitator to the effective translation of web-based health information⁴²⁸.

4.4.3 Search strategy

Searches were performed using two search engines, Google and Bing. These search engines were selected due to their widespread use (estimated unique monthly visitors of 1.8 billion and 500 million, respectively⁴²⁵). Two search terms were used: i) “knee osteoarthritis” and ii) “knee arthritis”. “Knee osteoarthritis” was chosen due to the specificity of the condition being investigated. “Knee arthritis” was chosen as it is a more simplistic term that may be used by health information seekers, with an informal Google TrendsTM analysis suggesting it is searched approximately 50% more than knee osteoarthritis. These searches were targeted to identify websites for people who have either been diagnosed with, or have a suspicion that they may have, knee osteoarthritis. One member of the research team (DOS) performed the searches and extracted website URLs on the 16th of October 2020, from Melbourne, Australia. Prior to performing the searches, the browsing history, cookies and temporarily cached files were deleted, and no user accounts were logged in to avoid user-automated preferences (i.e., Google account). The first 20 URLs for each search term on each search engine were included for screening (80 search results). This is in line with a previous web-content evaluation for people with patellofemoral pain⁴²⁵ and is based upon the assumption that health information seekers are most likely to view websites that appear on the first page of search results. This decision was also made to ensure the feasibility of the study. URLs that were duplicated, inactive or not related to knee osteoarthritis, or links to published research, were excluded. Published articles about knee osteoarthritis were excluded for two reasons: i) the assumption that people with knee osteoarthritis were unlikely to read or have the skills to interpret findings, and ii) that an article is not considered a ‘website about knee osteoarthritis’. A

second member of the research team (AJG) checked extraction and exclusion decisions.

4.4.4 Data extraction and analysis

When search URLs were different pages of the same website, each page was assessed independently for all outcomes. URLs of the same website were pooled so that the website was only represented once in the results for each outcome. Basic characteristics of included websites were extracted by one member of the research team (AJG), including whether it was; i) Australia-based (i.e. .com.au or .org.au address), ii) co-designed⁴⁰² with people with knee osteoarthritis, iii) clearly focused on advertising a product or service and, iv) HONcode certified. For co-design, the relevant web page was assessed in addition to the home and any relevant pages that described the development of the website (i.e., ‘about this site’ or ‘about us’). To be classified as co-designed, it had to specifically state that people with knee osteoarthritis were involved in the design or development of content^{401,402}. Websites were classified as advertising a product if there was a direct link to purchase a product and were classified as selling a service if they contained ‘book an appointment’ type links.

4.4.5 Comprehensiveness, accuracy and clarity of content

A pre-defined rubric from previous research²⁹¹ was used to assess the comprehensiveness, accuracy and clarity of content about knee osteoarthritis. The rubric was developed by identifying overarching themes of patient education content from key research evidence^{4,22,34,72,320,404-406,408} and recommendations in clinical practice guidelines^{116-118,331}.

Themes included information relating to the burden of osteoarthritis^{4,72}, pathophysiology and diagnosis of the condition^{22,34,404,408}, first-line care^{116-118,331}, effectiveness of surgery^{405,406} and recommended statements to provide people with knee osteoarthritis³²⁰. Specific content topics were then created based upon the interpretation of the themes: i) general information about

knee osteoarthritis (seven topics), ii) information about first-line care options (four topics), and iii) information about other treatment options (three topics). A transparent, criterion-based scoring rubric was used to determine when topic descriptions were: i) accurate and clear, ii) partially accurate/lacks clarity, iii) inaccurate, or iv) not reported ([Appendix 3A](#)). For example, an accurate and clear description for exercise therapy was “advise people with osteoarthritis to exercise as a core treatment irrespective of age, comorbidity, pain severity or disability. Exercise should include local muscle/neuromuscular strengthening and general aerobic fitness”³³¹. Stating that exercise “should be avoided” or is “unsafe/harmful” for people with knee osteoarthritis was classified as inaccurate⁴⁰⁸. For accuracy and clarity, two assessors involved in the creation of the rubric (AJG and DOS) independently matched content from webpages (and their immediate links) to the rubric. Any content categorised as accurate and clear, partially accurate/lacks clarity or inaccurate was included for the comprehensiveness calculations. Both AJG and DOS are qualified physiotherapists and have over five years of academic research experience each, with a focus on painful knee conditions. An alignment meeting was held prior to extraction to ensure consistent interpretation and a third assessor also involved in the rubric development (CJB) was available to facilitate final agreement, if required.

4.4.6 Quality of information about treatment choices

Quality of information about treatment choices was assessed using the DISCERN⁴²⁹ instrument, a valid and reliable questionnaire that has been used for previous osteoarthritis research^{89,430}. The DISCERN instrument judges the quality of 16 pre-defined items relating to descriptions of treatment choices using a 1-5 Likert scale ranging from ‘No’ to ‘Yes’. The DISCERN instrument measures more than just accuracy or comprehensiveness of content, also including other factors such as if the benefits and risks of each treatment option are

clearly presented; these are important factors for people with knee osteoarthritis to make informed treatment choices. Two assessors (AJG and MM) independently judged the quality of information about treatment choices on the included webpages (and their immediate links) for all items. An alignment meeting was held prior to extraction to ensure consistent interpretation and a third assessor (DOS) was available to facilitate final agreement, if required. In line with a recent study for people with knee osteoarthritis⁸⁹, the sum of all 16 items was used to calculate a composite score for each assessor and was then averaged to produce a final composite score.

4.4.7 Credibility

The HONcode certification criteria (www.hon.ch/HONcode/ accessed 23rd September 2021) were used to determine the overall credibility of included websites. These criteria were chosen as they are the global standard for health information website credibility and have been previously used in osteoarthritis research^{89,430}. Full descriptions of each item can be found on the HON Foundation website (www.hon.ch/HONcode/, accessed 23rd September 2021). Items include: i) authoritative, ii) complimentary, iii) privacy, iv) attribution, v) justifiability, vi) transparency, vii) financial disclosure, and viii) advertising policy. Content for each category was identified as either i) present and clear, ii) present but unclear, or iii) not present. Three members of the research team (AJG, AQ and CH) reviewed websites to determine their credibility. Two assessors (AQ and CH) worked together, and one assessor (AJG) worked independently to determine credibility of all items for all websites before reaching a consensus. An alignment meeting was held prior to extraction to ensure consistent interpretation and a fourth assessor (DOS) was available to facilitate final agreement, if required.

4.4.8 Readability

Two measures of readability were used in this study, the Flesch Reading Ease Score⁴³² and the Flesch-Kincaid Grade Level⁴³³. Both measures of readability were selected due to their common use in health information research^{430,434} and are calculated based upon the average number of syllables per word and the average number of words per sentence. For the Reading Ease Score, a difficulty score from 0 to 100 is generated, with higher scores indicating easier readability⁴³². For the Grade Level, a score is calculated based on the difficulty of reading equivalent to the United States (US) school system grade ages⁴³³. The age of pupils and grade levels are comparable between the US and Australia. Current Australian guidelines suggest that health information should be communicated at 7-8th grade level (suitable for ages 12-14 years, corresponding to eight years of Australian education^{435,436}). The following web-based tool (<https://www.webfx.com/tools/read-able/>) was used in October 2020 to assess the readability of each website, in line with previous web-content research⁴³⁰. For search URLs that were different pages of the same website, each page was assessed independently before an average was calculated.

4.4.9 Data representation

For categorical data (accuracy and clarity, plus credibility), the agreement rate (percent (%)) was calculated between each rater before final agreement was achieved. For continuous data (total DISCERN score), an intraclass correlation coefficient (ICC) was obtained using IBM SPSS Statistics for Windows, version 26 (IBM Corp., Armonk, N.Y., USA) to determine the level of agreement between each rater before calculating the final composite score. Descriptive statistics were used to summarise the comprehensiveness, accuracy and clarity, quality of information about treatment choices, credibility and readability of websites. The comprehensiveness data were presented as the median, mean and range of the 14 pre-defined

content topics mentioned within the websites, regardless of accuracy and clarity. Data on accuracy and clarity were presented as the number and proportion (%) of content from websites that matched the pre-defined criteria for each of the 14 content topics. Data on quality of information about treatment choices were presented as the overall median, mean and range of the final composite DISCERN score, together with a breakdown of mean score by item. Data on credibility were presented as the number and proportion (%) of websites that matched the pre-defined criteria for each of the eight HONcode items. Data on readability were presented as the overall median, mean and range for each outcome.

4.4.10 Sensitivity analyses

Websites that were Australia-based (i.e., .com.au or .org.au) were compared against those that were not, and websites that were advertising or selling a product were compared against those that were not, for all outcomes. Categorical data (accuracy and clarity, plus credibility) were reported as the proportion (%) of websites matching each descriptor. Scale data (comprehensiveness, quality of information about treatment choices, readability) were reported as the median, mean and range.

4.5 Results

Of the 80 URLs identified from searches, 30 were duplicates of the same webpage and nine were excluded (three links to peer reviewed articles, six irrelevant). Six URLs were different pages from the same website; therefore, they were pooled for analysis. Thirty-five unique websites were included in the analysis (Figure 4.1). Full search results including pooling, reasons for exclusion and basic information about included websites can be found in

[Appendix 4A](#).

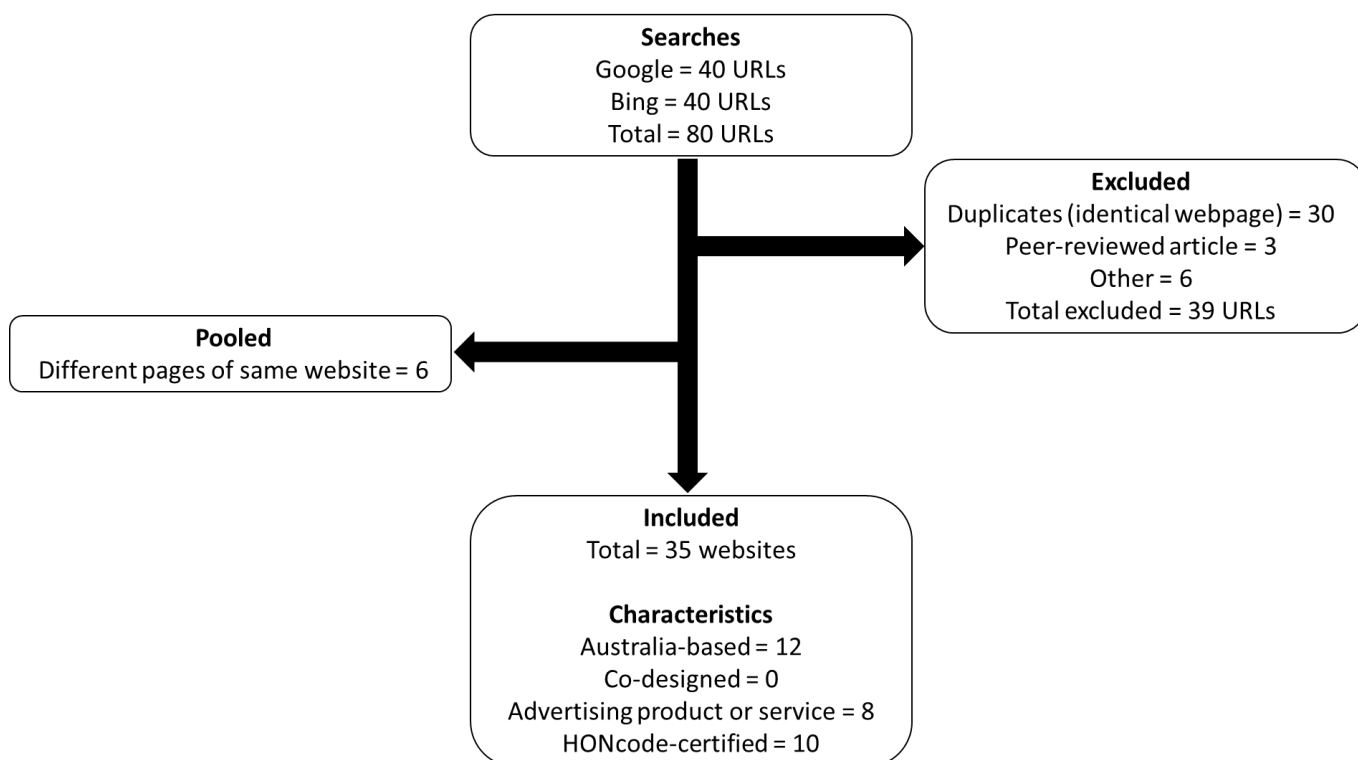


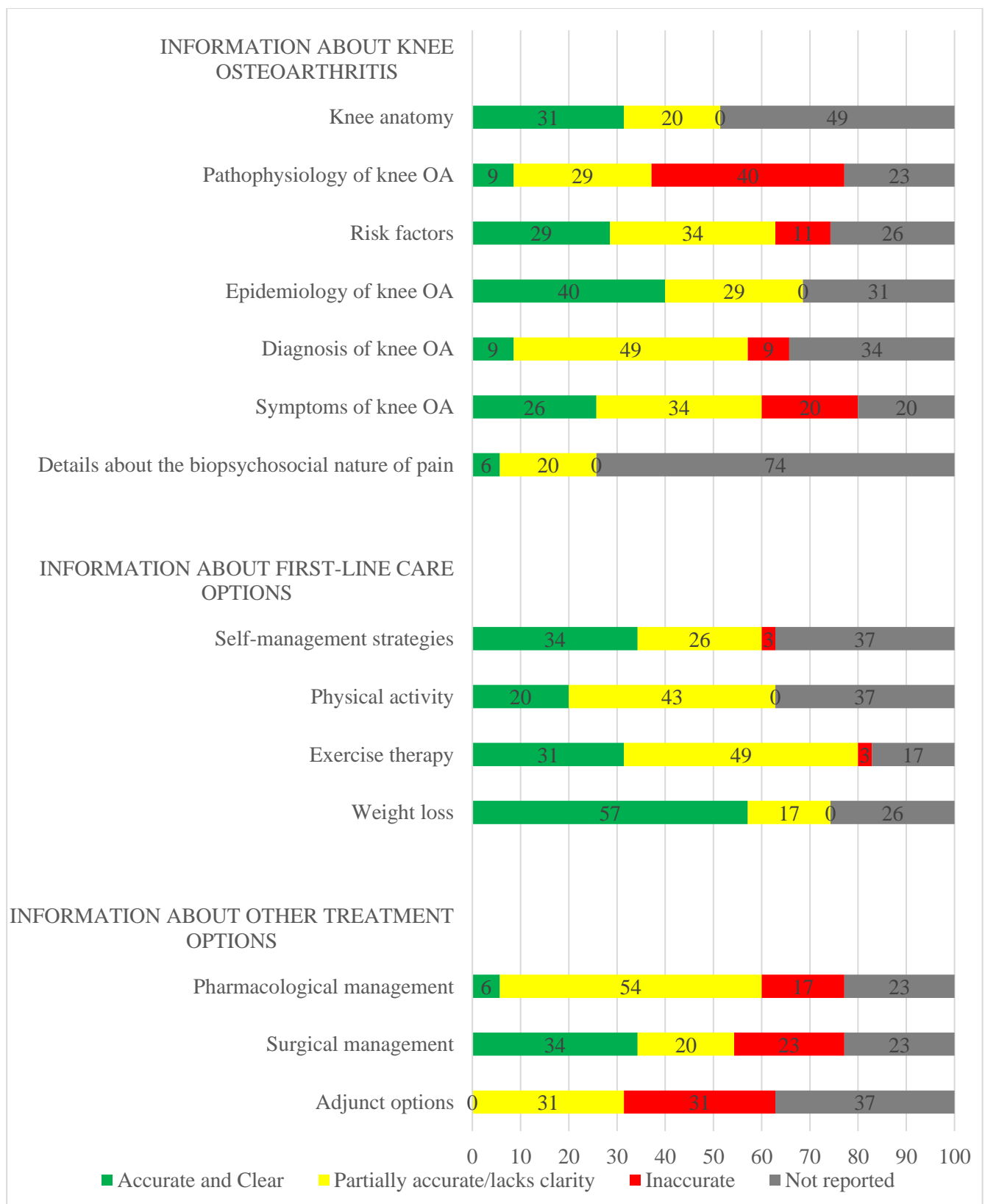
Figure 4.1 Search results, website selection and included website characteristics.

4.5.1 Comprehensiveness of content

Descriptors were available for 67% ($n = 330/490$) of content topics across all websites. The median number of content topics mentioned across all websites was 12/14 (mean, range = 9, 0-14/14). A full breakdown of comprehensiveness by website can be found in [Appendix 4B](#).

4.5.2 Accuracy and clarity of content

Summarised findings of the accuracy and clarity of content descriptions available can be found in Figure 4.2. A full breakdown of accuracy and clarity by website can be found in [Appendix 4B](#). There was a 69% agreement rate between each independent rater before consensus.



OA = Osteoarthritis

Figure 4.2 Accuracy and clarity (%) of content for all websites.

4.5.3 Quality of information about treatment choices

For quality of information about treatment choices, the median final composite DISCERN score was 40/80 (mean, range = 39, 16-56/80). The level of agreement in the composite DISCERN scores between each rater before final composite score was calculated was excellent (ICC = 0.96, 95%CI 0.90 to 0.98). A summary of the mean DISCERN scores by item is presented in Figure 4.3. Full details of quality of information about treatment choices by website can be found in [Appendix 4C](#).

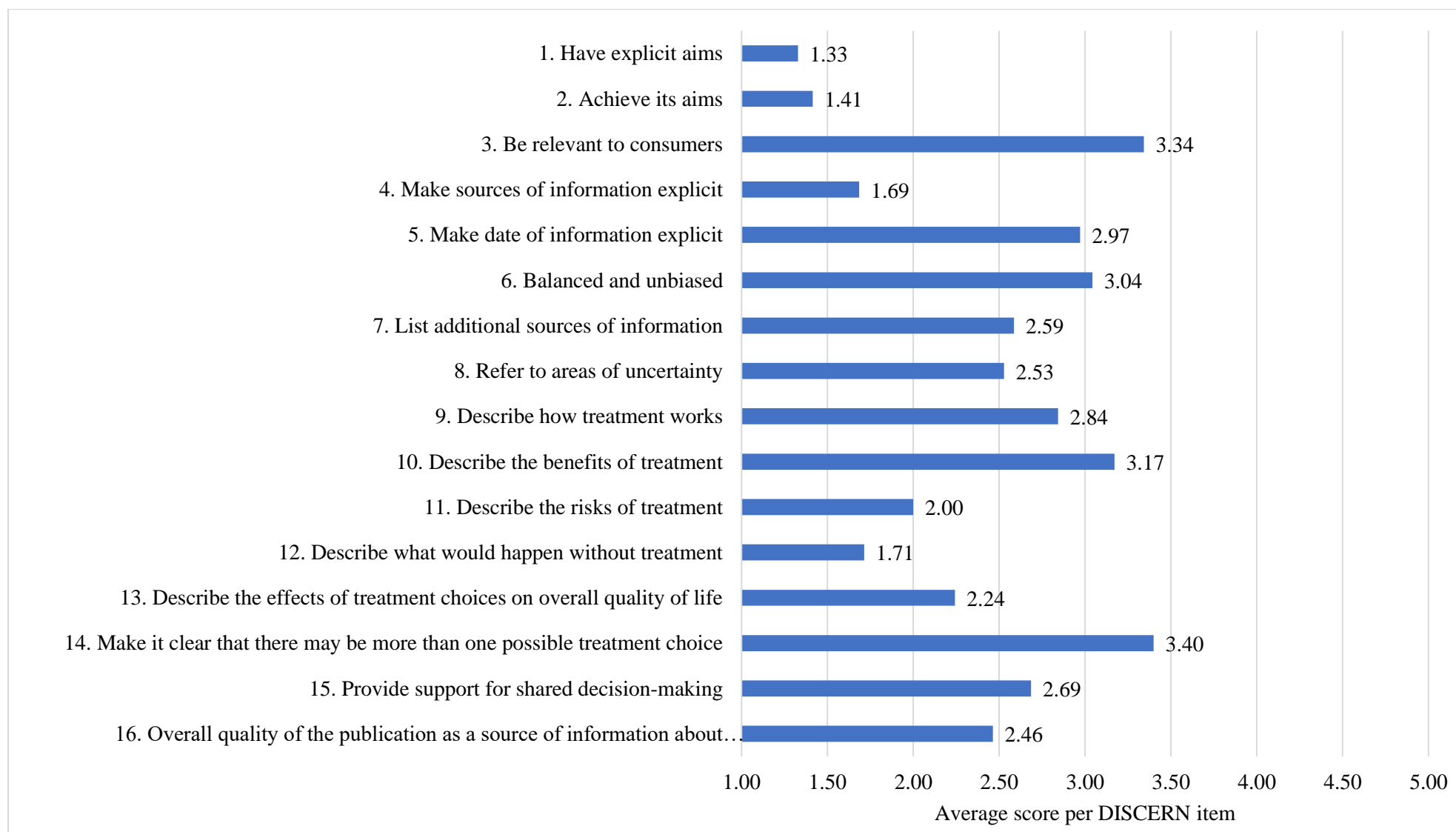


Figure 4.3 Mean DISCERN score by item.

4.5.4 Credibility of websites

Summarised credibility findings for all websites can be found in Figure 4.4. For credibility, there was a 79% agreement rate between each independent rater before consensus. Full details of credibility by website can be found in [Appendix 4C](#).

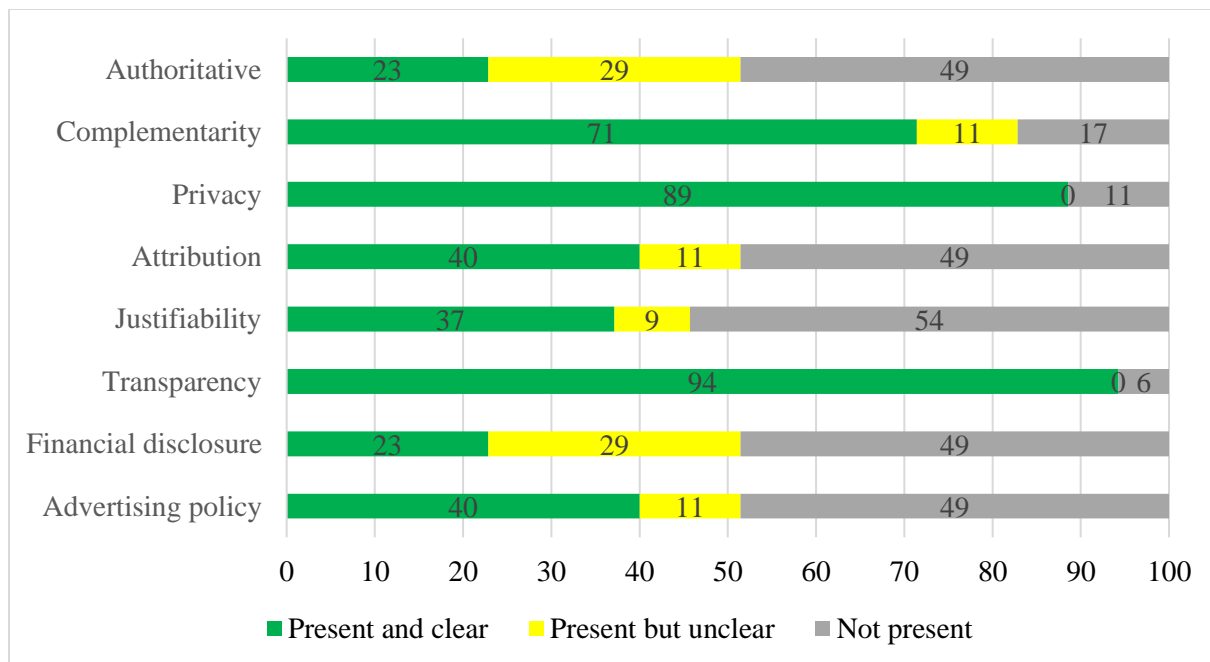


Figure 4.4 Credibility (%) of websites using the HONcode criteria.

4.5.5 Readability of websites

The median Flesch Reading Ease score was 53 (mean, range = 52, 21-74) and the Flesch-Kincaid Grade Level was 8 (mean, range = 8, 5-11) across all websites. Full details of readability by website can be found in [Appendix 4C](#).

4.5.6 Sensitivity analyses

Full details of sensitivity analyses can be found in [Appendix 4D](#). In summary, Australia-based

websites were slightly less comprehensive compared to non-Australia-based websites (median $n = 9/14$ vs $n = 12/14$, respectively) and generally contained less inaccurate information, but had similar quality of information about treatment choices, credibility and readability. Websites that advertised a product or service were much less comprehensive (median $n = 4/14$ vs $n = 12/14$), provided lower quality information about treatment choices (median DISCERN 28/80 vs 41/80) and were generally less credible than those that did not, but had similar readability.

4.6 Discussion

The findings of this systematic appraisal of web-based information about knee osteoarthritis indicated that there were few instances where content provided was accurate and clear. There was also large variation in the comprehensiveness and readability of content, the overall quality of information about treatment choices, and the credibility of websites evaluated. Considering that people with knee osteoarthritis are increasingly seeking health information web-based^{419,427}, health professionals should advise patients that web-based information may be inaccurate and address any of their patients' misinformed beliefs. Creating or identifying accurate, credible web-based resources should be prioritised to facilitate more effective shared decision-making, self-management and engagement with first-line care for people with knee osteoarthritis⁴²⁶.

Websites were generally comprehensive, with most including information about first-line care options of self-management, physical activity, exercise therapy and weight loss. Yet, very few stated that this is considered first-line care and should be offered to all people with knee osteoarthritis^{116-118,331}. Additionally, only one-third of websites provided enough information to support people with knee osteoarthritis to engage with recognised self-management strategies

(e.g., pacing or relaxation exercises). Providing information or tools to support implementation has the potential to increase engagement in first-line care, improve patient outcomes and reduce unnecessary healthcare utilisation^{340,426}. Given the high prevalence of knee osteoarthritis⁴ and the estimated increasing costs associated with its management¹¹⁰, websites that more clearly identify what constitutes first-line care and provide information or tools to support its implementation are needed. Clinically, health professionals should prioritise providing education about first-line care to inform shared decision-making, and address any misinformed beliefs resulting from web-based information-seeking.

Web-based information about weight loss was the most accurately and clearly described of all topics in this study. This is encouraging since it is a guideline-recommended first-line intervention for people with knee osteoarthritis^{116-118,331}. Web-based information about exercise therapy was the most frequently included topic in the websites evaluated, but most descriptions were partially accurate or lacked clarity. This is consistent with the partially accurate or clear exercise therapy descriptors within patient education interventions in clinical trials for people with knee osteoarthritis²⁹¹. Information about aerobic exercise was frequently omitted by websites, and very few stated that exercise therapy is suitable for all people with osteoarthritis regardless of age, comorbidity, pain severity or disability³³¹. The omission of this information may act as a barrier to engagement in guideline-recommended first-line care. Websites should provide more complete information about exercise therapy, considering the low levels of physical activity in people with knee osteoarthritis¹⁸ and the benefits of exercise for osteoarthritis and general physical and mental health¹³².

Very few websites provided information about the biopsychosocial nature of pain, and inaccurate information was frequently provided about the pathophysiology of knee osteoarthritis. For example, inaccurate descriptions of ‘bones rubbing against each other’ and ‘wear and tear’ as the explanation for the condition and cause of symptoms were identified. The inaccurate and simplistic mechanical descriptions of the pathophysiology of osteoarthritis, causes of symptoms, and treatment options identified in this study have the potential to negatively influence an individual’s behaviours and engagement with holistic first-line care^{81,85}. Given the potential vulnerability of older adults when assessing web-based information⁴³⁷, it is important for clinicians to identify and guide patients towards accurate and clear sources of information so as to facilitate informed decision-making and reduce unnecessary healthcare utilisation⁴²⁶.

The quality of information about treatment choices evaluated in this study was poorer than the most recent synthesis of evidence for web-based information about osteoarthritis⁸⁹. My contrasting results may be due to the inclusion of different websites in each study as a result of the search domain and geographical location of the searches. The DISCERN instrument was originally developed to support consumers of health information to make informed decisions about their treatment choices, but has since been adopted as a measure of quality in clinical research⁴²⁹. Subjective biases when scoring DISCERN may have been a factor considering that it was performed by physiotherapists in the current study, while in the previous study it appears to have been performed by orthopaedic surgeons. Amongst the poorest scoring of the 16 DISCERN items in this study were i) describing risks of each treatment, ii) describing what would happen if no treatment is used, and iii) describing how treatment choices affect overall quality of life. Considering that these are topics that people with knee osteoarthritis often seek information

about⁴²⁷, it is essential that web-based information about knee osteoarthritis provides balanced, evidence-based descriptions about both the benefits and risks of each treatment option and the prognosis to facilitate appropriate decision-making.

The findings from this study indicate that HONcode-certified websites were generally more credible than uncertified websites. The lack of websites supporting their claims relating to benefits and performance of a specific treatment (justifiability), disclosing the qualifications of the authors (authoritative), and the presence of financial disclosure were the least reported and clearly described items. These factors are considered important to older adults when determining the credibility of web-based health information^{438,439}. However, health consumers may judge the credibility of websites beyond the criteria defined in HONcode. For example, the perceived credibility of websites can be influenced by factors such as the source of the website, its design/layout and the inclusion of pictures or graphics^{438,439}. This study found that Australia-based websites had similar credibility to those that were not. The development of a tool that considers the source, content and design of a website may give a more realistic appraisal of both the actual and perceived credibility of websites.

Consistent with a previous evaluation of web-based information about osteoarthritis⁴³⁰, one-third of all websites evaluated exceeded the recommended grade level for the readability of health information⁴³⁵. Additionally, no websites that were evaluated involved people with knee osteoarthritis in their development (co-design). Considering the importance of health literacy, and the potential vulnerability of older adults⁴³⁷, providing more readable and accurate information may optimise informed decision-making and improve engagement with first-line

care. To facilitate this, co-design with people of varying levels of health literacy is recommended and should be a major focus of future website development and revisions⁴⁰¹.

4.6.1 Limitations and future directions

Web-based health information for people with knee osteoarthritis is constantly evolving, therefore search results and findings of this study may change quickly. It is therefore recommended that all websites regularly update content to reflect the latest evidence and best practice. It is plausible that people with knee osteoarthritis may search for more specific terms (i.e., knee arthritis treatment) or more generic terms (i.e., knee pain) than those used in this study. Additionally, searches will be influenced by factors such as geographical location, past searches/caches and whether the searcher is signed into personal accounts (i.e., Google). Therefore, people with knee osteoarthritis may access and be exposed to different websites to those identified and analysed in this study. Geographical location influenced the search results of this study, with 34% (12/35) of websites being .com.au or .org.au based. The sensitivity analysis comparing Australia-based websites with websites from other regions (e.g., .com) revealed similar results across the majority of outcomes ([Appendix 4D](#)), however this study was not set up or powered to conclusively compare across countries. This study only searched for websites in English and restricted screening to the top 20 URLs for each search only to ensure feasibility. These restrictions were in line with previous website evaluations for younger people with knee pain⁴²⁵, and reflect the websites most likely to be viewed by people seeking healthcare information. The inclusion of additional sources of web-based information (e.g., beyond the first 20 URLs, exploring more webpages of larger healthcare websites or websites that are shared on social media) may change findings. Further, caution should be adopted when interpreting the

comprehensiveness results as some websites may be specifically targeted towards one aspect of care (i.e., exercise therapy) and provide accurate and clear information about this aspect only.

In this study, I did not explore whether websites provide tools to support the implementation of information (i.e., tools to facilitate weight management or exercise therapy). This should be a focus of future research and may assist health professionals when providing patient education in addition to improving adherence to treatments. A particular focus should be on tools to facilitate weight management, given that health professionals are less confident in providing weight management advice compared to other first-line interventions⁴⁴⁰. Determining the validity and reliability of the tool used to assess comprehensiveness, accuracy and clarity is also encouraged, and may facilitate the development of future web-based resources for people with knee osteoarthritis. Additionally, identification and analysis of websites that health professionals commonly use in their clinical encounters, alongside websites aimed at people who do not already have a diagnosis of knee osteoarthritis, is warranted to better understand what information people with knee osteoarthritis are being exposed to. Finally, analysis of content being shared about knee osteoarthritis on commonly accessed social media platforms (e.g., Facebook, Instagram) is warranted due to the increasing use⁴⁴¹ of and perceived trust⁴⁴² of social media to disseminate health information.

4.7 Conclusion

Few websites that met the inclusion criteria for this study provided accurate and clear content about knee osteoarthritis that aligned to key research evidence or guideline recommendations. Inaccurate information was often provided about the pathophysiology of osteoarthritis, cause of

symptoms and surgical or pharmacological treatment options. Overall, the quality of information about treatment choices was poor and large variation was observed in the comprehensiveness, credibility and readability of information on included websites. Whilst most websites provided information about first-line care, descriptions of recommendations frequently lacked accuracy or clarity. Careful consideration is required by clinicians to identify what web-based information people with knee osteoarthritis have been exposed to so that they can address any misinformed beliefs and facilitate better self-management and engagement with first-line care. Co-design of high-quality, accurate web-based resources to support first-line care implementation for people with knee osteoarthritis is encouraged.

PART B – IDENTIFYING EDUCATION PRIORITIES PEOPLE WITH KNEE OSTEOARTHRITIS AND PHYSIOTHERAPISTS

Chapter 1 of this thesis provided an overview about knee osteoarthritis including its pathogenesis, diagnosis, societal impact, and treatments. It also provided a detailed exploration of the potential role of patient education for the treatment and management of knee osteoarthritis. My systematic review and meta-analysis³¹² in Chapter 2 identified that although patient education was superior for short term improvements in pain and function compared to usual care, improvements were small and not clinically important. Further, patient education was inferior to exercise therapy for short term improvements in pain, and providing exercise therapy in addition to patient education resulted in clinically important short-term improvements in function compared to patient education alone. My ancillary analysis of the content, development and delivery of included education interventions²⁹¹ in Chapter 3 attempted to understand these results further. However, it revealed overall poor reporting of content and development of patient education interventions in published clinical trials. These reporting limitations prevent guidelines from providing specific recommendations about how education is best implemented in practice, and clinicians from being able to implement evidence-based practice.

My web-content analysis to determine the comprehensiveness, accuracy and clarity of web-based information about knee osteoarthritis⁸⁷ in Chapter 4 revealed that many commonly-accessed public websites contain inaccurate or misleading information about the pathophysiology of the condition and surgery for its treatment. The presence of this inaccurate information may

contribute towards many people with knee osteoarthritis possessing inappropriate beliefs about the condition and its management, that can act as a barrier to engagement in first-line care^{79,85}. Therefore, careful consideration is needed by health professionals to identify what web-based information people with knee osteoarthritis have been exposed to so that they can address any misinformed beliefs and optimise self-management and engagement with first-line care. Another important finding from this web-content analysis⁸⁷ was that no included websites were co-designed⁴⁰². I therefore encouraged the use of co-design to create high-quality, accurate web-based resources to support people with knee osteoarthritis to engage in first-line care.

Exploring the perceived educational priorities of people with knee osteoarthritis and health professionals could further guide understanding of ‘what’ patient education may be important to provide. Chapter 5 and Chapter 6 explore the education priorities of people with knee osteoarthritis and physiotherapists respectively.

Chapter 5 : People with knee osteoarthritis attending physiotherapy have broad education needs, and prioritise information about surgery and exercise: A concept mapping study

5.1 Preface

Guidelines contain limited and varied information about ‘what’ to provide education about for people with knee osteoarthritis (Chapter 1), and the poor reporting of interventions in clinical trials limits the translation of interventions into clinical practice (Chapter 3²⁹¹). It is therefore important to identify the educational priorities of people with knee osteoarthritis to help guide development of future guideline recommendations and interventions. In this Chapter, concept mapping methodology⁴⁴³ was used to identify, sort and rate the educational priorities of people with a lived experience of knee osteoarthritis. The primary aims were to identify the educational priorities of people with knee osteoarthritis and the perceived i) relative importance of each priority, and ii) confidence that a health professional can address each priority. The secondary aims were to investigate whether the educational priorities of people with knee osteoarthritis are covered by education recommendations within major clinical practice guidelines for knee osteoarthritis.

The following chapter contains an edited version of the following paper that has been accepted
by the Journal of Orthopaedic and Sports Physical Therapy:

Goff, A.J., Donaldson, A., De Oliveira Silva, D., Crossley, K.M., & Barton, C.J.

“People with knee osteoarthritis attending physical therapy have broad education needs, and
prioritise information about surgery and exercise: A concept mapping study”

All edits of the re-submitted manuscript are grammatical to facilitate alignment with the
remainder of this thesis.

5.2 Abstract

Objectives: To (1) identify the education priorities of people with knee osteoarthritis, including perceived importance and confidence that a healthcare professional can address each, and (2) match priorities to education-specific content recommendations in knee osteoarthritis guidelines.

Design: Concept mapping methodology

Methods: Participants generated, sorted (based on themes) and rated (5-point Likert scales: importance and confidence) education priorities. Multidimensional scaling and hierarchical cluster analysis of sorting data produced a cluster map with overarching domains. Priorities were matched against education-specific content recommendations in knee osteoarthritis guidelines.

Results: Participants (brainstorming n=43; sorting and rating n=24) generated 76 priorities. A four-domain, eleven-cluster map was the most useful representation of sorting data: (i) understanding treatment options (relationship of education and exercise with surgery; adjunct options; treatment decision-making); (ii) exercise therapy (how to exercise; why exercise); (iii) understanding and managing the condition (symptom management; understanding symptoms; understanding the condition) and; (iv) surgical, medical and dietary management (surgery; medications; diet and supplements). The ‘relationship of education and exercise with surgery’ (3.88/5), ‘surgery’ (3.86/5) and ‘how to exercise’ (3.78/5) clusters were rated highest for importance. Few priorities identified by participants were clearly recommended as education-specific content recommendations in ACR (3%, n=2/76), EULAR (12%, 9/76), NICE (16%, 12/76) and OARSI (1%, 1/76) guidelines respectively.

Conclusion: People with knee osteoarthritis presenting to physiotherapists have broad education needs, and prioritise information about surgery and exercise.

5.3 Introduction

Symptomatic knee osteoarthritis affects approximately one in ten people over the age of 60^{70,71}. All major guidelines^{41,116-118} for knee osteoarthritis recommend patient education as first-line care alongside exercise therapy and weight loss. However, guidelines vary regarding ‘what’ education content to provide^{41,116-118}. People with knee osteoarthritis seek varying information about their condition^{75,85,427}, but are often dissatisfied with the education they receive²¹⁰. Up to two thirds of people with knee osteoarthritis feel ill-informed about their condition and its management before consulting an orthopaedic surgeon^{267,269}. Failing to meet education needs can perpetuate unsatisfactory relationships with healthcare professionals⁷⁵ and turn people off engaging in first-line care⁷⁵. Health professionals can positively influence self-management by addressing the education priorities of people with knee osteoarthritis^{75,85}.

Few guideline recommendations^{41,116-118} have been developed with input from people with lived experience of knee osteoarthritis. It is therefore not known whether education topic recommendations within knee osteoarthritis guidelines align with the education priorities of people with knee osteoarthritis. Investigating this may inform future recommendations, clinical practice and education resource development.

The primary aims of this study were to identify the education priorities of people with knee osteoarthritis, and the perceived: i) relative importance; and ii) confidence that a healthcare professional can address, each priority. The secondary aim was to determine if the education priorities of people with knee osteoarthritis were included as education-specific content

recommendations in knee osteoarthritis guidelines.

5.4 Methods

La Trobe University Human Ethics Committee approved this study (HEC19211). All participants received written information about the study and contact details of the research team to clarify any queries if required. Participants were eligible if they met the National Institute for Health and Clinical Excellence (NICE) diagnostic criteria for knee osteoarthritis⁴¹ and did not have rheumatoid arthritis or other chronic pain conditions (e.g., fibromyalgia). All data were collected online via a Concept Systems groupwisdom (Ithaca, USA)⁴⁴⁴ study-specific web platform. The rights of the participants were protected.

5.4.1 Methodology

A mixed-methods concept mapping approach⁴⁴³ was used to generate and organise the ideas of people with knee osteoarthritis. Concept mapping consists of six steps: i) preparation, ii) generating ideas (brainstorming), iii) structuring statements (sorting and rating), iv) concept mapping analysis, v) interpreting maps and vi) utilisation⁴⁴³. People with knee osteoarthritis were involved in steps ii and iii only.

5.4.2 Recruitment

Multiple recruitment strategies were used in an attempt to obtain responses from a diverse group of people with knee osteoarthritis. The study was advertised through the GLA:D[®] Australia and Musculoskeletal Australia (MSK Australia) e-mail distribution lists, social media (Facebook and

Twitter), and the research team's networks of clinicians. Interested participants followed a link embedded in study recruitment materials to the web-based platform where they provided consent, self-confirmed eligibility, and answered baseline demographic questions before engaging in brainstorming. Brainstorming recruitment was initiated in September 2019 and remained open until February 2021. The study was re-advertised on several occasions in an attempt to attract a diverse participant group. Sorting and rating recruitment occurred between February 2021 and August 2021. Participants who engaged in brainstorming received an email invitation to participate in sorting and rating activities, plus the study was re-advertised through the recruitment strategies described above. Participants received a AU\$10 supermarket voucher for participation in the brainstorming and a AU\$20 supermarket voucher for participation in sorting and rating activities.

5.4.3 Brainstorming

Participants were instructed to identify education priorities in response to a focus prompt: '*What information do you want to know about your knee osteoarthritis or knee pain?*'. Participants were encouraged to keep each priority to one idea and to create multiple priorities if necessary. Brainstorming recruitment continued until the research team agreed that no new ideas were being captured.

Four researchers (AJG, AD, DOS, CJB) met three times to synthesise and edit brainstorming responses. Responses that did not answer the focus prompt were removed, and priorities that represented two or more ideas were divided into single ideas. Priorities representing the same idea were grouped, with the response that most clearly articulated the education need selected to

represent the group. Priorities were then reviewed and edited to: i) correct typographical errors, ii) replace abbreviations with full words and, iii) add/delete words as necessary to ensure clarity. Finally, all priorities were converted into questions for sorting and rating, taking care to remain as close to the original response as possible. For example, “best ways to sleep at night to relieve pain” became “what are the best ways to sleep at night to relieve pain?”.

5.4.4 Matching to education specific content recommendations in guidelines

The final list of patient education priorities was matched to education-specific content recommendations in guidelines for knee osteoarthritis ([Appendix 5A](#)); American College of Rheumatology¹¹⁸ (ACR), European Alliance of Associations for Rheumatology¹¹⁶ (EULAR), National Institute of Health and Care Excellence⁴¹ (NICE) and Osteoarthritis Research Society International¹²⁵ (OARSI). Two researchers (AJG, CJB) independently classified each priority as: ‘clearly’ recommended as an education topic, ‘possibly’ recommended as an education topic (i.e., it could potentially be covered by a broader recommendation) or ‘no’ it is not recommended. A third researcher (DOS) adjudicated any disagreements.

5.4.5 Sorting and rating

Sorting: Participants were provided with the edited list of education priorities in a random order and instructed to sort the priorities into piles that made sense to them, based on relatedness of theme or topic. Participants then named each pile based on its contents. Participants were informed that it is common to create between 5–20 piles and that they should not create value-based piles (e.g. importance or relevance) or piles of unrelated priorities (e.g. ‘miscellaneous/other’).

Rating: Participants were required to rate each priority in response to the following: 1) ‘How important is it that you receive the answer to this question?’: 2) ‘How confident are you that a healthcare professional can provide you answers to this question?’, and 3) ‘Where do you think you will most likely receive answers to this question?’. For rating questions 1 and 2, participants rated each priority on a 1–5 Likert scale from ‘not important/confident at all’ (1) to ‘very important/confident’ (5). For questions 1 and 2, participants were instructed to use the full rating scale and to rate each priority in relation to each other, rather than provide an absolute rating. For question 3, participants could select one of the following mutually exclusive categories for each priority: (1) ‘directly from a healthcare professional’, (2) ‘your own research (including looking on the internet, asking people who are not healthcare professionals (e.g. family members) etc.)’, (3) ‘you already know this information’, (4) ‘other source of information’, or (5) ‘I don’t know’.

5.4.6 Concept mapping analysis

All sorting and rating data analysis was conducted using the Concept Systems groupwisdom (Ithaca, USA)⁴⁴⁴ study-specific web platform. Sorting data were analysed through multidimensional scaling to produce a two-dimensional ‘point map’ and hierarchical cluster analysis to partition the priorities in the point map to produce a two dimensional ‘cluster map’. Full details of the multidimensional analysis, stress index calculation and hierarchical cluster analysis used are published elsewhere⁴⁴³.

To select a final cluster map, guidance from Kane and Trochim (Concept Systems Incorporated

pp. 101–103)⁴⁴³ was followed. Initially, cluster maps were examined from a 12-cluster to a six-cluster solution, identifying which clusters and priorities were merged as the number of clusters was reduced. Clusters were merged when their contents appeared to logically belong together until the research team agreed that merging clusters no longer made sense based upon their interpretation and knowledge of the subject area. If the research team considered that an education priority on the map conceptually belonged to an adjacent cluster, similarity matrix and spanning information were considered and boundaries were re-drawn to accommodate this when appropriate. This only occurred if re-assignment of priorities produced a map with no overlapping boundaries. The research team then assessed the edited cluster map to identify whether a higher-level domain organisation of clusters was apparent⁴⁴⁵.

In line with previous research^{446,447}, a qualitative, interpretive analysis of the map was performed, considering the proximity of the clusters and the priorities within each cluster to provide a meaningful interpretation.

Descriptive statistics were generated for rating all rating questions. Specifically, the mean rating for each priority related to perceived importance (Question 1) and confidence that a health professional would provide an answer to the question (Question 2) was calculated. A ‘Go-Zone’ scatter plot graph⁴⁴³ was created based upon these means using the Concept Systems groupwisdom (Ithaca, USA)⁴⁴⁴ web platform. Consistent with common concept mapping methodology, the Go-Zone graph was divided into four quadrants based upon the grand means (total means of all priorities) of each scale. These quadrants provided a visual representation of

each priority's relative importance and confidence that it could be met by a healthcare professional. Division into quadrants further aids interpretation of results: Quadrant 3 represented priorities were rated relatively high importance but lower confidence that healthcare professionals can address it, indicating potential priorities for training and education. A Pearson's correlation co-efficient was also obtained to determine relationship between rating questions 1 and 2. For rating question 3, descriptive statistics (frequency and percentage (%) of responses in each category) were generated.

5.5 Results

Participant numbers and characteristics for brainstorming, sorting and rating activities are presented in Table 5.1.

Table 5.1 Participant characteristics.

	Brainstorming	Sorting and rating
Total participants <i>n</i>=	43	24
Age, Mean (SD)	66 (9)	65 (9)
Sex (M/F)	10/33	9/15
Years living with osteoarthritis, Mean (SD)	13 (13)	11 (11)
Recruitment source <i>n</i>= (%)		
Community health center	0 (0)	1 (4)
Eastern Health and Access Community Health	2 (5)	1 (4)
Osteoarthritis Hip and Knee Service (OAHKS)		
GLA:D® Australia	30 (70)	15 (63)
Private physiotherapy	6 (14)	7 (29)
Other		
- Orthopaedic Surgeon	1 (2)	0 (0)
- Rheumatologist	1 (2)	0 (0)
- Not specified	2 (5)	0 (0)

SD = standard deviation, M = Male, F = Female, GLA:D® = Good living with arthritis, Y = Yes, N = No

* Advanced musculoskeletal physiotherapist triage service based in Victorian public hospitals.

5.5.1 Brainstorming

Brainstorming yielded 110 responses following division of raw responses (*n*=84) into single idea education priorities. Following removal of irrelevant responses and pooling of priorities that represented the same idea, 76 unique education priorities were identified. Original participant responses and pooling decisions/edits are presented in [Appendix 5B](#).

5.5.2 Matching to education specific content recommendations in guidelines

Categorisation for whether each priority was included in education-specific content recommendations in knee osteoarthritis guidelines (clearly, possibly or no) is presented in Tables

5.2–5.5. Of all priorities, 3%, (n=2/76), 12%, (n= 9/76), 16%, (n=12/76) and 1% (n=1/76) were clearly recommended, and 25% (n=19/76), 42% (n=32/76), 66% (n=50/76) and 20% (n=15/76) were possibly included as education-specific content recommendations in ACR¹¹⁸, EULAR¹¹⁶, NICE⁴¹, and OARSI¹²⁵ guidelines respectively.

Table 5.2. ‘Understanding treatment options’ domain. Educational priority, cluster where the priority fits, mean importance, mean capability, Go-Zone quadrant and whether the priority is included in education specific content recommendations in guidelines.

Cluster number and title Priority		How important? † (1-5)	How confident? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
1. Relationship of education and exercise with surgery		3.88	3.72					
41	Will I be able to avoid surgery by committing to an education and exercise program?	4.17	3.09	3	No	No	Clearly 3.8	No
22	Is education and exercise useful post total knee replacements?	3.58	4.35	4	No	No	Clearly 3.8	No
7. Treatment decision-making		3.43	3.77					
24	What are my options beyond exercise?	3.88	3.52	4	No	Clearly 2.1, 2.3	Clearly 3.1	Possibly 4.2
2	Why are education and exercise programs the best option for knee osteoarthritis?	3.79	4.26	4	No	Possibly 2.1, 2.2, 2.3	Possibly 3.1, 3.2, 3.5	No
52	What methods will assist mobility?	3.65	4.00	4	No	No	No	No
73	Do most people's symptoms improve when completing an education and exercise program?	3.64	4.00	4	No	No	Possibly 3.1, 3.2, 3.5	Possibly 4.3
54	What methods will improve confidence that I will not fall?	3.40	3.48	2	No	No	No	No
46	Will losing weight help?	3.32	3.83	2	No	Clearly 2.1, 2.2, 2.6	Clearly 3.4	No
53	What methods will improve balance?	3.28	4.00	2	No	No	No	No
6	How far to bend my knee to avoid locking?	2.48	3.09	1	No	No	No	No
9. Adjunct options		3.35	3.33					
45	What is the best thing I can do to help my situation?	4.42	4.04	4	No	Possibly 2.1	Clearly 3.1, 3.2, 3.5	No
37	Is there any point in strapping the knee?	3.48	3.35	1	No	No	Clearly 3.1	No

Cluster number and title Priority		How important? † (1-5)	How confident? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
61	Are there inexpensive over the counter knee braces that help?	2.83	2.70	1	Possibly 1.4	Possibly 2.1	Possibly 3.1	No
38	How should I strap my knee?	2.67	3.23	1	No	No	No	No
Grand mean of all statements		3.53	3.46					

† - How important is it that you receive the answer to this question? (1 = least, 5 = most).

‡ - How confident are you that a health professional can provide you with answers to this question? (1 = least, 5 = most).

§ 1 = below grand mean for importance and below grand mean for confidence, 2 = below grand mean for importance and above grand mean for confidence, 3 = above grand mean for importance and below grand mean for confidence 4 = above grand mean for importance and above grand mean for confidence.

ACR – American College of Rheumatology, EULAR - European alliance of associations for rheumatology, NICE - National institute of health and care excellence, OARSI - Osteoarthritis research society international.

Table 5.3. ‘Exercise therapy’ domain. Educational priority, cluster where the priority fits, mean importance, mean capability, Go-Zone quadrant and whether priority is included in education specific content recommendations in guidelines.

Cluster number and title Priority		How important? † (1-5)	How confident? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
3. How to exercise		3.78	3.79					
7	What are the best exercises to do?	4.72	4.39	4	No	Clearly 2.5	Possibly 3.1, 3.2, 3.4	Possibly 4.2
5	What are the best exercises to strengthen the muscles around the knee?	4.65	4.50	4	No	Possibly 2.5	Possibly 3.1, 3.2, 3.4	No
8	What are the exercises to avoid?	4.32	3.96	4	No	No	No	No
47	Will walking more help?	4.12	4.04	4	No	Possibly 2.5	Possibly 3.6	No
3	Is exercise good for my knee even when it’s painful or swollen?	4.08	3.55	4	No	No	Possibly 3.6	No
23	What exercise can I do beyond the GLAD program?	4.00	3.87	4	No	Possibly 2.4, 2.5	Possibly 3.6	No
31	Is it possible to strengthen leg muscles to improve ability to move from sitting to standing?	3.96	4.41	4	No	No	No	No
32	Can I do more physical activity?	3.96	3.65	4	No	Possibly 2.2, 2.5	Possibly 3.6	No
34	How much exercise should I do?	3.92	3.91	4	No	Possibly 2.2, 2.5	Possibly 3.2, 3.4	No
33	Is there a point at which I should stop exercising?	3.88	3.48	4	Possibly 1.4	Possibly 2.5	Possibly 3.1, 3.2, 3.4	No
26	Where can you join with others to keep exercising after treatment is over?	2.75	3.13	1	No	Possibly 2.4	No	No
68	Can I find exercises online?	2.75	3.65	2	No	Possibly 2.4	No	No
57	Do you recommend a slow jog if there is no pain while jogging or post jogging?	2.08	2.74	1	No	No	No	No

Cluster number and title Priority		How important? † (1-5)	How confident? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
4. Why exercise?		3.70	3.64					
63	How to strengthen the joint?	4.52	4.35	4	Possibly 1.5	Possibly 2.5	Possibly 3.6	No
74	Does strengthening muscles around my knee help with osteoarthritis?	4.50	4.57	4	No	Possibly 2.5	Possibly 3.1, 3.2, 3.4, 3.5, 3.6	Possibly 4.1, 4.2, 4.3
20	Can continuing to exercise despite pain make the knee worse?	4.17	3.61	4	No	No	Possibly 3.6	No
35	Will my knee improve with exercise?	4.17	3.96	4	No	Possibly 2.1	Possibly 3.1, 3.2, 3.3, 3.4	Possibly 4.2, 4.3
9	Will exercise provide pain relief?	4.13	3.61	4	No	Possibly 2.1, 2.5	Possibly 3.1, 3.2, 3.3, 3.4	Possibly 4.2, 4.3
19	Am I better off continuing to exercise with pain rather than take medications?	3.88	4.09	4	Possibly 1.2, 1.3	No	Possibly 3.1, 3.2, 3.3, 3.4	No
25	How long will it take to remove pain if I exercise?	3.67	3.26	3	No	No	Possibly 3.1, 3.2, 3.3, 3.4	No
28	Why did an education and exercise program increase my pain?	2.83	3.00	1	No	No	No	No
65	Is exercise as a panacea or cure all?	2.67	2.96	1	No	No	Possibly 3.1, 3.2, 3.3, 3.4	No
75	If I complete an education and exercise program, am I likely to be free of commitment to knee related exercise in the future?	2.50	3.00	1	No	Possibly 2.3	Possibly 3.1, 3.2, 3.3, 3.4	No
Grand mean of all statements		3.53	3.46					

† - How important is it that you receive the answer to this question? (1 = least, 5 = most).

‡ - How confident are you that a health professional can provide you with answers to this question? (1 = least, 5 = most).

Cluster number and title Priority	How important? † (1-5)	How confident? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
	Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵

§ 1 = below grand mean for importance and below grand mean for confidence, 2 = below grand mean for importance and above grand mean for confidence, 3 = above grand mean for importance and below grand mean for confidence 4 = above grand mean for importance and above grand mean for confidence.
ACR – American College of Rheumatology, EULAR - European alliance of associations for rheumatology, NICE - National institute of health and care excellence, OARSI - Osteoarthritis research society international.

Table 5.4 ‘Understanding and managing the condition’ domain. Educational priority, cluster where the priority fits, mean importance, mean capability, Go-Zone quadrant and whether priority is included in education specific content recommendations in guidelines.

Cluster number and title Priority		How important? † (1-5)	How confident? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
5. Symptom management		3.67	3.49					
4	What are the best ways to minimise pain?	4.44	3.65	4	No	Possibly 2.1, 2.3	Possibly 3.1	Possibly 4.2
12	What are the best ways to manage pain?	4.21	3.87	4	No	Possibly 2.1, 2.3	Possibly 3.1	Possibly 4.2
39	How do I manage the pain without medication?	4.04	3.61	4	No	Possibly 2.1, 2.3	Possibly 3.1	Possibly 4.2
42	What is the best way to manage pain in one knee without creating excessive strain on the other one?	3.75	3.77	4	Possibly 1.4	Possibly 2.1	No	No
56	Why is it worse some days than others for no apparent reason?	3.28	2.96	1	Possibly 1.1	Possibly 2.1	Possibly 3.3	No
21	What is the success rate of pain reduction?	3.24	3.30	1	No	No	Clearly 3.1	No
62	Why does it become stiff and painful when I don't move (e.g. driving a long distance)?	3.21	3.52	2	No	Possibly 2.3	Possibly 3.3	No
11	What are the best ways to sleep at night to relieve pain?	3.16	3.22	1	No	No	No	No
6. Understanding symptoms		3.60	3.44					
50	What are the best methods to control and manage the condition?	4.79	3.95	4	No	Possibly 2.1	Possibly 3.1	Possibly 4.2, 4.3
58	What will make my knee osteoarthritis worse?	4.16	3.41	3	Possibly 1.1	Possibly 2.3	Possibly 3.3	No
66	Is it going to worsen despite my efforts?	3.83	3.05	3	Possibly 1.1	Possibly 2.3	Clearly 3.3	Possibly 4.1 4.3
60	Is pain the only indication of worsening arthritis?	3.71	3.57	4	Possibly 1.1	Possibly 2.3	Possibly 3.3	Possibly 4.1, 4.3
29	Why knees 'crunch'?	2.72	3.27	1	Possibly 1.1	Possibly 2.3	Possibly 3.3	No

Cluster number and title Priority	How important? † (1-5)	How confident? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
	Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
30 Why knees lock?	2.38	3.39	1	Possibly 1.1	Possibly 2.3	Possibly 3.3	No
8. Understanding the condition	3.43	3.39					
15 What is the current research for improving pain?	4.13	3.74	4	Possibly 1.1	Possibly 2.3	Possibly 3.1	No
51 What is the expected progression of knee arthritis?	4.13	3.83	4	Possibly 1.1	Clearly 2.3	Clearly 3.3	Clearly 4.1
43 What are the latest methods used to treat debilitating knee osteoarthritis?	3.96	4.26	4	No	No	Possibly 3.1	No
1 Can I regrow my cartilage?	3.32	3.00	1	Possibly 1.1	Possibly 2.3	Possibly 3.3	No
14 What causes my knee pain?	3.24	3.59	2	Possibly 1.1	Possibly 2.3	Possibly 3.3	No
64 Will it ever be 100% - or perhaps 90%?	3.17	2.87	1	Possibly 1.1	Clearly 2.3	Possibly 3.3	Possibly 4.1
27 Can osteoarthritis be reversed?	3.16	2.91	1	Possibly 1.1	Clearly 2.3	Possibly 3.3	Possibly 4.1
49 Why did I get knee osteoarthritis?	2.33	2.91	1	Possibly 1.1	Clearly 2.3	Possibly 3.3	No
Grand mean of all statements	3.53	3.46					

† - How important is it that you receive the answer to this question? (1 = least, 5 = most).
‡ - How confident are you that a health professional can provide you with answers to this question? (1 = least, 5 = most).
§ 1 = below grand mean for importance and below grand mean for confidence, 2 = below grand mean for importance and above grand mean for confidence, 3 = above grand mean for importance and below grand mean for confidence 4 = above grand mean for importance and above grand mean for confidence.
ACR – American College of Rheumatology, EULAR - European alliance of associations for rheumatology, NICE - National institute of health and care excellence, OARSI - Osteoarthritis research society international.

Table 5.5 ‘Surgical, medical and dietary management’ domain. Educational priority, cluster where the priority fits, mean importance, mean capability, Go-Zone quadrant and whether priority is included in education specific content recommendations in guidelines.

Cluster number and title Priority		How important? † (1-5)	How confident? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
2. Surgery		3.86	3.50					
44	What are the latest methods used to delay surgery?	4.32	4.09	4	No	No	Possibly 3.1, 3.8	No
36	How do I know when/if it is time to accept the need for knee surgery (replacement)?	3.92	3.73	4	No	No	Clearly 3.8	No
40	How to get rid of pain a long time after surgery?	3.79	3.04	3	No	No	Possibly 3.8	No
13	Will I need surgery eventually?	3.76	3.26	3	No	Possibly 2.1	Clearly 3.1, 3.5, 3.8	Possibly 4.3
67	Will having a knee replacement be beneficial?	3.52	3.39	1	No	No	Clearly 3.1, 3.8	No
10. Medications		3.34	3.24					
76	Are there medications that will help with the pain in the longer-term without side effects?	3.68	3.09	3	Clearly 1.2, 1.3	No	Possibly 3.1	No
18	Will medication make a difference to my pain?	3.22	3.23	1	Clearly 1.2	No	Possibly 3.1	No
10	Are injections likely to assist with knee osteoarthritis?	3.13	3.39	1	Possibly 1.2	No	Possibly 3.1	No
11. Diet and supplements		2.87	2.60					
55	Are there any food or drinks that I should be avoiding?	3.60	2.74	3	No	Clearly 2.6	No	No
59	Does diet help?	3.38	3.17	1	No	Clearly 2.1, 2.2, 2.6	Possibly 3.1	No
48	Will taking supplements help?	3.13	2.59	1	No	No	Possibly 3.1	No

Cluster number and title Priority		How important? † (1-5)	How confident? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
16	What are the benefits of turmeric for osteoarthritis?	2.92	2.52	1	No	No	Possibly 3.1	No
69	Is glucosamine helpful with lessening stiffness?	2.71	2.32	1	No	No	Possibly 3.1	No
71	Is chondroitin helpful with lessening stiffness?	2.63	2.35	1	No	No	Possibly 3.1	No
72	Is chondroitin helpful with lessening pain?	2.58	2.39	1	No	No	Possibly 3.1	No
70	Is glucosamine helpful with lessening pain?	2.45	2.48	1	No	No	Possibly 3.1	No
17	What is the latest research into glucosamine?	2.40	2.83	1	No	No	Possibly 3.1	No
Grand mean of all statements		3.53	3.46					

† - How important is it that you receive the answer to this question? (1 = least, 5 = most).

‡ - How confident are you that a health professional can provide you with answers to this question? (1 = least, 5 = most).

§ 1 = below grand mean for importance and below grand mean for confidence, 2 = below grand mean for importance and above grand mean for confidence, 3 = above grand mean for importance and below grand mean for confidence 4 = above grand mean for importance and above grand mean for confidence.

ACR – American College of Rheumatology, EULAR - European alliance of associations for rheumatology, NICE - National institute of health and care excellence, OARSI - Osteoarthritis research society international.

5.5.3 Sorting and rating

Sorting data from 24 participants were used. An 11-cluster map with four overarching domains was considered the most appropriate representation of the data (Figure 5.1). Cluster boundaries were re-drawn for seven education priorities based upon conceptual fit ([Appendix 5C](#)).

Of the 24 participants who completed rating activities, one did not complete question 2, and two did not complete question 3. Mean scores for each priority for rating question 1 (importance) and 2 (confidence), and the mean cluster ratings by domain are presented in Tables 5.2-5.5. The Go-Zone graph for importance and confidence ratings is presented in Figure 5.2. A strong positive correlation was observed between perceived priority importance, and confidence that a health professional would provide an answer to it ($r=0.73$). Results for rating question 3 are presented in [Appendix 5D](#).

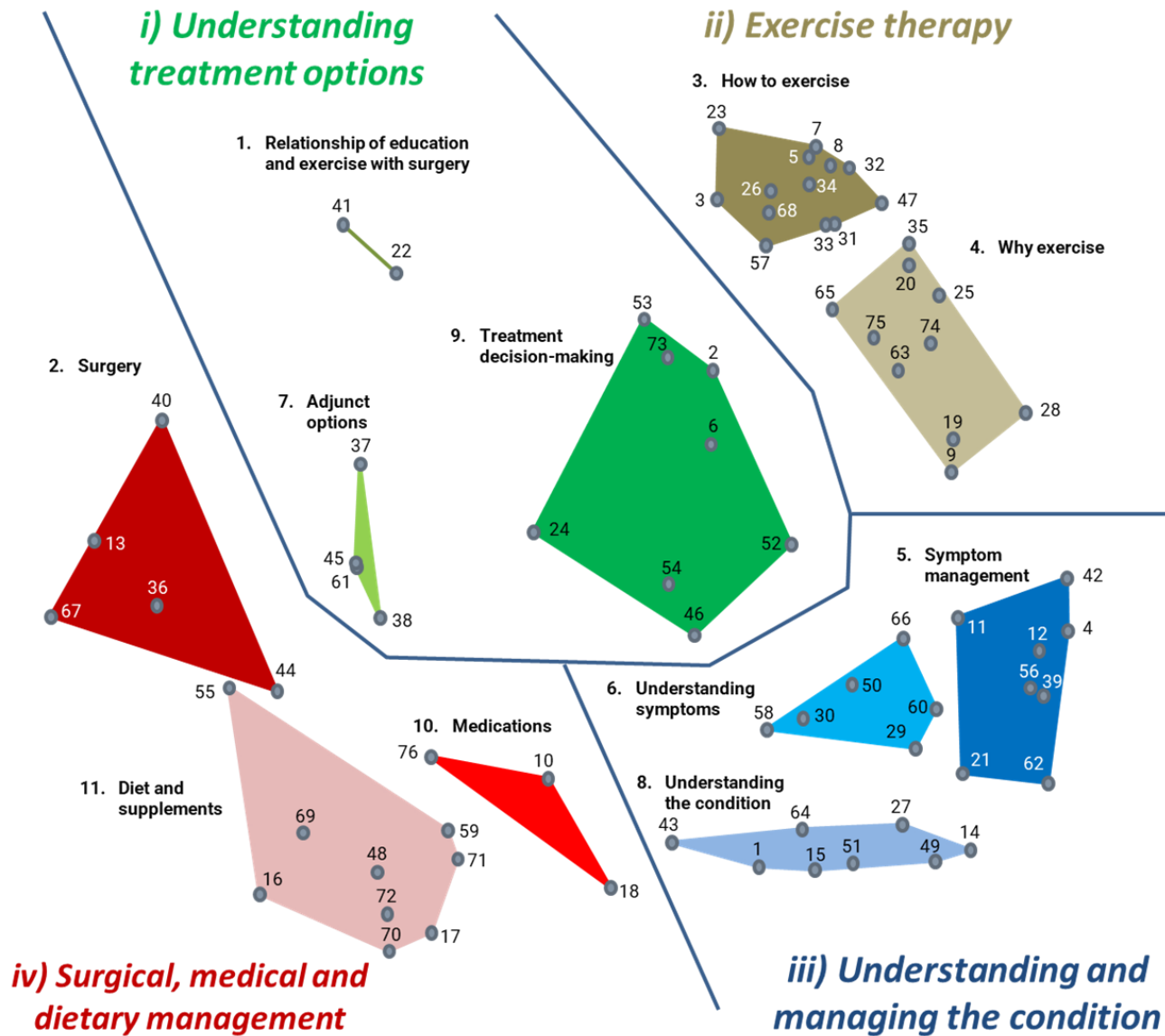
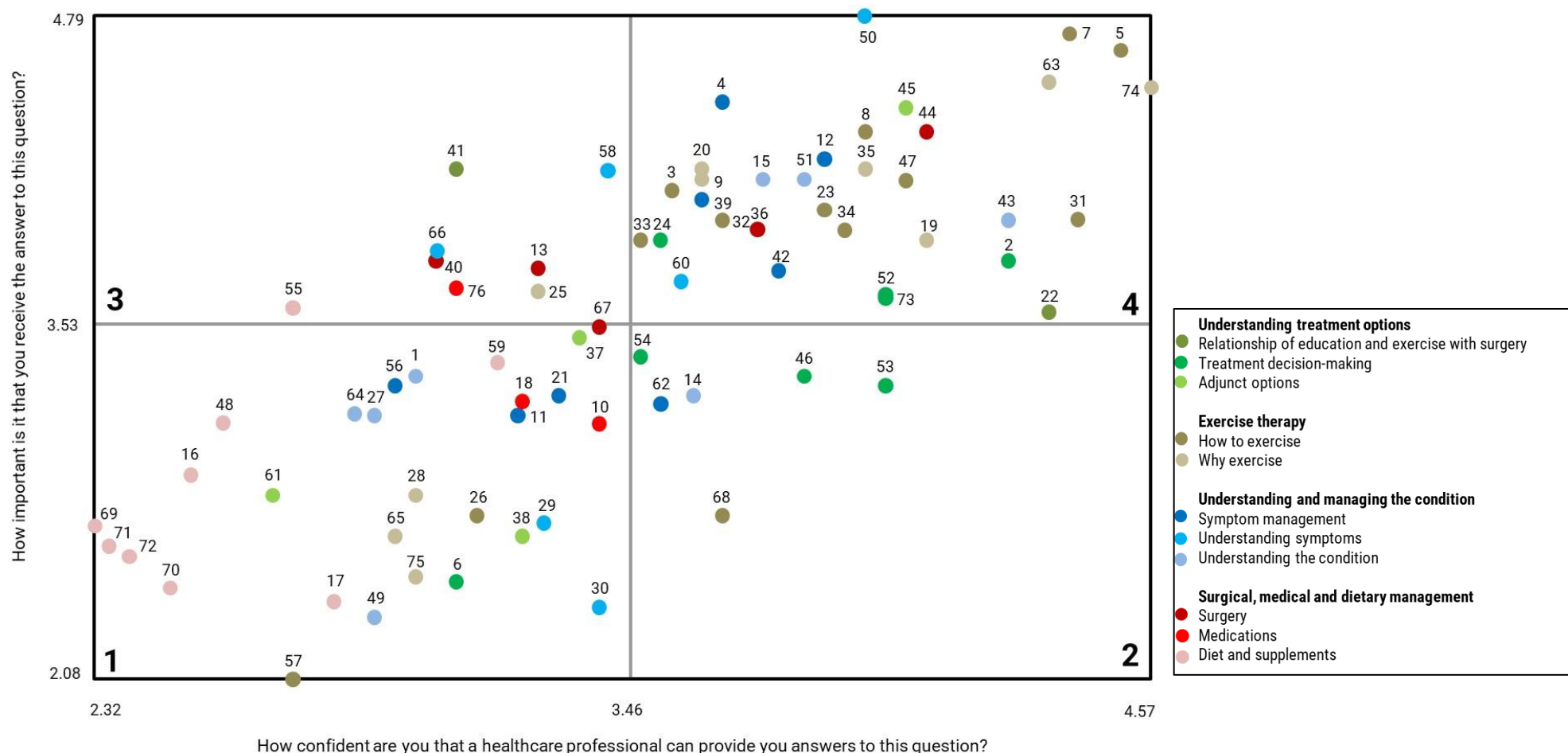


Figure 5.1 A four-domain, 11-cluster map of perceived education priorities for people with knee osteoarthritis



Quadrant 1 = below grand mean for importance and below grand mean for confidence, Quadrant 2 = below grand mean for importance and above grand mean for confidence, Quadrant 3 = above grand mean for importance and below grand mean for confidence, Quadrant 4 = above grand mean for importance and above grand mean for confidence

Figure 5.2 Go-Zone of priorities created by people with knee osteoarthritis

5.6 Discussion

This study identified the education priorities of people with a lived experience of knee osteoarthritis presenting to physiotherapists. Four overarching domains were identified, including ‘understanding treatment options’, ‘exercise therapy’, ‘understanding and managing the condition’ and, ‘surgical, medical and dietary management’. The three most important clusters of education priorities were; ‘the relationship of education and exercise with surgery’, ‘surgery’ and ‘how to exercise’. Most education priorities are not clearly included as education-specific content recommendations in knee osteoarthritis guidelines^{41,116,118,125}. The findings from this study may inform future clinical practice and guideline recommendations, plus facilitate development of resources or interventions to meet the education priorities of people with knee osteoarthritis.

Priorities about the relationship between education and exercise in avoiding surgery, or post-operative rehabilitation formed the highest rated cluster for importance, possibly reflecting that many people with knee osteoarthritis believe surgery is inevitable⁷⁹. Participants were confident that health professionals could meet their education priorities relating to rehabilitation after surgery. However, knowing whether surgery could be avoided was found in Go-Zone quadrant 3, indicating relatively high importance but low confidence that a health professional could address this priority. Only NICE⁴¹ guidelines clearly recommend providing education to address these important priorities related to surgery. Considering that beliefs about surgery and exercise can act as a barrier and facilitator to engagement in first-line care^{80,81,85}, we encourage other guideline developers^{116,118,125} to provide more specific education recommendations about these topics to facilitate informed decision-making.

The ‘exercise therapy’ domain contained the 3rd and 4th highest mean importance rated clusters – ‘how to exercise’ and ‘why exercise?’. Most priorities from this domain were in Go-Zone quadrant 4, indicating high relative importance and confidence that the priority can be addressed by a health professional. The perceived importance of topics about exercise is encouraging given compelling evidence supports the effectiveness of exercise therapy for people with knee osteoarthritis^{127,128,312}. However, only one priority (#7 – ‘what are the best exercises to do?’) from these exercise therapy clusters was clearly included as an education-specific content recommendation in a guideline (i.e. EULAR)¹¹⁶. The absence of education-specific recommendations to support implementing interventions such as exercise therapy is consistent with previous criticisms of guidelines for osteoarthritis^{137,138}. Guideline developers are encouraged to address this in future guidelines, and clinicians to address it in practice to help enhance self-efficacy for, improve adherence to, and reduce barriers to engagement with, exercise therapy^{129,141,311,313}.

The ‘surgical, medical and dietary management’ domain included the second most important cluster – ‘surgery’ – and the lowest-rated clusters for both importance and confidence: ‘medications’ and ‘diet and supplements’. The low priority ratings for ‘medications’ and ‘diet and supplements’ may reflect the fact that all participants completing sorting and rating activities were recruited from physiotherapy services, which do not typically focus on these treatments. A previous concept mapping study indicated that physiotherapists do not typically prioritise education about these topics⁴⁴⁷. Recruitment from physiotherapists may also explain why participants expected to find answers to questions about medications, diet and supplements

online, while they expected answers to questions from other clusters such as exercise therapy from health professionals.

Participants did not generate any priorities about several guideline-recommended adjunct treatments, including footwear, hot/cold, and topical non-steroidal anti-inflammatories (NSAIDs)^{41,116,118,125}. Published expert opinion recommendations³²⁰, and physiotherapists' education priorities⁴⁴⁷, consider information about the relationship between radiology findings and symptoms as important. These topics were not generated during brainstorming by the knee osteoarthritis cohort in this study. It is unclear whether participants were unaware of the potential importance of these education topics, or whether they did not value or want information about them. Understanding this may inform future education-specific content recommendations in guidelines.

Of currently available guidelines, EULAR¹¹⁶ provided the most detailed education-specific content recommendations to facilitate implementation and engagement with other first-line care interventions: exercise therapy and weight management. NICE⁴¹ guidelines recommended providing education about the risks and benefits of treatment options, an essential recommended component for written health information about treatment options according to DISCERN⁴²⁹. Collectively, The findings from this study highlight inconsistencies between, and potential shortcomings of, the education recommendations in guidelines to address education priorities of people with knee osteoarthritis. Guideline developers are encouraged to consider providing more detailed recommendations to support clinical practice, in an attempt to address the inconsistent

education provided to people with knee osteoarthritis^{75,210,269}.

The inclusion of all patient education priorities of people with a lived experience of knee osteoarthritis in guidelines may be unrealistic. Equally, providing education on all priorities identified in this study to all people with knee osteoarthritis is not recommended. However, health professionals should be trained and ready to educate people with knee osteoarthritis about each topic identified in this study as a priority on a case-by-case basis. Application of strong communication skills to identify individual health beliefs and literacy, alongside education needs is encouraged in practice to guide education content provided and ensure high-quality person-centered care.

Beyond guidelines, health professionals may seek guidance from other research sources (i.e. clinical trials or expert opinion). However, the poor reporting of education interventions in clinical trials threatens the clinical translation of evidence-based education²⁹¹. Expert opinion Delphi research³²⁰ provides a list of recommended statements that everyone with knee osteoarthritis should ‘know’, and the *OARSI core capability framework*⁴⁴⁸ provides recommendations that may facilitate education about lifestyle, self-management and behavior change. Further, narrative reviews^{140,449} may guide education-specific content about other topics (i.e., exercise therapy). Future research should canvas the opinions of other groups of people with knee osteoarthritis about education priorities.

5.6.1 Limitations and future directions

Inherent limitations of concept mapping methodology include small and non-randomised samples, and a heavy reliance on the skills of researchers to determine data saturation and interpret results^{450,451}. Although this study attempted to recruit a diverse group of participants with knee osteoarthritis, a high proportion during the brainstorming activity, and all in the sorting and rating activities were recruited from physiotherapy services. Therefore, participants may have been subject to the biases of the physiotherapy profession^{271,272}. Most participants were recruited from GLA:D[®] Australia and would have already received formal patient education sessions that covered topics including understanding the condition of knee osteoarthritis, risk factors, symptoms, general treatments, exercise, coping and self-help techniques⁴⁵². Further investigation of people newly diagnosed with knee osteoarthritis, consulting other health professionals (e.g. general practitioners, dieticians, rheumatologists etc.) and from culturally and linguistically diverse (CALD) communities may elicit different priorities.

The methods of this study demanded relatively high levels of computer and health literacy. Groups with lower literacies may have additional or different education priorities. Additionally, whether certain priorities (e.g., #66 – ‘Is it going to worsen despite my efforts?’) referred to a structural or clinical presentation of knee osteoarthritis was not clarified in this study. Exploring whether defining structural or clinical knee osteoarthritis influences findings is warranted. Finally, this study’s definition of whether a priority was ‘clearly’ or ‘possibly’ included as education-specific content recommendations in knee osteoarthritis guidelines may be open to interpretation. Consequently, this study’s findings could differ from others completing the same analysis. To address this limitation, three members of the research team were involved in

classifying and reached consensus, and the specific recommendation that was used to inform the decision is presented in Tables 5.2–5.5.

5.7 Conclusion

People with knee osteoarthritis presenting to physiotherapists have broad education priorities, including a desire for an understanding of treatment options, and they prioritise education about surgery and exercise. People with knee osteoarthritis are generally confident that health professionals can meet their most important education priorities. However, most education priorities identified by people with knee osteoarthritis are not clearly recommended as education topics in knee osteoarthritis guidelines.

Chapter 6 : Physiotherapists prioritise providing education about exercise therapy and to dispel misconceptions about radiology for people with knee osteoarthritis. A concept mapping study.

6.1. Preface

In Chapter 5 I identified that people with knee osteoarthritis have broad educational priorities and relatively high confidence that health professionals can address their most important educational needs. Physiotherapists are the most commonly referred to allied health profession in Australia for people with knee osteoarthritis¹⁷³, and play a key role the provision of first-line care²¹¹. Therefore, they would have important insights into what education content may be most important to provide to people with knee osteoarthritis. This Chapter uses concept mapping methodology⁴⁴³ to identify, sort and rate physiotherapists' perceived education priorities, including their perceived importance of, and capability to provide, each. Findings of this study will help to guide development of future education resources or interventions, including a patient education and self-management toolkit in Chapter 7.

The following chapter contains an edited version of the following paper that has been accepted
by the Journal of Orthopaedic and Sports Physical Therapy:

Goff, A.J., Donaldson, A., De Oliveira Silva, D., Crossley, K.M, & Barton, C.J.

“Physiotherapists prioritize providing education about exercise therapy and to dispel
misconceptions about radiology for people with knee osteoarthritis. A concept mapping study.”

All edits of the re-submitted manuscript are grammatical to facilitate alignment with the
remainder of this thesis.

6.1 Abstract

Objectives: To (1) identify the education priorities that physiotherapists have for people with knee osteoarthritis, including perceived importance and capability to provide, and (2) match priorities to education-specific content recommendations in knee osteoarthritis guidelines.

Design: Concept mapping methodology.

Methods: Physiotherapists generated, sorted (based on themes) and rated (5-point Likert scales: importance and capability) patient education priorities. Priorities were matched against education-specific content recommendations in knee osteoarthritis guidelines. Additional education-specific content recommendations were added from guidelines and expert opinion if necessary. Multidimensional scaling and hierarchical cluster analysis produced a cluster map with overarching domains.

Results: Physiotherapists (brainstorming, $n=41$; sorting, $n=20$; rating, $n=22$) generated 56 priorities, with 13 added ($n=2$ from guidelines, $n=11$ from expert opinion). Few priorities were clearly included as education-specific content recommendations in guidelines (ACR (2%, $n=1/56$), EULAR (14%, $8/56$), NICE (11%, $6/56$) and OARSI (0%, $0/56$)). An eight-cluster map emerged with three overarching domains: i) first-line care (exercise therapy; lifestyle modification and general health; and weight management); ii) knowledge formation and countering misconceptions (radiology misconceptions; understanding and managing pain and disability; and general beliefs and understanding about osteoarthritis) and, iii) decision making for medical management (surgery; and medications). The exercise therapy cluster was highest-rated for both importance (3.84/5) and capability (4.00). The medications and weight management clusters were lowest-rated for importance (2.54) and capability (2.82) respectively.

Conclusion: Physiotherapists prioritise a range of education topics for people with knee osteoarthritis, focusing on exercise therapy. Physiotherapists feel least capable of providing weight management education.

6.3 Introduction

Guideline-recommended^{41,116,118,125} first-line care for people with knee osteoarthritis includes patient education, exercise therapy plus weight loss. These recommendations apply to all people with knee osteoarthritis, regardless of age, comorbidity, pain severity, or disability⁴¹. Despite guidelines prioritising patient education, they contain limited and varied guidance on ‘what’ content should be provided to facilitate delivery of best practice care^{41,116,118,125}. This may account for health professionals’ inconsistent and sometimes confusing provision of patient education^{75,210,267,325}.

Physiotherapists frequently educate patients with knee osteoarthritis^{273,321,453-455}, and may have valuable insights into important or impactful education content to provide. It is therefore important to identify physiotherapists’ education priorities and explore the extent to which they align to education recommendations in guidelines. Understanding what clinicians prioritise may inform future guidelines and clinical practice, and help to develop educational interventions or resources for people with knee osteoarthritis.

The primary aims of this study were to identify physiotherapists’ education priorities for people with knee osteoarthritis, and the perceived; i) relative importance of, and ii) capability to provide education about, each priority. The secondary aim was to determine if the education priorities of physiotherapists reflected education-specific content recommendations in leading knee osteoarthritis guidelines.

6.4 Methods

La Trobe University Human Ethics Committee approved this study (HEC19211). All

participants received written information about the study, alongside the research team's contact details to clarify any queries. Participants were eligible if they were an Australian Health Practitioner Regulation Agency (APRHA) registered physiotherapist providing care to people with knee osteoarthritis. All data, including self-confirming eligibility and consent, were collected via the Concept Systems groupwisdom (Ithaca, USA)⁴⁴⁴ web platform. The rights of the participants were protected.

6.4.1 Methodology

Mixed-methods concept mapping methodology was used⁴⁴³ to generate and organise education priorities. Concept mapping involves six steps; i) preparation (establishing the focus prompt and identifying and recruiting participants), ii) generating ideas from a group of individuals (brainstorming), iii) structuring (sorting and rating), iv) concept mapping analysis, v) interpreting maps and vi) utilisation.⁴⁴³ Participants were involved in steps ii) and iii) of this study.

6.4.2 Recruitment

This study was advertised through multiple digital channels in an attempt to attract a diverse range of participants. Brainstorming recruitment occurred between September 2019 and September 2020, through social media including special interest physiotherapist groups on Facebook and the research team's network of physiotherapists; and Good Living with osteoArthritis Denmark, Australia (GLA:D[®] Australia), and Australian Physiotherapy Association (APA) newsletters. Interested participants followed a link to the study-specific web platform where they viewed study information and completed baseline demographic questions before engaging with concept mapping activities. Recruitment for sorting and rating occurred between October 2020 and April 2021. All participants who engaged with

brainstorming were emailed an invitation to participate in sorting and rating activities, and the study was re-advertised through the same recruitment channels described above. Participants received a \$20 supermarket voucher for their time.

6.4.3 Brainstorming

Participants were instructed to generate responses to a focus prompt: *‘What educational information do you think is important to deliver to patients with knee osteoarthritis?’*.

Participants could add multiple responses and were instructed that each response should contain one idea only. Recruitment remained open until the research team agreed that data saturation had occurred and no new topics were being captured within responses.

Four researchers (AJG, AD, CJB, DOS) met three times to synthesise and edit brainstorming responses. Initially, compound responses were divided into single-idea education priorities, and responses that were not relevant to the focus prompt were removed. Priorities that represented the same ideas were grouped, with the response that best articulated the priority retained for the final list. Priorities were edited when; i) abbreviations were used, ii) there were typographical errors, or iii) adding/deleting words improved clarity. All priorities were kept as close to the original responses as possible.

6.4.4 Matching of physiotherapists’ education priorities to education specific content recommendations in guidelines

The edited list of physiotherapists’ priorities from brainstorming were matched against education-specific content recommendations from the American College of Rheumatology (ACR)¹¹⁸, European Alliance of Associations for Rheumatology (EULAR)¹¹⁶, National

Institute of Health and Care Excellence (NICE)⁴¹, and Osteoarthritis Research Society International (OARSI)¹²⁵ knee osteoarthritis guidelines ([Appendix 6A](#)). Physiotherapists brainstorming responses were categorised as ‘clearly’, ‘possibly’ or ‘no’ (i.e. not) covered by the education-specific content recommendations from guidelines by two researchers (AG, CB). A third reviewer (DOS) was available to facilitate agreement, if required.

6.4.5 Addition of priorities

Four researchers (AJG, AD, DOS and CJB) compared the edited list of physiotherapists’ priorities from brainstorming against education-specific content recommendations from guidelines^{41,116,118,125}, plus recommendations from two expert opinion studies^{320,321} ([Appendix 6A](#)). The expert opinion studies were chosen due to their robust Delphi methodologies that resulted in direct education content recommendations for people with knee osteoarthritis,³²⁰ and recommendations specific to physiotherapists³²¹. Any education-specific content recommendations not covered by brainstorming responses were added to the list of priorities for sorting and rating.

6.4.6 Sorting and rating

Sorting: Participants viewed the final list of synthesised priorities from brainstorming in a random order, and sorted priorities into piles that made sense to them, based on related themes or topics. Participants then named each pile based on its content. Participants were informed that it is common to create between 5–20 piles and that they should not sort piles based on a value (e.g., importance or relevance), or create piles of unrelated priorities (e.g., ‘miscellaneous’ or ‘other’).

Rating: Two rating questions were used: ‘*How important is it that you deliver this education topic to a person with knee osteoarthritis?*’ and: ‘*How capable are you at delivering this education topic to a person with knee osteoarthritis?*’. Participants were instructed to rate each priority on a 1–5 Likert scale. Options for importance ranged from not important at all (1) to very important (5), and for capability ranged from not at all capable (1) to very capable (5). Participants were instructed to use the full rating scale and to rate each priority relative to each other rather than provide an absolute rating. Rating data were excluded from analysis if the participant rated all priorities as important (4) or very important (5) as this suggested that priorities were rated individually rather than in relation to each other, which would lead to a diluted cluster map and challenges with interpretation.

6.4.7 Concept mapping analysis

Participant sorting data were excluded if less than 75% of priorities were placed into piles. This is an inbuilt pre-requisite of the Concept Systems groupwisdom (Ithaca, USA)⁴⁴⁴ web platform. Participant sorting data was also extracted if more than 40% of priorities were grouped into one pile, as preliminary data analysis identified that this created broad clusters and made interpretation of data challenging. Eligible sorting data were analysed in two stages; i) multidimensional scaling analysis to produce a two-dimensional ‘point map’ and, ii) hierarchical cluster analysis to partition the point map into a two dimensional ‘cluster map’. Full details of the multidimensional analysis, stress index calculation and hierarchical cluster analysis used in the Concept Systems groupwisdom (Ithaca, USA)⁴⁴⁴ web platform are published elsewhere⁴⁴³.

Analysis followed guidance from Kane and Trochim (Concept Systems Incorporated pp. 101–

103)⁴⁴³ to identify and finalise clusters. Cluster maps were examined from a 12-to-6 cluster solution, paying attention to which priorities were merged as the number of clusters was reduced. Based on the research team's knowledge of patient education for knee osteoarthritis, the cluster level that retained the most useful detail between clusters was identified, and clusters that logically belonged together were merged. If a priority seemed to conceptually belong in an adjacent cluster, the cluster boundaries were re-drawn to accommodate this, provided that it did not lead to overlapping boundaries. The similarity matrix and spanning information for each priority was reviewed to inform decisions when re-drawing cluster boundaries.

The final cluster map was analysed by the research team to determine whether a higher-level domain-based organisation of clusters was apparent⁴⁴⁵. In line with previous research⁴⁴⁶, a qualitative, interpretive analysis of the map was performed, considering the proximity of the clusters and the priorities within them, to provide a meaningful interpretation of physiotherapists' patient education priorities for people with knee osteoarthritis.

Descriptive statistics were generated for importance and capability rating questions.

Consistent with common concept mapping methodology, a 'Go-Zone' scatter plot graph was created using the Concept Systems groupwisdom (Ithaca, USA)⁴⁴⁴ web platform by plotting the mean rating for each priority related to perceived importance and capability. The Go-Zone graph was divided into four quadrants based on the grand means (total means of all priorities) of each scale. This provides a visual representation of each priority's relative perceived importance and capability to provide education about it. Division into quadrants facilitates interpretation of results – e.g. Quadrant 3 represented priorities rated above the grand mean

for importance but below the grand mean for capability to provide education about it, indicating potential priorities for training and education.

6.5 Results

Characteristics of all participants included in the brainstorming, sorting and rating activities are presented in Table 6.1.

Table 6.1 Participant characteristics.

	Brainstorming	Sorting	Rating
Total participants <i>n</i>=	39	20	22
Years as physiotherapist, Mean (SD)	16 (11)	16 (11)	15 (10)
Post graduate qualifications <i>n</i>= (%)			
Nil/not answered	17 (44)	7 (35)	8 (36)
Graduate Certificate	5 (13)	4 (20)	6 (27)
Graduate Diploma	4 (10)	3 (15)	2 (9)
Masters	13 (33)	5 (25)	5 (23)
Doctorate/PhD	0 (0)	1 (5)	1 (5)
Workplace <i>n</i>= (%)			
Community healthcare center	7 (18)	4 (20)	5 (23)
Hospital – Private	2 (5)	1 (5)	1 (5)
Hospital – Public	0	1 (5)	1 (5)
Osteoarthritis Hip and Knee Service*	4 (10)	2 (10)	4 (18)
Private practice	26 (67)	12 (60)	11 (50)
Workplace delivers GLA:D®? (Y/N)	18/21	11/9	12/10

* Advanced musculoskeletal physiotherapist triage service based in Victorian public hospitals.
GLA:D® = Good Living with osteoArthritis Denmark® Australia SD = standard deviation, M = Male, F = Female, GLA:D® = Good living with arthritis, Y = Yes, N = No

6.5.1 Brainstorming

Thirty-nine participants generated 89 responses. When divided into single ideas, 145 responses were produced. Grouping of similar ideas and removal of irrelevant responses

produced 56 unique education priorities.

6.5.2 Matching of physiotherapists' education priorities to education specific content recommendations in guidelines

Of all priorities, 2%, (n=1/56), 14%, (n= 8/56), 11%, (n=6/56) and 0% (n=0/56) were clearly included, and 20% (n=11/56), 29% (n=16/56), 70% (n=39/56) and 36% (n=20/56) were possibly included as education specific content recommendations in ACR¹¹⁸, EULAR¹¹⁶, NICE⁴¹, and OARSI¹²⁵ guidelines respectively. Whether each priority was included in education-specific content recommendations in knee osteoarthritis guidelines (clearly, possibly or no) is presented in Tables 6.2–6.4.

6.5.3 Addition of priorities

Thirteen priorities were added to participant responses (n=1 from EULAR¹¹⁶, n=1 from NICE⁴¹, n=11 from French et al.³²⁰, n=1 from Teo et al.³²¹). Therefore, 69 priorities were used for sorting and rating activities. Details of all original responses, condensing decisions/edits and additions is presented in [Appendix 6B](#). See Tables 6.2-6.4 for a breakdown of priorities by domain and cluster.

Table 6.2 ‘First-line care’ domain. Priority, cluster where the priority fits, mean importance, mean capability, Go-Zone quadrant, source of statement and whether the priority is included in education specific content recommendations in guidelines.

Cluster number and title Priority		How important? † (1-5)	How capable? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
1. Exercise therapy		3.84	4.00					
64#	Individualised exercise programs (including strength, cardiovascular and flexibility) can reduce your pain, prevent worsening of your osteoarthritis, and improve your daily function	4.61	4.22	4	N/A	N/A	N/A	N/A
19	Exercise can be very effective	4.50	4.39	4	No	Possibly 2.1, 2.5	Possibly 3.1, 3.2, 3.4, 3.5, 3.6	Possibly 4.2, 4.3
51	Acceptable and safe to feel pain during exercise	4.39	4.39	4	No	No	No	No
9	Appropriate load and exercise is good for knee cartilage and health	4.30	4.17	4	No	No	Possibly 3.1, 3.3, 3.5	No
63#	Regular physical activity can reduce your pain, prevent worsening of your osteoarthritis, and improve your daily function	4.26	4.30	4	N/A	N/A	N/A	N/A
8	When to consider adapting exercise and activity in response to pain	4.09	4.22	4	No	Possibly 2.1	Possibly 3.4	No
23	Exercise and education can delay joint replacement due to symptom control and improved function	4.09	4.09	4	No	No	Possibly 3.1, 3.8	No
33	Identifying and overcoming barriers to exercise	4.04	3.74	4	Possibly 1.5	Possibly 2.5	Possibly 3.4	No
46	A consistent, progressively overloaded strength program helps to improve function	4.04	4.30	4	No	Possibly 2.5	Possibly 3.4, 3.6	No
4	Understanding when to progress and regress exercise	4.00	4.30	4	No	No	No	No

Cluster number and title Priority		How important? † (1-5)	How capable? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
25	Therapeutic exercise will not make the knee worse in the long-term	4.00	4.22	4	No	No	Possibly 3.1	Possibly 4.3
7	How to monitor pain during exercise and activity	3.91	3.96	4	No	No	No	No
5	Strategies in making exercise a routine and working it into your life	3.83	3.74	4	No	Clearly 2.4	Possibly 3.4	No
18	That no matter how painful your joint is, there is always some type of exercise you can do to benefit your joint	3.78	4.13	4	No	No	Possibly 3.1, 3.2, 3.3, 3.4, 3.5	Possibly 4.2, 4.3
22	It is never lost/wasted time. Even if you need to proceed to joint replacement after receiving education and exercise, you'll still enter stronger which will help recovery	3.65	3.96	4	No	No	Possibly 3.1, 3.8	Possibly 4.2, 4.3
53	With education and exercise, most people notice their function improves even if the pain remains	3.57	3.74	4	No	No	Possibly 3.1, 3.2, 3.3	Possibly 4.2, 4.3
24	Even if you are already very physically active exercise still has potential for benefit because it targets specific muscle strength, and improved limb alignment/control	3.48	3.83	2	No	No	Possibly 3.6	Possibly 4.3
27	Strengthening can improve shock absorbing capacity in the lower limb	3.48	3.74	2	Possibly 1.4	Possibly 2.5	Possibly 3.1, 3.2, 3.6	No
12	How exercise can work as a mediator for pain and disability	3.39	3.57	1	No	No	No	No
36	The importance of being committed to exercise	3.39	3.91	2	Possibly 1.5	Possibly 2.1	Possibly 3.1, 2.2, 3.4	Possibly 4.2
52	Difference between joint pain and delayed onset of muscle soreness (DOMS) when exercising	3.39	3.78	2	No	No	No	No
26	Basic information about the principles of strengthening and progressive load	3.17	4.35	2	No	Possibly 2.5	Possibly 3.6	No

Cluster number and title Priority		How important? † (1-5)	How capable? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
69#	Provide information on opportunities for people to exercise locally at minimal financial cost	2.96	2.96	1	N/A	N/A	N/A	N/A
4. Lifestyle modification and general health		3.48	3.42					
48	Lifestyle changes can play a big role in the management of knee osteoarthritis	4.30	3.87	4	No	Clearly 2.2	Possibly 3.2, 3.4	Possibly 4.2, 4.3
38	Pain can be affected by non-mechanical factors including mood, sleep, diet etc.	3.96	3.52	3	No	No	Possibly 3.3	No
61#	Non-drug treatments have similar benefits for your osteoarthritis symptoms to pain relieving drugs, but with very few adverse side effects	3.96	3.48	3	N/A	N/A	N/A	N/A
56	Improving general health is important in the management of knee osteoarthritis	3.91	3.57	3	No	Clearly 2.2	Possibly 3.2, 3.4	No
66#	Living a sedentary life could worsen your osteoarthritis	3.83	3.74	4	N/A	N/A	N/A	N/A
17	The importance of setting short and long-term goals	3.30	3.70	2	Clearly 1.5	Clearly 2.2	Possibly 3.4	No
65#	Living a sedentary life could increase your risk of other lifestyle-related diseases, such as diabetes and cardiovascular disease	3.26	3.65	2	N/A	N/A	N/A	N/A
68	Counselling about modifiable work-related factors e.g. behaviours, tasks, hours, assistive technology, workplace modification	2.52	2.65	1	N/A	N/A	N/A	N/A
67	Use of suitable footwear is important for managing your osteoarthritis (e.g. supportive, shock-absorbing properties)	2.30	2.57	1	N/A	N/A	N/A	N/A
5. Weight management		3.30	2.82					
21	Weight loss can be very effective	3.87	3.57	3	No	Possibly 2.1, 2.6	Possibly 3.1, 3.2, 3.4	Possibly 4.2
16	Importance of small achievable goals in weight loss	3.30	2.74	1	Possibly 1.5	Clearly 2.2, 2.6	Possibly 3.4	No

Cluster number and title Priority		How important? † (1-5)	How capable? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
34	Identifying and overcoming barriers to weight loss	3.13	2.48	1	No	Clearly 2.6	Possibly 3.4	No
30	Information on 'how to' lose weight	2.91	2.48	1	No	Clearly 2.6	Possibly 3.2, 3.4	No
Grand mean of all statements		3.56	3.65					
† - How important is it that you deliver this education topic to a person with knee osteoarthritis? (1= least, 5 = most) ‡ - How capable are you at delivering this education topic to a person with knee osteoarthritis? (1= least, 5 = most) § 1 = below grand mean for importance and below grand mean for capability, 2 = below grand mean for importance and above grand mean for capability, 3 = above grand mean for importance and below grand mean for capability, 4 = above grand mean for importance and above grand mean for capability - Priority added based upon education recommendation from clinical practice guidelines # - Priority added based upon recommendation from expert opinion								

Table 6.3 ‘Knowledge formation and countering misconceptions’ domain. Priority, cluster where the priority fits, mean importance, mean capability, Go-Zone quadrant, source of statement and whether the priority is included in education specific content recommendations in guidelines.

Cluster number and title Priority		How important? † (1-5)	How capable? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
2. Radiology misconceptions		3.74	3.81					
1	The disparity between symptoms and quality of life with imaging findings	3.96	3.70	4	No	No	Possibly 3.3	No
50	Radiological findings cannot accurately predict prognosis	3.87	3.83	4	No	No	Possibly 3.3	No
2	There is a high prevalence of knee degenerative changes in asymptomatic individuals	3.74	3.91	4	No	No	Possibly 3.3	No
29	Degenerative changes on Xray are a normal part of ageing	3.65	3.83	4	No	No	Possibly 3.3	No
3	Why imaging is discouraged	3.48	3.78	2	No	No	Possibly 3.3	No
3. Understanding and managing pain and disability		3.63	3.76					
6	Pain does not equal harm or damage	4.70	4.30	4	No	No	Possibly 3.3	No
35	Osteoarthritis management requires active input from client. Physiotherapist is there to guide the process	4.04	4.04	4	No	No	No	No
37	How we get pain	3.87	3.74	4	No	No	No	No
28	Pacing of activities helps manage pain	3.83	4.05	4	Possibly 1.4	Clearly 2.1,2.4	Clearly 3.4	Possibly 4.2
49	People can remain healthy and active with osteoarthritis	3.83	4.17	4	No	No	Possibly 3.3	Possibly 4.3
11	There are many factors that influence pain and disability	3.70	3.52	3	No	No	No	No
20	Education can be very effective	3.43	3.74	2	No	No	Possibly 3.1	No

Cluster number and title Priority		How important? † (1-5)	How capable? ‡ (1-5)	Priority Go-Zone quadrant ^s	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
31	We can improve pain with movement and with less fear around movement	3.43	3.83	2	No	No	No	Possibly 4.3
32	That central nervous system changes are part of the picture - not just 'tissue damage'	3.35	3.35	1	No	No	Possibly 3.3	No
40	Improving self-efficacy relating to knee pain is important	3.35	3.48	1	No	No	No	No
10	Osteoarthritic joints adapt to imposed demands	3.17	3.61	1	No	No	No	No
13	How education can work as a mediator for pain and disability	2.87	3.26	1	No	No	Possibly 3.1	No
6. General beliefs and understanding about osteoarthritis		3.27	3.29					
54	Osteoarthritis is not a "wear and tear" disease	3.70	3.43	3	Possibly 1.1	Possibly 2.3	Possibly 3.3	Possibly 4.1
45	Not everyone with osteoarthritis gets worse	3.57	3.61	3	Possibly 1.1	Possibly 2.3	Clearly 3.3	Possibly 4.1
57#	Osteoarthritis is not just a disease of the cartilage but affects your whole joint including muscles and ligaments	3.48	3.43	1	N/A	N/A	N/A	N/A
58#	The symptoms of osteoarthritis can vary greatly from person to person	3.43	3.74	2	N/A	N/A	N/A	N/A
43	Effect of osteoarthritis on other symptoms not just pain- e.g. mood, fatigue	3.26	3.22	1	Possibly 1.1	Possibly 2.1	Possibly 3.3	Possibly 4.1
14	The osteoarthritis process - onset and drivers of disease progression	3.13	3.09	1	Possibly 1.1	Possibly 2.1	Possibly 3.3	Possibly 4.1
15	How chronic inflammation influences osteoarthritis	3.00	2.57	1	Possibly 1.1	Possibly 2.1	Possibly 3.3	Possibly 4.1
55	Osteoarthritis is not a normal part of ageing	2.61	3.26	1	Possibly 1.1	Possibly 2.1	Possibly 3.3	Possibly 4.1
Grand mean of all statements		3.56	3.65					
† - How important is it that you deliver this education topic to a person with knee osteoarthritis? (1= least, 5 = most)								
‡ - How capable are you at delivering this education topic to a person with knee osteoarthritis? (1= least, 5 = most)								

Cluster number and title Priority	How important? † (1-5)	How capable? ‡ (1-5)	Priority Go-Zone quadrant [§]	Included in education specific content recommendations?			
	Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
§ 1 = below grand mean for importance and below grand mean for capability, 2 = below grand mean for importance and above grand mean for capability, 3 = above grand mean for importance and below grand mean for capability, 4 = above grand mean for importance and above grand mean for capability							
# - Priority added based upon recommendation from expert opinion							

Table 6.4 ‘Knowledge formation and countering misconceptions’ domain. Priority, cluster where the priority fits, mean importance, mean capability, Go-Zone quadrant, source of statement and whether the priority is included in education specific content recommendations in guidelines.

Cluster number and title Priority		How important? † (1-5)	How capable? ‡ (1-5)	Priority Go-Zone quadrant§	Included in education specific content recommendations?			
		Cluster mean Priority rating	Cluster mean Priority rating		ACR ¹¹⁸	EULAR ¹¹⁶	NICE ⁴¹	OARSI ¹²⁵
7. Surgery		3.22	3.47					
39	Surgery is not the only option to help reduce pain	3.96	4.00	4	No	Possibly 2.1	Clearly 3.8	Possibly 4.3
47	Joint surgery is not mandatory just because it is recommended by a specialist but a choice the individual makes with appropriate levels of information.	3.65	3.52	3	No	Possibly 2.1	Clearly 3.8	Possibly 4.1
41	Knee arthroscopy for osteoarthritis is ineffective	3.39	3.26	1	No	No	Possibly 3.1	No
42	Joint replacement is a last resort, it is useful for a relatively small group of patients	3.39	3.57	1	No	No	Clearly 3.8	No
44	Most people do well after arthroplasty but not everyone does	3.00	3.50	1	No	No	Clearly 3.8	No
62#	Keyhole surgery may be considered if there is mechanical blocking of your joint	1.91	3.00	1	N/A	N/A	N/A	N/A
8. Medications		2.54	3.11					
59#	You should avoid the use of nonsteroidal anti-inflammatory drugs for your osteoarthritis over the long term	2.61	3.04	1	N/A	N/A	N/A	N/A
60#	You may get some pain relief from your osteoarthritis by using acetaminophen (paracetamol) medications	2.48	3.17	1	N/A	N/A	N/A	N/A

† - How important is it that you deliver this education topic to a person with knee osteoarthritis? (1= least, 5 = most)
‡ - How capable are you at delivering this education topic to a person with knee osteoarthritis? (1= least, 5 = most)
§ 1 = below grand mean for importance and below grand mean for capability, 2 = below grand mean for importance and above grand mean for capability, 3 = above grand mean for importance and below grand mean for capability, 4 = above grand mean for importance and above grand mean for capability
- Priority added based upon recommendation from expert opinion

6.5.4 *Sorting and rating*

Twenty-five participants attempted sorting and rating activities. Data for five participants were excluded from analysis due to: i) sorting <75% of priorities into piles ($n=2$), ii) sorting priorities into piles based upon a value (e.g. importance) ($n=1$), and iii) placing more than 40% of priorities (i.e., 28/69) in one pile ($n=2$). An eight-cluster map was considered the most appropriate representation of the sorting data (Figure 6.1). Thirteen priorities were re-allocated to adjacent clusters based on conceptual fit ([Appendix 6C](#)). Three overarching domains were identified: i) first-line care, ii) knowledge formation and countering misconceptions and iii) decision making for medical management (Figure 6.1).

Rating data for three participants were excluded from the analysis as all ratings were concentrated across 4–5 on the Likert scale. Mean rating scores for each priority and cluster are presented in Tables 6.2-6.4. The Go-Zone graph for all priorities is in Figure 6.2. There was a strong correlation between perceived importance and capability to provide education related to that priority ($r=0.77$).

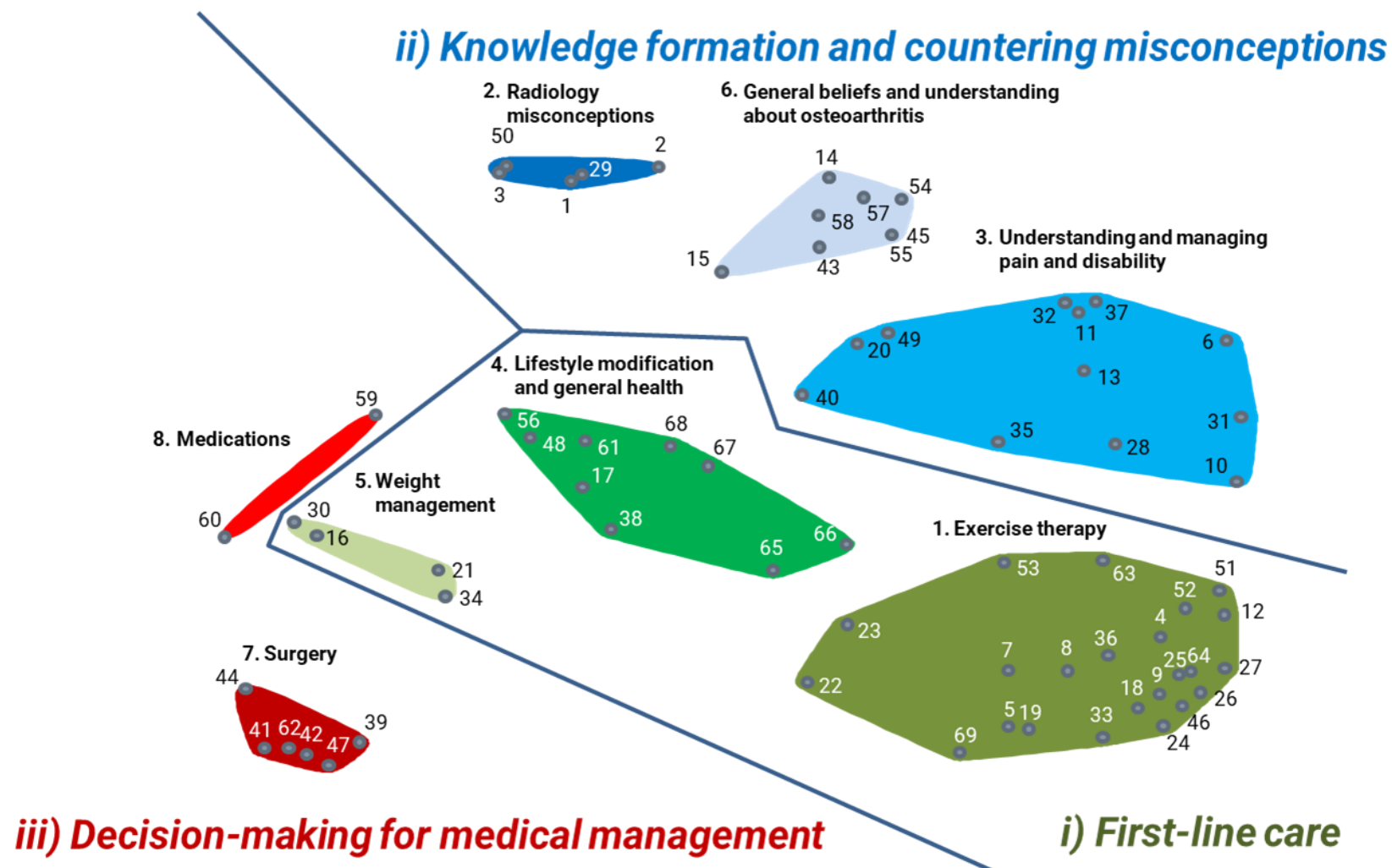
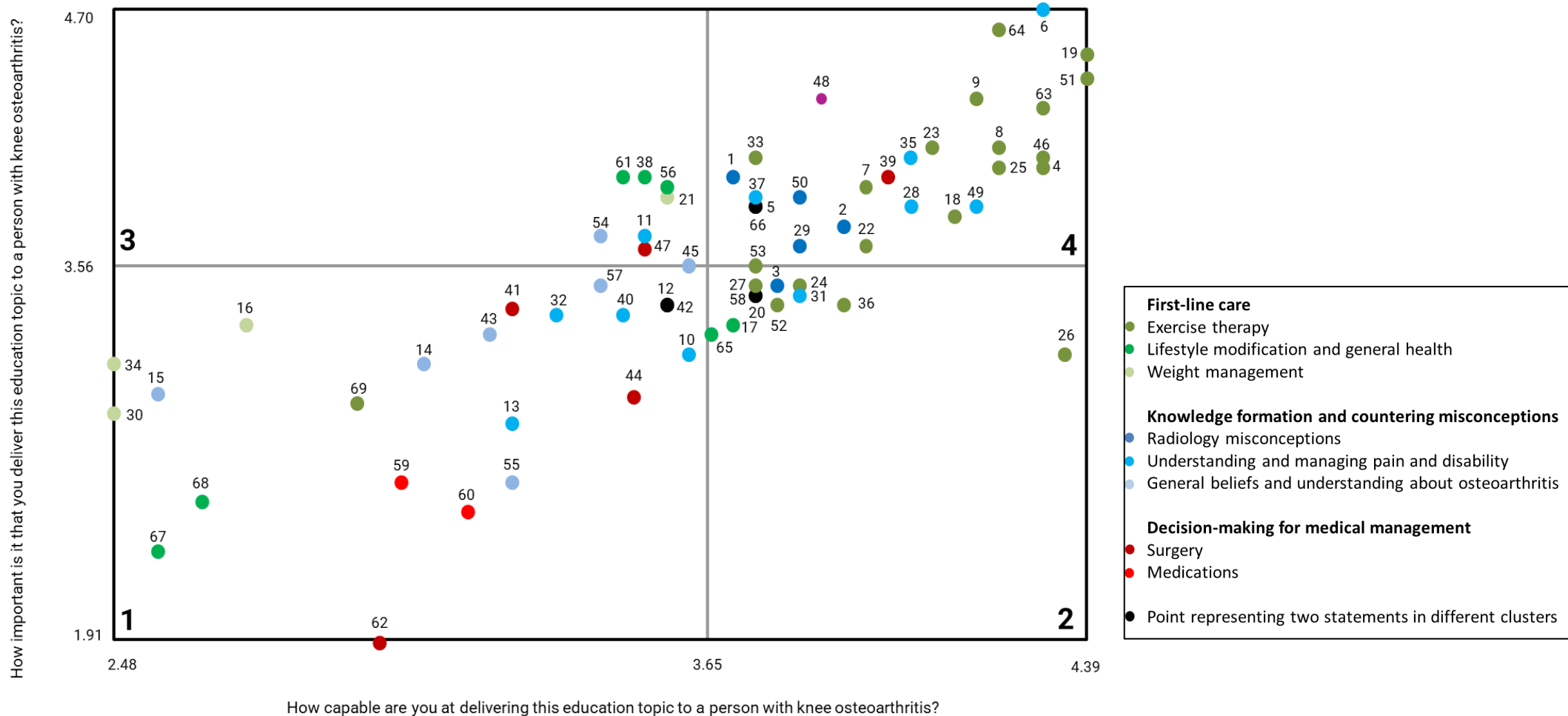


Figure 6.1 A three-domain, 8-cluster map of physiotherapists' education priorities



Quadrant 1 = below grand mean for importance and below grand mean for capability, Quadrant 2 = below grand mean for importance and above grand mean for capability, Quadrant 3 = above grand mean for importance and below grand mean for capability, Quadrant 4 = above grand mean for importance and above grand mean for capability

Figure 6.2 Go-Zone of priorities

6.6 Discussion

This study identified physiotherapists' patient education priorities for people with knee osteoarthritis encompassing three overarching domains: i) first-line care (exercise therapy; lifestyle modification and general health; and weight management); ii) knowledge formation and countering misconceptions (radiology misconceptions; understanding and managing pain and disability; and general beliefs and understanding about osteoarthritis) and, iii) decision-making for medical management (surgery; and medications). Very few education priorities identified by physiotherapists in this study were clearly included in education-specific content recommendations in knee osteoarthritis guidelines^{41,116,118,125}. Findings from this study may inform future education-specific recommendations within guidelines, and to develop resources or interventions to support longer-term engagement in guideline-recommended first-line care for people with knee osteoarthritis.

The 'exercise therapy' cluster from the first-line care domain had the highest mean importance and capability ratings, with 70% (16/23) of priorities located in Go-Zone quadrant 4. The value placed on exercise therapy is encouraging as it aligns with physiotherapist's perceived scope of practice^{271,314}, evidence supporting effective treatments^{127,128,312}, and guideline recommendations for people with knee osteoarthritis^{41,116,118,125}. Providing information on opportunities to exercise locally at minimal financial cost was not generated by physiotherapists during brainstorming and was rated lowest in the 'exercise therapy' cluster for both importance and capability. Further research to identify and address barriers to providing education about these topics may support longer-term positive behaviors towards guideline-recommended first-line care, plus address commonly reported financial concerns for people with knee osteoarthritis⁴⁵⁶⁻⁴⁵⁸.

Physiotherapists did not generate any education priorities about aerobic exercise during brainstorming, which reflects their less frequent use of this form of exercise therapy compared to others (e.g. resistance training) when managing knee osteoarthritis^{271,273}. It is unclear why aerobic exercise was not a priority for physiotherapists, considering its potential to reduce pain and manage comorbidities in this population^{131,459}. Physiotherapists may perceive that prescribing, or providing education about aerobic exercise was unhelpful to their patients. Physiotherapists may also lack knowledge and perceived capability to prescribe aerobic exercise³¹⁴.

Within the knowledge formation and countering misconceptions domain, the ‘radiology misconceptions’ was rated second highest for both mean importance and capability. Countering the misconception that pain equals damage was the highest rated of all priorities for importance in this study. Countering misconceptions about radiology and the relationship of pain and damage were not explicitly included as education-specific content recommendations within guidelines for people with knee osteoarthritis^{41,116-118}, indicating a potential priority for future guidelines. It may be particularly important to address pervasive biomedical beliefs about osteoarthritis^{79,80} which can negatively impact engagement with first-line care^{79,460}.

Overall, there was a strong relationship between the topics physiotherapists perceived as important to deliver and the topics they felt capable to provide education about. However, providing education about weight loss was located in Go-Zone quadrant 3, indicating

physiotherapists considered it of high importance, but had low perceived capability to provide it. This finding is consistent with previous research involving physiotherapists^{211,271}, and may reflect a belief that providing education about weight loss is outside their scope of practice²¹¹. Additional topics located in Go-Zone quadrant 3 included information about factors that influence pain, the importance of general health in the management of knee osteoarthritis, and countering misconceptions about the condition being ‘wear and tear’, or that ‘everyone will get worse’. Education and training initiatives to enhance the knowledge of health professionals about these topics, and ‘how’ to provide them, is warranted to reduce barriers to provision and engagement with first-line care.

Very few education priorities were clearly included in education-specific content recommendations from guidelines^{41,116,118,125}. Perhaps physiotherapists in Australia are typically unaware of guidelines for knee osteoarthritis, and are not consulted to facilitate practice in their current form²⁷¹. Complete alignment of priorities was not expected due to the trans-disciplinary nature of guidelines and the broad recommendations that they contain. The NICE⁴¹ education-specific content recommendations either clearly or possibly included four out of five priorities identified in this study. Physiotherapists should therefore consider using this guideline to identify potentially important patient education content for people with knee osteoarthritis.

Guidelines typically pay little attention to providing recommendations on ‘how’ to implement interventions in practice^{137,138}. All guidelines for people with knee osteoarthritis recommend providing individualised or person-centered care^{41,116,118,125}. However, physiotherapists,

especially those who are less experienced, can struggle to provide patient-centered education⁴⁶¹. Guideline developers are strongly encouraged to consider providing more detailed recommendations to guide the goal(s) of patient education, content to provide, and delivery methods to use.

Physiotherapists may seek guidance for ‘what’ education content to provide from other research sources (i.e., clinical trials or expert opinion). However, a recent review identified overall poor reporting of education interventions in clinical trials that threaten their translation clinically²⁹¹. An expert opinion Delphi study involving physiotherapists³²⁰ provides a list of recommended statements that every person with knee osteoarthritis should ‘know’, and the OARSI *core capability framework*⁴⁴⁸ includes recommendations that may facilitate providing education about topics such as lifestyle, self-management and behavior change. Additionally, some narrative reviews^{140,449} may help health professionals identify potentially important education content about exercise therapy. Until research and guidelines provide more detailed and comprehensive education-specific content recommendations, physiotherapists are encouraged to consider using these alternate sources^{140,320,448,449} alongside findings from this study and a previous study identifying the educational priorities of people with knee osteoarthritis⁴⁶² to guide clinical practice.

6.6.1 Limitations

Limitations inherently associated with concept mapping include small and non-randomised samples, and reliance on the skills of researchers to interpret results^{450,451}. The sample for this

study only included English speaking physiotherapists from Australia. However, the diversity of physiotherapists across public and private musculoskeletal settings should be considered a study strength.

Over half of all participants' workplaces provide the GLA:D[®] Australia patient education and exercise therapy program⁴⁶³. Therefore, participants may have completed GLA:D[®] training and certification. The GLA:D[®] program facilitates providing patient education to people with knee osteoarthritis on the topics covering the condition, risk factors, symptoms, general treatments, exercise, coping and self-help techniques⁴⁵². This may have increased the likelihood of these topics being brainstormed, subsequently leading to higher ratings for these topics within this study.

Due to the concept mapping methodology used, it is not possible to determine the reasons for the perceived lack of importance or capability for some priorities, and this could be explored in future qualitative research. Additionally, this study did not define whether priorities (e.g. #56 Improving general health is important in the management of knee osteoarthritis) referred to a clinical or structural presentation of knee osteoarthritis. Exploring whether defining clinical and structural knee osteoarthritis influences findings is warranted.

The interpretation of whether a priority was 'clearly' or 'possibly' included as education-specific content recommendations in knee osteoarthritis guidelines is subjective and may differ from others completing the same analysis. To address this limitation, three members of the research

team were involved in categorisation and reached consensus, and the specific recommendation that the decision was based upon is presented in Tables 6.2-6.4.

The priorities and perspectives of people with a lived experience of knee osteoarthritis is covered in an accompanying publication⁴⁶², which may further inform guidelines and resources to support implementation of patient education.

6.7 Conclusion

Physiotherapists' patient education priorities for people with knee osteoarthritis covered a diverse range of topics. Education about exercise therapy was a key priority, and participants felt least capable of providing weight management education. Most education priorities identified were not clearly covered by education-specific content recommendations in published guidelines.

PART C – DEVELOPING A CO-DESIGNED EDUCATION AND SELF-MANAGEMENT TOOLKIT FOR PEOPLE WITH KNEE OSTEOARTHRITIS

The concept mapping studies in Chapter 5⁴⁶² and Chapter 6⁴⁴⁷ identified that people with knee osteoarthritis and physiotherapists have broad education priorities. Additionally, major guidelines for knee osteoarthritis frequently fail to provide clear education specific content recommendations to address these priorities and facilitate implementation of patient education. This is consistent with previous criticisms of guidelines^{137,138} and may explain why few people with knee osteoarthritis feel well informed about their condition and its management²⁶⁷. It may also explain why physiotherapists typically feel they have low capability to provide effective weight management education, despite perceiving this to be an important first-line treatment option for people with knee osteoarthritis⁴⁴⁷. Co-design of an educational resource that aligns with the educational priorities of all stakeholders and provides comprehensive, accurate information is warranted. Such a resource should be designed so that it can be used both as a self-directed resource and in collaboration with a health professional, depending on the individual with knee osteoarthritis' needs and preferences.

Chapter 7 : Co-design of a web-based education and self-management toolkit for people with knee osteoarthritis

7.1 Preface

Involving people with a lived experience of a chronic health condition in the co-design of interventions is considered best practice to provide effective care^{402,464,465}. Co-design involves the application of user-centric research and service/system development approaches to solve a particular problem or challenge^{466,467}. The term ‘experience-based co-design’ is most commonly used in healthcare⁴⁶⁷, with other terms less commonly used interchangeably, including ‘co-creation’⁴⁶⁸, ‘co-production’⁴⁰¹ and ‘co-development’⁴⁶⁹. Experience-based co-design (here on in referred to simply as ‘co-design’) is viewed as both a philosophy and a method⁴⁶⁷. Its origins are primarily within quality service improvements at the meso and macro levels, but it is increasingly being used to create interventions at a micro level⁴⁶⁵. Co-design at a macro and meso level primarily focuses on user experiences at a cognitive and emotional level, but at a micro level, may be more based upon views, attitudes, needs and perceptions⁴⁰² (Figure 7.1). Co-designed services and interventions can improve quality, satisfaction and experiences^{402,464,466,470,471}.

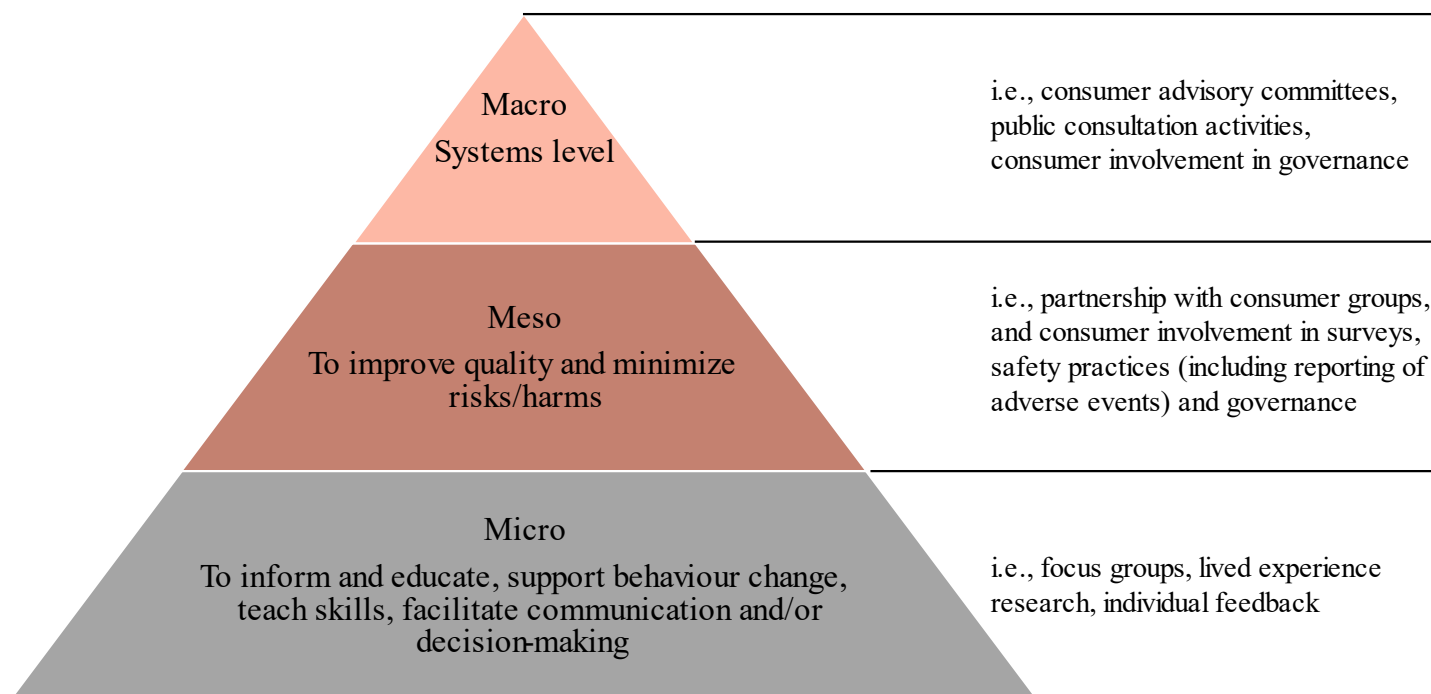


Figure 7.1 Co-design at the micro, meso and macro levels. Adapted from Walsh et al 2016⁴⁶⁵

A key advantage of co-designing education interventions is the ability to ensure that the needs of the people seeking, receiving or providing information are met^{402,464}. To facilitate this, best practice co-design of interventions and resources involves collaborating with multiple people experienced in the area of interest (for example, care providers and receivers of care) to gain varied insight and perspectives⁴⁰².

The co-design of interventions usually involves four stages⁴⁷²: (i) understand and define the problem, (ii) prototype, (iii) test and iterative adaptation, and (iv) delivery and continual improvement. People with a lived experience of the condition and/or health professionals usually contribute to stage (i) (understanding and defining) and stage (iii) (testing). They may also inform continual improvement initiatives during stage (iv). Methods to gain collaborator opinions vary and may include surveys, interviews and/or focus groups⁴⁰².

The ancillary analysis²⁹¹ (Chapter 3) of my previous systematic review³¹² (Chapter 2) identified that only 10% of interventions were developed via any co-designed method. Additionally, no highly accessed websites evaluated during my web-content analyses (Chapter 4) appeared to be developed through co-designed⁸⁷ methods. Greater collaboration between researchers, health providers and people with knee osteoarthritis in the co-design of interventions and educational resources may improve the likelihood that people with knee osteoarthritis' educational needs are being met⁴⁶². This might reduce the consumption of inaccurate information commonly found on the internet⁸⁷, improve engagement and satisfaction with interventions, and improve patient outcomes.

The remainder of this chapter describes the co-design process I used to develop a web-based education and self-management toolkit for people with knee osteoarthritis – '[My Knee](#)'. This chapter will be submitted for publication to a peer-reviewed journal.

This chapter contains the following manuscript:

Goff, A.J., De Oliveira Silva, D., Ezzat, A.M., Crossley, K. Pazzinatto, M.F., & Barton, C.J.

Co-design of a web-based education and self-management toolkit for people with knee
osteoarthritis.

It has not yet been submitted for peer review. The expected date of submission in June 2022 to a
journal that is yet to be confirmed

7.2 Abstract

Background:

Knee osteoarthritis is a leading cause of disability worldwide. Yet, many people with the condition do not receive first-line care. Barriers are complex and initiatives to facilitate quality education and self-management to improve care are needed.

Objective:

Describe the three-stage, six-step co-design process used to create the Translating Research Evidence and Knowledge (TREK) ‘[My Knee](#)’ education and self-management toolkit.

Methods:

Stage i (understand and define) systematically reviewed the effectiveness, development and content of patient education interventions for knee osteoarthritis in published trials; appraised commonly accessed web-based information about knee osteoarthritis; and applied concept mapping methods to identify education priorities of people with knee osteoarthritis and physiotherapists. Stage ii (prototype) involved creation of a theory-, guideline- and evidence-informed toolkit prototype. Stage iii (test and iterative adaptation) involved three workshops (two with people with knee osteoarthritis and one with health professionals), followed by expert opinion review, to refine the toolkit.

Results:

Stage i identified the need to create board content aligned to key research evidence and the educational priorities of people with knee osteoarthritis, and tools to facilitate engagement with exercise therapy. Stage iii workshops and expert review facilitated toolkit navigation improvements, and informed the creation of additional content to improve clarity and engagement. The live version of the toolkit is available at myknee.trekeducation.org/

Clinical implications:

The '[My Knee](#)' toolkit can be used independently by people with knee osteoarthritis, or in collaboration with health professionals to facilitate education, self-management and engagement in first-line care. Future work is planned to determine its effectiveness to improve care, and to investigate how it may be used as a self-directed and therapist-facilitated resource.

7.3 Background

Knee osteoarthritis is a leading cause of disability, resulting in substantial personal and societal burdens worldwide^{72,75,110}. All major clinical practice guidelines for knee osteoarthritis recommend patient education as first-line care alongside exercise therapy and, when appropriate, weight management^{41,116,118,125}. Patient education is particularly important considering its potential to influence engagement with other first-line interventions^{80,85,210} and willingness to undergo surgery^{79,310,463}. However, a large proportion of people with knee osteoarthritis do not receive adequate patient education or engage in first-line care^{173,210,265,268,269}. For example, only one-third of people with the condition feel informed about the condition, treatment options, and how to self-manage prior to an orthopaedic consultation²⁶⁷.

Barriers to receiving patient education and engaging in first-line care for people with knee osteoarthritis are complex, and span multiple levels when viewed from a socio-ecological perspective^{473,474}. For example, lack of knowledge, low self-efficacy, lack of peer support, short health professional consultation times, and the availability (or lack thereof) of resources, facilities and care pathways represent barriers spanning individual, interpersonal, institutional and policy levels^{75,270,475,476}. Additionally, people with chronic health conditions such as osteoarthritis commonly present with misinformed beliefs about the condition, possibly influenced by inaccurate web-based information^{81,87,89}, that can act as a barrier to engagement with first-line care⁸⁷. Barriers also exist from a health professional's perspective, including insufficient knowledge, confidence and capability to provide accurate and patient-centered education^{85,270,273,475,476}. For example, education provided by health professionals may not strongly align with the education priorities of people with knee osteoarthritis^{447,462}. The poor

reporting of education interventions in clinical trials²⁹¹, alongside the absence of clear recommendations in guidelines^{41,116,118,125} for ‘what’ and ‘how’ to provide it, may also impede the consistent implementation of patient education.

Co-designing educational resources and interventions so that they align with the priorities of people with chronic conditions and those of health professionals can improve patient satisfaction and is considered best practice^{466,471}. However, for knee osteoarthritis just 10% of education interventions in clinical trials²⁹¹, and no websites evaluated in my content evaluation study were developed using co-design methods⁸⁷. Co-designing a web-based resource that can support education and self-management of people with knee osteoarthritis independently or in collaboration with a health professional may help to address their education needs, counter inaccurate web-based information, and improve engagement with first-line care.

The aim of this study is to provide detailed descriptions of the processes undertaken to co-design the web-based TREK ‘[My Knee](#)’ education and self-management toolkit for people with knee osteoarthritis.

7.4 Methods

This section is informed by the CONSORT-EHEALTH checklist⁴⁷⁷ ([Appendix 7A](#)). Guided by experienced-based co-design methodology^{401,402}, thorough and engaging iterative methods were applied to create the ‘[My Knee](#)’ education and self-management toolkit. The specific aims of the web-based toolkit were to:

1. Improve an individual with knee osteoarthritis' knowledge about the condition to inform decision-making and self-management.
2. Provide tools to facilitate self-efficacy for, and engagement in, guideline recommended first-line care.
3. Be used as a blended resource by health professionals providing care for people with knee osteoarthritis

The three stages involved in the co-design approach I applied reflect accepted experience-based co-design methodology, including: (i) understand and define the problem from multiple perspectives, (ii) prototype, and (iii) test and iterative adaptation. These three stages can be further broken down into six steps (Figure 7.2). There was overlap between steps 1-4, with steps 5 and 6 occurring in successive order. Ethical approval for the co-design process was obtained from the La Trobe Human Ethics Committee (HEC 20188).

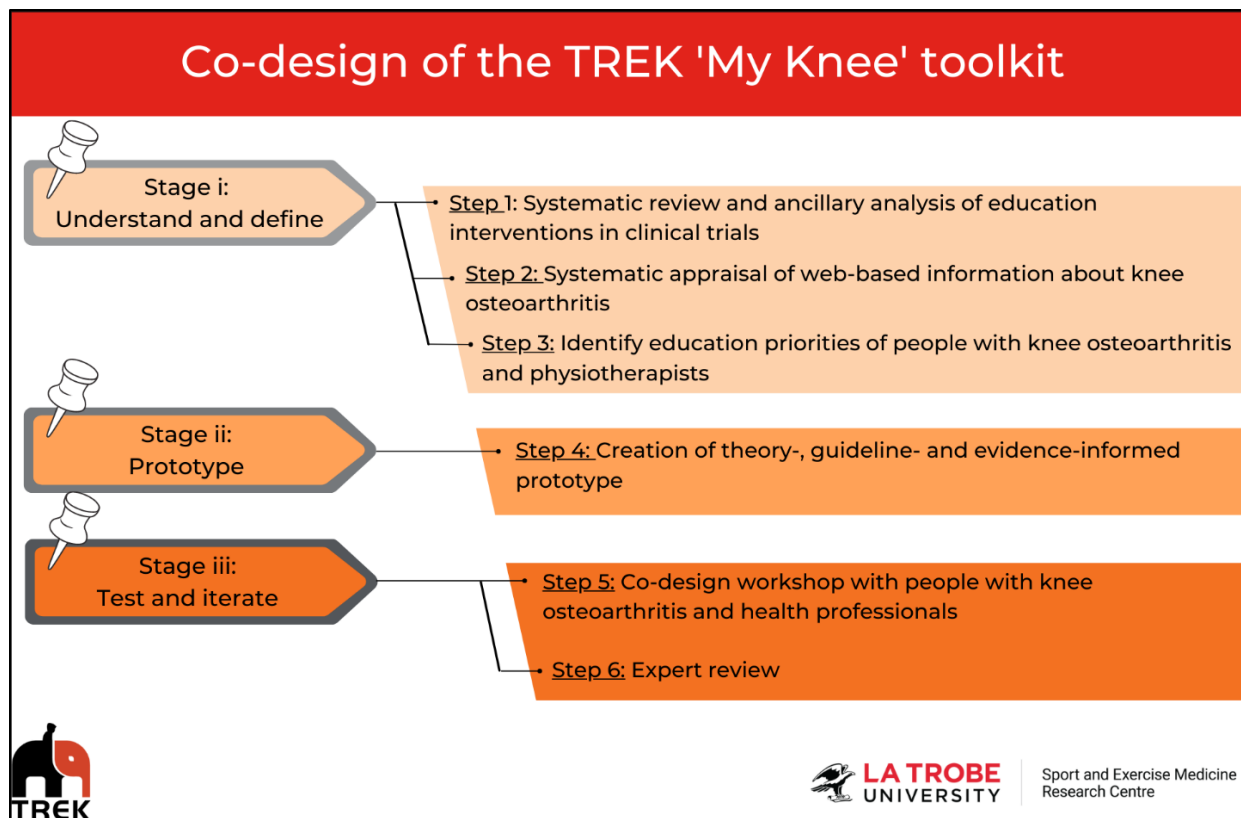


Figure 7.2 Three stage, six-step co-design process used to create the TREK ‘[My Knee](#)’ toolkit.

7.4.1 Stage i (understand and defining)

Step 1 involved a systematic review and meta-analysis evaluating the effectiveness of patient education as a standalone intervention, and in combination with other interventions³¹².

Subsequently, detailed assessments of the content, development and delivery method and mode²⁹¹ of patient education interventions were performed. These assessments included the appraisal of content comprehensiveness and accuracy based upon clinical practice guidelines^{116,118,125,331}, expert opinion³²⁰ and clinical research^{4,22,34,72,404-408}. Step 2 involved appraisal of commonly-accessed web-based resources for people with knee osteoarthritis in Australia, including evaluation of their comprehensiveness, accuracy, credibility, quality of information and readability⁸⁷. Step 3 identified the educational priorities of people with knee

osteoarthritis⁴⁶² and physiotherapists⁴⁴⁷ using a mixed-methods concept mapping approach. Specifically, participants identified educational priorities and ranked them according to their perceived importance (both groups) and confidence that they would receive the information (people with knee osteoarthritis) or capability to provide (physiotherapists).

7.4.2 Stage ii (prototype)

Step 4 involved the development of a prototype of the ‘[My Knee](#)’ toolkit using WordPress® (www.wordpress.org), and hosted as a subdomain under the TREK domain (www.trekeducation.org). TREK is a not-for-profit initiative that aims to develop and share freely available web-based digital resources to support education of health professionals and people managing musculoskeletal pain and other chronic diseases. Care was taken to ensure that content was aligned with the education priorities of both people with knee osteoarthritis and physiotherapists as well as with clinical practice guideline recommendations^{41,116,118,125} and key research evidence that informed my ancillary²⁹¹ and web-content⁸⁷ analyses. HONcode⁴³¹ certification and DISCERN⁴²⁹ criteria were also considered in the development of content.

7.4.3 Stage iii (test and iterate)

Step 5 involved three workshops to test, facilitate feedback, and refine the toolkit, including resources contained within it. Workshop 1 and 3 involved people with a lived experience of knee osteoarthritis. Workshop 2 involved health professionals who commonly provide care for people with knee osteoarthritis. Participants were recruited via multiple channels, including GLA:D® Australia and MSK Australia e-mail distribution lists, social media (Facebook and Twitter), contacts from previous concept mapping projects^{447,462}, and the research team’s networks. To

reduce feedback bias during workshop 3 (final workshop), people with a lived experience of knee osteoarthritis were not eligible to participate if they were involved in the creation of any videos embedded within the toolkit.

Interested workshop participants followed an electronic link on the recruitment materials to a web-based platform where they provided consent, self-confirmed eligibility, answered baseline demographic questions and provided their email address for communication regarding availability. All participants were provided with a link to access the working version of the toolkit at least one week prior to their workshop or individual session and were encouraged to explore the toolkit's contents. All workshops lasted two hours and included a brief introduction presentation, small breakout room activities, and larger group discussions (see [Appendix 7B](#)). Those interested but who were subsequently unable to attend a workshop were invited to provide feedback via an individual web-based meeting (with AJG) or via email. Individual meetings lasted approximately 30-40 minutes and targeted the same outcomes as the workshops. Four researchers facilitated discussion and assisted with note-taking at the workshops (AJG, AME, CJB and DOS). All participants who provided feedback received a AU\$40 supermarket voucher for their time. Revisions were made to the toolkit following each workshop, and prior to the next step in the co-design process.

All workshop discussions were audio and video recorded. One member of the research team (AJG) reviewed audio and video recordings, plus researcher notes to identify common themes and specific areas for improvement. The themes or areas for improvement were then discussed as a group with action plans agreed before changes to the toolkit and resources were made.

To develop the lived experience videos within the iteration stages, a member of the research team (AJG) sent out a recruitment email asking for volunteers to share their stories. This email was sent to participants at the first workshop as well as to participants from the concept mapping study completed during step 3⁴⁶². The lived experience videos were created by recording semi-structured interviews with a researcher (AJG) via Zoom, before editing participant responses to create simplified video resources. All participants gave consent and were provided with an opportunity to view and provide feedback and suggested changes on the edited videos to ensure that their views and opinions were not misinterpreted during editing. The lived experience participants received a AU\$40 supermarket voucher as compensation for their time. For the creation of the expert/clinician videos, content experts (e.g., exercise therapy, medications, diet, etc.) were identified through the research team's network, and were contacted via email by AJG to invite them to video record themselves answering a series of pre-defined questions that were contained within a PowerPoint file. Experts shared the completed recordings, which were then edited by the research team to create video files to be uploaded to the toolkit.

Step 6 involved expert review of, and feedback about, the toolkit following the revisions facilitated by workshop 3. Three categories of experts were recruited from the author groups network:

1. Experienced in the development of web-based toolkits
2. Osteoarthritis researchers
3. Intervention content experts (e.g. medications or weight management)

Each expert was provided with a basic outline of the feedback topics, including perceived accuracy, comprehensiveness, usability and engagement of the toolkit, and had the option to provide additional miscellaneous comments. Experts were able to provide feedback via a web-based survey link (Qualtrics, Provo, UT) ([Appendix 7C](#)), email, text file, Zoom or pre-recorded audio. One member of the research team (AJG) reviewed all feedback to identify common themes and specific areas for improvement. The themes or areas for improvement were then discussed as a group with action plans agreed before changes to the toolkit and resources were made.

7.5 Results

7.5.1 Stage *i* (understand and define)

Step 1: Detailed systematic review³¹² (Chapter 2) and ancillary analysis²⁹¹ (Chapter 3) findings are published elsewhere. Briefly, patient education as a standalone intervention improves pain and function compared to usual care, but differences are small and may not be clinically important³¹². Additionally, combining patient education with exercise therapy results in statistically significant and clinically important improvements in function compared to patient education alone³¹². Consequently, a key focus of the ‘[My Knee](#)’ toolkit was to support exercise therapy implementation and adherence. Historically, very few patient education interventions reported in published trials are theory-based or co-designed, especially when education is used as a control condition²⁹¹. In the absence of clear guidance or evidence for theory-based interventions³⁰⁶, the development of the ‘[My Knee](#)’ toolkit was informed by theories related to enhancing self-efficacy^{123,302}, and principles of andragogy³⁰⁵ and motivational interviewing²⁹⁹.

Step 2: Detailed web-based content evaluation findings are presented elsewhere⁸⁷. Briefly, no website included in the analysis appeared to be co-designed, and up to 40% provided inaccurate information according to clinical practice guidelines^{116,118,125,331}, expert opinion³²⁰ and clinical research^{4,22,34,72,404-408}. Very few websites provided tools supplementing information to facilitate engagement and adherence to treatment. To address these gaps, care was taken to ensure that the content of the ‘[My Knee](#)’ toolkit aligned to guidelines and key research evidence, dispelled common misinformation from other web-based resources (i.e. about surgery and the pathophysiology of the condition), and provided tools to facilitate implementation and adherence to patient-centered treatment (e.g. a personalised treatment guide maker).

Step 3: Detailed concept mapping studies identified the patient education priorities of people with knee osteoarthritis⁴⁶² and physiotherapists⁴⁴⁷ are presented elsewhere. Briefly, people with knee osteoarthritis prioritised education about surgical decision-making, including understanding the relationship of education and exercise in the prevention of, or rehabilitation after, surgery. They also generally felt confident that health professionals would address their most important needs, but felt least confident that they would address priorities about diet and supplements⁴⁶². Physiotherapists prioritised providing information about exercise therapy and dispelling misconceptions about radiology but felt least confident to provide weight management education despite believing it to be important⁴⁴⁷. Therefore, content to facilitate education about, and implementation of, weight management, diet and supplements was included prominently within the toolkit. Additionally, care was taken to ensure the toolkit addressed all educational priorities identified in both concept mapping studies^{447,462}.

7.5.2 Stage ii (prototype)

Step 4: A summary of how steps 1-3 informed the development of the ‘[My Knee](#)’ toolkit prototype, as well as the key features and theoretical underpinnings, are presented in Table 7.1. Screenshot examples of the prototype toolkit can be found in [Appendix 7D](#).

Table 7.1 Summary of initial ‘[My Knee](#)’ toolkit development

Item	Rationale and/or explanation (see Appendix 7D for screenshot examples)
Aims	
1. Improve an individual with knee osteoarthritis’ knowledge about the condition to inform decision-making and self-management.	<ul style="list-style-type: none"> - I ensured that content addressed the educational priorities of physiotherapists and people with knee osteoarthritis that were identified in my concept mapping studies^{312,462}. - I ensured that content was comprehensive and accurate in accordance with clinical practice guidelines and key research evidence (as per the rubric for my ancillary²⁹¹ and web-content⁸⁷ analyses). - I ensured that content countered misinformation frequently found on the internet⁸⁷. - I ensured that content provided was aligned with the DISCERN⁴²⁹ principles for informed treatment decision-making and the HONcode⁴³¹ principles for information credibility. - An interactive quiz was created to test knowledge and challenge common misconceptions.
2. Provide tools to facilitate self-efficacy for, and engagement in, guideline recommended first-line care.	<ul style="list-style-type: none"> - Content provided explicitly stated what constitutes first-, second- and third-line care, and the reasons supporting the recommendations. - Content was created to assist with accurate interpretation of symptoms to improve self-efficacy for exercises. - Personalised guide-maker was created to supplement information in the toolkit and facilitate performance mastery¹²³. - A lived experience case-study video plus videos of an individual with knee osteoarthritis were included within the ‘My Knee’ toolkit to facilitate modelling¹²³.
3. Be used as a blended resource by health professionals providing care for people with knee osteoarthritis.	<ul style="list-style-type: none"> - The personalised guide-maker included sections to improve communication between the person with knee osteoarthritis and the health professional. - A ‘for clinicians’ tab was created containing an introductory video to the site and some quick-access links. - A resources section was provided for clinicians or people with knee osteoarthritis to be able to find and share infographics or resources.
Principles	
Co-design ⁴⁰²	- The education priorities of physiotherapists and people with knee osteoarthritis were used to inform initial content development.
Patient-centered	- A personalised guide maker was created to allow users to tailor their learning and self-management.
Theory-based	<ul style="list-style-type: none"> - Informed by theoretical principles to enhance self-efficacy¹²³: <ul style="list-style-type: none"> - Performance mastery – personalised guide to facilitate mastery of various skills, plus videos and a guide to support learning. - Modelling – Inclusion of a lived experience video from clinical research⁴⁷⁸ plus a video of an individual with knee osteoarthritis performing the NEMEX program⁴⁷⁹ at varying degrees of difficulty.

	<ul style="list-style-type: none"> - Interpretation of symptoms – Quiz to challenge beliefs and content focusing on accurate interpretation of symptoms. - Interactive features were based upon the principles of andragogy³⁰⁵, namely involving learners in mutual planning, diagnosing their own needs to trigger internal motivation, formulating their own learning objectives, and providing tools to develop skills and evaluation through reflection. These were primarily features of the interactive personalised guide-maker, exercise therapy decision-maker, and quiz. - The exercise therapy decision-making tool was informed by motivational interviewing principles, which are based upon self-determination theory²⁹⁹.
Other features	
Presentation	<ul style="list-style-type: none"> - Primarily consisted of written information in the form of slides, infographics and links to external sites, and was split into three sections:(i) making the most of this toolkit, (ii) understanding osteoarthritis, and (iii) treatment options. - Most written content in the toolkit focused on enhancing self-efficacy through re-interpreting symptoms by providing information about modifiable risk factors, debunking myths about radiology and explaining symptoms from a biopsychosocial perspective.
Engagement/interactivity	<ul style="list-style-type: none"> - The following interactive features were included: <ul style="list-style-type: none"> - Slide presentations (scrollable slideshow). - Quiz (slideshow with added interactivity). - Exercise therapy decision-making tool (branching scenario). - Personalised guide-maker tool (branching scenario).

HONcode = Health On the Net, NEMEX = Neuromuscular exercise program.

7.5.3 Stage iii (test and iterate)

Step 5: Demographics of all participants attending workshops or providing individual feedback are provided in Table 7.2. Workshop 1 was held in June 2021, involving seven people with knee osteoarthritis. An additional two people unable to attend this workshop provided feedback via individual web-based meetings. General feedback indicated that the content was appropriate, and the ‘create your own guide’ feature was novel. However, the toolkit was considered complicated, lacked inspiration for some, and was perceived to be too similar to other web-based sources of information. Numerous suggestions to improve usability and engagement were provided. The major feedback points from workshop 1 and the subsequent toolkit revisions are presented in Table 7.3. Screenshot examples of the revisions are presented in [Appendix 7E](#).

Table 7.2 Participant demographics

Lived experience feedback – workshop 1 + individual feedback (n=9)	
Male/Female	4/5
Age*	68 (6)
Health professionals feedback – workshop 2 + individual feedback (n=9)	
Male/Female	1/8
Age*	41 (12)
Years of experience*	15 (8)
Profession (n=)	
- Physiotherapist	7
- Exercise physiologist	1
- Nurse practitioner	1
Lived experience feedback – workshop 3 (n=6)	
Male/Female	1/5
Age*	72 (10)
Years living with knee osteoarthritis*	11 (8)

*Age = Mean (standard deviation)

Table 7.3 Summary of major feedback from workshop 1 leading revisions in the toolkit

Feedback from workshop 1	Supporting statements	Actions (see Appendix 7E for screenshot examples)
Content was good but too much and difficult to navigate	<i>“this needs to be simplified” (P1); “slides were difficult to use” (P6); “it was a lot of information to take in all at once” (P3); “I like the fact that there was detail...it's just a question of where it's placed”(P7); “It’s all there, it’s just a case of presenting it in a better manner...I want more of a choice what I select to click on” (P2); “keep it simple initially and then give a choice” (P5); “I want a list of things” (P3); “Maybe a frequently asked questions kind of section” (P2).</i>	Written information was simplified and reorganised from being slide based to FAQs using accordion functionality
More quizzes as they reported these were “engaging and fun”.	<i>“there was a test your knowledge section, I like that sort of thing. A similar quiz at the end of exercise, or surgery would focus my mind a little bit”(P2); “I did the quiz and got 11/14 right and I thought how dare I get 3 wrong so it made me look into the content more” (P1); “I like the quizzes and I was very pleased that I got them all right”(P7); “I thought the test was really good 6.38, I thought I knew a lot but I got 3 or 4 questions wrong. Some obvious things I didn’t know so that was really good”(P3); “(the quiz) was straight forward, it worked”(P8).</i>	Creation of two distinct quizzes – one about the condition and its symptoms, and one on treatments
A single ‘work-along’ video for the suggested exercises rather than sorting through multiple videos	<i>“I’d love to have within something like this a little program that I could follow” (P8); “I don’t want to have to think about exercises, I want to just put something on and watch it” (P9); “I would like to click on a link that takes me to exercises just for knees, backs or whatever” (P5); “maybe even some workout videos where people can work out along” (P7); “that exercise ‘buddy’ works for me” (P6).</i>	Creation of a work-along exercise video
More lived experience videos to make the site more engaging, motivating and relatable	<i>“(I want to see) this is the result of doing that sort of thing” (P2); ‘people love testimonials” (P3).</i>	Addition of lived experience videos throughout to provide insights and tips for living with the condition. Videos created: <ul style="list-style-type: none"> - What advice would you give? - Understanding symptoms - What to do in a flare up - Exercise therapy

		<ul style="list-style-type: none"> - Diet - Supplements - Assistive devices
Written information to be presented on video format from content experts	<i>"I just think it would be nice to have one of you introduce the material... make it like a webinar" (P4); "I agree (to the previous comment)" (P2,P5).</i>	<p>Addition of clinician/expert videos discussing common misconceptions and addressing FAQs.</p> <p>Videos created:</p> <ul style="list-style-type: none"> - Exercise and physical activity - Weight management - Medications - Assistive devices - Hot or cold - Injections - Surgery - Footwear and orthoses
An engaging and inspiring introductory video to help navigate the site.	<i>"When I look at the content it has no appeal" (P1); "introductions from you as researchers about what the site has to offer, and what it aims to do" (P7); "I found it difficult to use" (P5); "I found it frustrating that I couldn't find things" (P6).</i>	Creation of an introductory video
More information on weight management and medications	<i>"Diet is not attended to as much as it should be... with the sub bracket of alcohol consumption" (P3); "Yes I thought that (in relation to the previous comment)" (P1).</i>	Addition of lived experience and expert video, more information about weight management in general
More information on medications and supplements	<i>"I think most people in Australia would pick up on Panadol rather than Tylenol"(P1); "I think glucosamine gets a page on its own that says it may or may not be effective but give it a go. I wanted more information on other things like turmeric, capsicum etc." (P2).</i>	Addition of lived experience and expert video plus additional content on supplements and changed wording to paracetamol
<p>FAQ – Frequently asked question</p> <p>(Note, participants 1-7 = workshop, participants 8&9 = individual feedback).</p>		

Workshop 2 was held in October 2021, involving seven health professionals. An additional two health professionals unable to attend this workshop provided feedback via email. The general feedback indicated that the health professionals liked the create your own guide feature, valued the lived experience resources, and were likely to use the toolkit in a blended learning format with patients. Possible improvements identified included navigation optimisation and content adaptation for diverse groups of people with knee osteoarthritis, particularly in relation to exercise therapy. The major feedback points, including subsequent toolkit revisions, from workshop 2 are presented in Table 7.4, with screenshot examples of revisions presented in [Appendix 7F](#).

Table 7.4 Summary of major feedback from workshop 2 leading to revisions in the toolkit

Feedback	Supporting statements	Actions (see Appendix 7F for screenshot examples)
Re-design the home page based upon where in the patient journey an individual is	<i>“Having some headings focused on where the person is in their journey (will help navigation)” (P1); “just thinking about the front page and navigation... when we’ve tried to design websites in the public health context we think of the three click rule” (P1).</i>	Home page re-designed
Desire for downloadable ‘factsheets’ that summarises key information	<i>“Sections that could be maybe printed off and like specific maybe summary sections” (P5); “printable resources are definitely something that’s key, maybe just summarises some of the key points for the videos” (P6).</i>	Three downloadable fact sheets were created – facts and myths about knee osteoarthritis, osteoarthritis treatments and what to do in a flare up. The facts and myths about knee osteoarthritis factsheet was also added to the downloadable personalised guide
NEMEX* exercises may be too hard or unsafe for some people with knee osteoarthritis, therefore there is a need to have screening information and alternate options	<i>“I see a population that have a high degree of multi-morbidity and high risk of falls, and so, most of the exercise, they are probably too hard for my clients” (P2); “having a disclaimer out if you’ve had a fall, maybe consult with someone before you start”(P3); “there’s a massive falls risk with some of the exercises”(P1); “the exercise program looks suitable for people with mild to moderate issues; however, the vast majority of the patients that we see are unable to do most of those exercises” (P8).</i>	<p>This prompted overall reflection on the ‘exercise therapy decision-making’ tool. Consequently, it was split to create two distinct tools – ‘exercise checker’ for people who already have an exercise program and ‘exercise selector’ for people who don’t yet have an exercise program.</p> <p>In the exercise checker, physical activity components were added as the initial tool was very focused on resistance exercises.</p> <p>In the exercise selector, new branches and screening questions were added, and two new exercise program end points were created to make exercise selection more personalised and safer.</p> <p>Additionally, changes were made to the personalised guide - the full NEMEX exercise program was taken out of the personalised guide. It was replaced with generic information about the</p>

		importance of exercise, a pain monitoring tool, an adherence log, and a hyperlink to the decision-making tool for users to find the most suitable exercises for their level.
Add content to help people with knee osteoarthritis navigate health resources or access funding	<i>"Maybe having some information about how public health funding could be accessed" (P3).</i>	Added basic information to the toolkit under the guide and resources tab
Create more visual animations so that not all are 'talking head' type videos	<i>"There are a lot of talking head videos and they don't deliver the message very well, especially if they aren't subtitled. Consider use of visuals to make it more accessible" (P1); "(adding animations) its not cheap and its not easy... it just adds so much more emphasis" (P1).</i>	Created a new animated video explaining the condition of knee osteoarthritis to facilitate testing the usefulness of this type of resource for people with knee osteoarthritis in workshop 3
Desire for more information on balance and falls	<i>"I think it would be a good idea to include it (balance and falls) in the guide"(P4).</i>	A researcher with experience in balance and falls was consulted to help create activities for the personalised guide

NEMEX – Neuromuscular exercise program

(Note participants 1-7 = workshop, participants 8&9 = individual feedback)

Workshop 3 was held in November 2021, involving six people with knee. Only one of the six participants was involved in workshop 1. The general feedback indicated that they liked the content within the toolkit, but navigation could be further improved. There were also suggestions relating to the name of the toolkit and how to best present video content. The major feedback points, including subsequent toolkit revisions, from workshop 3 are presented in Table 7.5, with screenshot examples of revisions presented in [Appendix 7G](#).

Table 7.5 Summary of major feedback from workshop 3 leading to revisions in the toolkit

Feedback	Supporting statements	Actions (see Appendix 7G for screenshot examples)
People with knee osteoarthritis generally liked the term ‘toolkit’ but provided refined suggestions	<i>“I like (the term) toolkit, but toolkit about what?” (P3); “what about osteoarthritis toolkit or knee arthritis toolkit” (P5); “I think the term toolkit is much better than website” (P2); “online workbook, online guide, online discovery (are alternate options)” (P1).</i>	The name TREK ‘ My Knee ’ education and self-management toolkit was agreed upon.
People with knee osteoarthritis preferred talking head videos compared to animated	<i>“The real person makes it more legitimate and credible” (P1).</i>	Videos remained as talking heads.
Navigation remained difficult, especially for the exercise resources	<i>“(Navigation was) a bit difficult, you could miss that the top menu was actually a drop down, the red boxes are giant in comparison” (P3); “I found things that I couldn’t find again” (P5); “I didn’t know where I was on the site as all the videos had the same image of a leg (the thumbnail)” (P4); “need to make the exercises easy to find/accessible” (P1).</i>	<p>Added drop down arrows to the top menu.</p> <p>Changed thumbnails to the videos so that it was easier to identify where you were/what you had already seen.</p> <p>Exercise resources had a dedicated page.</p> <p>Other layout/navigation edits included generic changes to site layout and increased use of images/tiles to select content to view.</p>
Language and presentation of content	<i>“What is meant by strength exercises? Do you mean with the bands” (P3); “I did notice a few typos” (P5).</i>	<p>Additional explanation of strength exercises was provided when appropriate.</p> <p>The toolkit was proof-read by a research assistant.</p>

TREK = Translating research, evidence and knowledge

Step 6: Emails were sent to 10 experts in December 2021, with five replying with feedback (1 general practitioner, 1 rheumatologist, 2 physiotherapists, 1 dietician). The major feedback points, including subsequent toolkit revisions, are presented in Table 7.6, with screenshot examples of the revisions presented in [Appendix 7H](#).

Table 7.6 Summary of major feedback leading to changes from expert opinion panel

Section	Feedback	Actions (see Appendix 7H for screenshot examples)
How do I know if I have knee osteoarthritis	<i>“The NICE criteria is not the most accurate, but is the most commonly used and has highest sensitivity. Amend wording accordingly”</i> (SS)	Wording amended
Treatment options	<i>“Recommend placing injections as second-line treatment”</i> (SS)	Injections section moved to second-line treatments
Exercise and Physical activity	<i>“Provide clearer recommendations regarding intensity and examples”</i> (DH) <i>“The exercise and physical activity log is biased towards strengthening – be more explicit”</i> (DH) <i>“Make navigation to exercise resources easier”</i> (SS)	Provided guidelines for intensity and examples Improved wording and updated workbook to state that the log was specifically for resistance training Exercise resource page was made more explicit on the toolkit
Healthcare resources and referrals	<i>“I think that this section needs a clean up....kind of reads like someone was making notes rather than a nice summary”</i> (J.M-N)	Significant edits to improve presentation of information. Each option has a dedicated page
Medications	<i>“Remove the recommendation about paracetamol”</i> (DH)	Improved the accuracy of information about paracetamol, including that some guidelines recommend against.
Weight management	<i>“Avoid the use of BMI, waist circumference and waist:hip ratio are much better”</i> (AF) <i>“Suggested alternate goals for the workbook to be more instructive”</i> (AF) <i>“Add in processed foods with added salt, sugar and fat to the ‘what to avoid’ sub section”</i> (AF) <i>“Add in a section to encourage individuals to check with a dietician about potential nutrition deficits”</i> (AF) <i>“Link to healthy weight for life or CSRIO”</i> (DH)	BMI was removed, with waist circumference and hip:waist ratio prioritised. Edited wording in the personalised guide Added to the toolkit Added to the toolkit Added to the toolkit
Surgery	<i>“The strength of the decision-making tool recommendation could be reduced, especially as some of the information contained within it conflicts information on the toolkit”</i> (JW) <i>“May be worth including more about osteotomy”</i> (SS)	Edited wording to reduce the strength of recommendation and added a disclaimer Included information about tibial osteotomy

For clinicians	<p><i>“I kind of expected to have some links to guidelines for management in the clinician section – it was a bit strange not to have anything” (J.M-N)</i></p> <p><i>“Add quick links to this section” (J.M-N)</i></p> <p><i>“I was expecting to see more about guidelines – include this” (J.M-N)</i></p>	<p>Added information from guidelines throughout</p> <p>Included quick links to this section</p> <p>Greater detail in the for clinicians section to align to guidelines</p>
Video content	<p><i>“Consider having a surgeon doing the surgery video” (SS)</i></p> <p><i>“Could videos be made that match other populations who have osteoarthritis in Australia (e.g. age, race, background etc.)” (SS)</i></p>	<p>Invited a surgeon to film video for future upload</p> <p>This is to be addressed in future iterations</p>
Quiz	<i>“Recommend not having the question about which structure osteoarthritis affects the most” (SS)</i>	This question was removed from the quiz
Usability	<i>“The guide is a better, quicker resource compared to the toolkit which is time consuming” (JW)</i>	Nil specific action – however improved navigation to the guide as a quicker resource to access

NICE = National Institute for Health and Care Excellence, AF = Dr Adrienne Forsyth (dietician), DH = Prof David Hunter (Rheumatologist), J.M-N =, Assoc Prof Jo-Anne Manski-Nankervis (general practitioner), SS = Prof Søren Skou (physiotherapist), JW = Dr Jason Wallis (physiotherapist).

7.6 Discussion

The '[My Knee](#)' education and self-management toolkit is the first co-designed and theory-informed web-based educational resource for people with knee osteoarthritis of its kind. It was developed to: 1) improve an individual with knee osteoarthritis' knowledge about the condition to inform decision-making and self-management, 2) provide tools to facilitate self-efficacy for, and engagement in first-line care, and 3) be used as a blended resource by health professionals providing care for people with knee osteoarthritis. The three-stage, six-step co-design process used to develop the '[My Knee](#)' education and self-management toolkit ensured that priorities of all stakeholders were met and may help to limit any barriers to its use as either an independent, or facilitated, resource.

Step 1 was unable to identify a superior education theory for people with knee osteoarthritis, or if theory-based interventions result in better outcomes than those not theory-based²⁹¹.

However, considering the potential importance of theory in learning outcomes^{123,480} and facilitating behaviour change^{481,482}, the development of the '[My Knee](#)' toolkit was informed by the theoretical principles of andragogy³⁰⁵, motivational interviewing²⁹⁹ and methods to enhance self-efficacy³⁰². The creation of a theory- and web-based intervention is challenging as many principles are most appropriately applied to face-to-face delivery^{299,302,305}.

Nonetheless, theoretical principles were used to develop and refine tools and content in an attempt to improve the quality, engagement and personalisation of the learning experience (i.e., personalised guide-maker tool, quizzes and lived experience videos for modelling).

Positive workshop feedback from both people with knee osteoarthritis and health professionals during step 5 supported the value of this approach and the resources developed.

The content provided by the '[My Knee](#)' toolkit addresses the diverse educational priorities of people with knee osteoarthritis identified during step 3⁴⁶², and aligns with clinical practice guidelines^{116,118,125,331}, expert opinion³²⁰, and clinical research^{4,22,34,72,404-408}. This toolkit also aims to provide content and resources to counter misleading or partially accurate information that is commonly found elsewhere on the internet⁸⁷. The potential for information overload (i.e. too much) was a key concern provided by co-design workshop participants, and this is a commonly reported problem with similar health education tools⁴⁸³. To address this feedback, navigation and usability refinements were made, including drop down arrows in the navigation bar, frequently asked question sections, a dedicated exercise resource page and image button hyperlinks instead of text hyperlinks. The ability of users to tailor their own learning guide may also help to prevent information overload and was reported as a strength of the '[My Knee](#)' toolkit by workshop participants during step 5.

Workshop feedback revealed that the diversity of resources available (i.e., written materials, infographics and video resources) was a strength of the toolkit when compared to similar resources currently available. Importantly, this diversity of information, including contribution from experts and people with a lived experience of knee osteoarthritis, will appeal to varied learning preferences⁴⁸⁴. However, future edits may still be required to improve the user experience and will be informed by similar co-designed research methods with other populations including rural populations, people with lower digital literacy, and CALD communities.

Step 1 identified the importance of providing education alongside exercise therapy to optimise pain and function outcomes for people with knee osteoarthritis.^{291,312} Additionally, concept mapping studies in step 3 identified that both people with knee osteoarthritis⁴⁶² and

physiotherapists⁴⁴⁷ strongly prioritise education about exercise therapy. Consequently, a large proportion of content on the toolkit was created to cover the importance of exercise therapy and provide tools and resources to facilitate its implementation. Workshop feedback in step 5 re-emphasised the desire for information and resources to facilitate exercise therapy, informing subsequent edits before expert review. For example, feedback led to the creation of a ‘work-along’ exercise video and the expansion of the exercise therapy decision-making tool to incorporate important exercise safety considerations.

Concept mapping findings from step 3⁴⁴⁷, combined with other research^{211,270-273}, highlighted that many health professionals lack the confidence, knowledge or skills to provide first-line care. Health professionals, including physiotherapists who commonly provide care to people with knee osteoarthritis, appear to lack the confidence and self-reported capability to support weight management for people with knee osteoarthritis^{211,273,447}. To address this, an academic dietitian (AF) was consulted to inform content and resource development (personalised guide activities and expert opinion video), and to identify important external sites to facilitate weight management for people with knee osteoarthritis. Additionally, feedback from the health professionals’ workshop in step 5 led to the development of several easy to access and downloadable fact sheets. The availability of these resources was reported by workshop participants to be a key enabler for the use of the ‘[My Knee](#)’ toolkit in clinical practice.

Implications and future directions

The ‘[My Knee](#)’ toolkit, and the resources within it, create opportunities to enhance engagement with first-line care and may improve clinical outcomes for people with knee osteoarthritis. However, further research is needed to determine the feasibility and effectiveness of this toolkit when used independently by someone with knee osteoarthritis, or

in collaboration with a health professional. Future trials of the freely accessible '[My Knee](#)' toolkit are planned, and other research groups are encouraged to consider using it in trials providing patient education to people with knee osteoarthritis. In particular, the '[My Knee](#)' toolkit offers opportunities to improve the implementation of theory-based education interventions in clinical trials, particularly when being provided as control conditions²⁹¹. Research to determine whether use of the '[My Knee](#)' toolkit is effective at improving knowledge or self-efficacy of an individual with knee osteoarthritis is warranted. A comparison of the '[My Knee](#)' toolkit against other more passive or non-theory-based information or education interventions to determine effectiveness is also encouraged.

Further research to better understand 'how' the '[My Knee](#)' toolkit is best used to support care is warranted. For example, research to determine whether health professionals feel confident or capable of incorporating the toolkit into patient education, or whether people with knee osteoarthritis value an initial consultation with a health professional to co-navigate the site and identify potentially important resources, is needed. Doing so may inform future iterations of the toolkit and facilitate its use, especially for those with lower health or digital literacy. Research to examine what content or resources are most frequently used or are most valued by people with knee osteoarthritis and health professionals is also encouraged to facilitate future iterations.

7.6.1 Limitations

Limitations related to how the '[My Knee](#)' toolkit was developed should be considered. Although participants were recruited from a wide range of sources, the recruitment methods and samples were biased towards physiotherapists, and English speaking, digital-literate people with knee osteoarthritis in Australia. Additionally, only one male health professional

provided feedback. Therefore, the toolkit may not represent the views or priorities of all people with knee osteoarthritis or health professionals. Notably, future research involving CALD communities and a greater diversity of health professionals is encouraged. Importantly, efforts are needed to make content within the ‘[My Knee](#)’ toolkit accessible to non-English speaking populations, considering the diversity of the Australian population and that knee osteoarthritis is a leading cause of disability worldwide¹. This may include translation and cultural adaptations of content. A comprehensive dissemination plan to ensure the toolkit is visible and accessed by people with knee osteoarthritis and health professionals is also needed to increase awareness and benefits of engaging with the ‘[My Knee](#)’ toolkit. This is in development, informed by previous chronic pain media campaigns⁴⁸⁵ and a framework for digital and social media knowledge translation⁴⁸⁴. Finally, as research evolves, the information and content contained within the toolkit will need to be regularly updated to reflect accurate and contemporary best practice.

7.7 Conclusion

This study outlines the six step process used to co-design the novel theory-informed ‘[My Knee](#)’ education and self-management toolkit. This web-based toolkit creates potential opportunities to enhance engagement with first-line care and improve patient outcomes. It may be used independently by people with knee osteoarthritis, or in collaboration with a health professional. Future research will determine feasibility and effectiveness of the toolkit and inform its continual improvement.

PART D – DISCUSSION AND CONCLUSION

Chapter 8 : Thesis Summary, Implications and Conclusion

This thesis investigated patient education for people with knee osteoarthritis. It aimed to i) evaluate the effectiveness of patient education interventions in clinical trials and assess their content, development and delivery, ii) identify and appraise common publicly-accessed web-based resources for people with knee osteoarthritis, iii) identify the educational priorities of physiotherapists and people with knee osteoarthritis, and iv) use co-design methods to create a web-based toolkit to facilitate self-management and informed decision-making for people with knee osteoarthritis. This chapter summarises the key findings of this thesis, the implications for clinical practice, and the strengths, limitations and directions for future research.

8.1 Summary of thesis findings

My systematic review and meta-analysis³¹² (Chapter 2) identified that there is very low certainty evidence to suggest that patient education interventions provided in clinical trials result in short-term improvements in pain and function compared to usual care. Improvements were small and did not exceed the MCID^{350,351}. The review identified very low certainty evidence that patient education is inferior to exercise therapy for short-term pain outcomes, with this difference being clinically important. Additionally, very low certainty evidence indicated that combining patient education with exercise therapy results in clinically important short-term improvements in function compared to exercise therapy alone. Collectively, these findings bring into question the value of providing patient education as a standalone intervention and support consistent guideline recommendations that it should be provided as first-line care alongside exercise

therapy for people with knee osteoarthritis^{41,116,118,192}. Providing patient education and exercise therapy is also recommended for the treatment and management of common comorbidities^{92,95,96,98} for people with knee osteoarthritis, including obesity¹⁶⁷, hypertension⁴⁸⁶ and depression⁴⁸⁷, and to reduce the risk of falls among older adults⁴⁸⁸. Therefore, providing patient education alongside exercise therapy has the potential to improve the overall health of people with knee osteoarthritis^{132,487}.

The ancillary analysis²⁹¹ of clinical trials included in my systematic review³¹² (Chapter 3) identified inadequate reporting of patient education content, which may impede guidelines from providing specific recommendations on implementation and prevent clinicians from knowing what effective patient education for people with knee osteoarthritis looks like. This analysis also indicated that processes used to develop patient education interventions used in published clinical trials is often inadequate to be considered best practice. For example, only 42% of education interventions were theory-based, 45% were based on previous research in chronic conditions, and just 11% were co-designed. Thirty-nine per cent of all patient education interventions analysed were control conditions, with these typically being less rigorously developed compared to education interventions that were tested as the experimental condition. Specifically, substantially fewer control interventions were theory- (65% vs 7%) or evidence-based (67% vs 12%). This has the potential to overestimate the effects of comparators (i.e., exercise therapy) in clinical trials and meta-analyses, given the importance of theory-based and evidence-based practice for optimising learning outcomes^{123,480} and facilitating behaviour change^{481,482}.

My systematic appraisal of freely available and commonly-accessed (from Australia) web-based content about knee osteoarthritis⁸⁷ (Chapter 4) identified that websites were generally comprehensive. However, between 20 and 40% provided inaccurate information about surgery and the pathophysiology of the condition. Additionally, websites advertising services or products, which made up 23% of those reviewed, were generally less comprehensive and were more likely to provide inaccurate information than those that did not advertise services or products. The presence of inaccurate web-based information may contribute to the limited use of web-based resources to support patient education by physiotherapists when providing care for people with knee osteoarthritis²⁷¹. Inaccurate web-based information about surgery identified may help to explain the common misconception among individuals with knee osteoarthritis that surgery is inevitable^{79,85}. Additionally, this may also contribute to rising referrals to orthopaedic surgeons¹⁷³ and the unsustainable increases in surgeries¹¹⁰ for the treatment of knee osteoarthritis in Australia. In reality, very few people with knee osteoarthritis should require surgery¹²² and willingness to undergo it can be reduced through engagement with appropriate first-line care^{79,310}. The inaccurate information about the pathophysiology of knee osteoarthritis identified in this research may create an additional barrier to engagement in first-line care. For example, the simplistic terms typically used to describe the pathophysiology of osteoarthritis I identified on websites (i.e., ‘bone on bone’ or ‘wear and tear’) are often cited as creating uncertainty, fear or avoidance of exercise therapy^{75,80,81,85,210,267,309}.

My concept mapping studies identified that people with knee osteoarthritis⁴⁶² (Chapter 5) and physiotherapists⁴⁴⁷ (Chapter 6) have broad education priorities. Importantly, these priorities are typically not clearly included in education specific content recommendations of clinical practice

guidelines^{41,116,118,125}. People with knee osteoarthritis prioritised education about the relationship of education and exercise with surgery⁴⁶², and physiotherapists prioritised education about exercise therapy and misconceptions about radiology⁴⁴⁷. People with knee osteoarthritis generally felt confident that health professionals could meet most of their important educational needs⁴⁶². However, physiotherapists felt relatively less capable to provide weight management education, despite identifying it as an important topic⁴⁴⁷. The lack of clear education specific content recommendations in guidelines to address priorities of people with knee osteoarthritis, combined with the perceived lack of capability among many physiotherapists to provide education about some important education topics may help to explain why patient education does not always address the needs of people with knee osteoarthritis needs²⁶⁷. Additionally, these factors may also negatively influence therapeutic alliance⁷⁵ and engagement in first-line care⁸⁵, and contribute towards many people with knee osteoarthritis seeking information from web-based resources^{197,419}, where the accuracy of content is often lacking or inadequate⁸⁷.

Chapter 7 outlined the three-stage, six-step co-design methodology used to create the ‘[My Knee](#)’ education and self-management toolkit. Its development was informed by all studies earlier in this thesis. This work had identified an opportunity to co-design⁸⁷ a theory-based²⁹¹ web resource that could accurately meet the broad educational needs of people with knee osteoarthritis⁴⁶², facilitate engagement in exercise therapy³¹², and support health professionals providing patient education such as weight management advice⁴⁴⁷. I was unable to identify an optimal theory on which to base the development of the ‘[My Knee](#)’ toolkit. Therefore, to optimise the potential for learning and engagement, the toolkit’s development was informed by the theoretical principles of andragogy³⁰⁵, motivational interviewing²⁹⁹ and self-efficacy³⁰². Workshop feedback indicated

that the tools and resources created based upon these theories (i.e., personalised guide-maker, quizzes and lived experience videos) added value to learning and engagement, and thus, may be key enablers to its use.

Workshop feedback indicated that people with knee osteoarthritis and health professionals wanted easy access to web-based resources to support the implementation of, and engagement with, exercise therapy. This supported my earlier concept mapping findings^{447,462}, and led to the adaptation of existing, and creation of new, exercise therapy resources within the ‘[My Knee](#)’ toolkit. Substantial revisions were also made to improve overall site navigation, as workshop feedback reported that information was occasionally overwhelming and difficult to find, acting as a barrier to its use either as a self-directed or therapist-facilitated resource (See Chapter 7). This feedback I received is consistent with studies evaluating similar web-based resources reporting that information overload (i.e., too much information) is a barrier to engagement, especially for people who are less health literate⁴⁸³. Health professionals participating in workshops voiced a desire to have quick access to multiple resources to facilitate education and self-management (i.e., downloadable factsheets, personalised guides and expert videos). As health professionals typically report being less confident to provide education about weight management, medications, and balance and falls education^{211,273,447,489,490}, creation of information and resources about these topics was prioritised. Finally, review of the toolkit by experts informed revisions to improve the accuracy, clarity and applicability of the ‘[My Knee](#)’ toolkit for use as both a self-directed and therapist-facilitated resource.

8.2 Strengths and limitations of the research design

The specific strengths and limitations of each study within this thesis are discussed in some detail in Chapters 2-6. The remainder of this section presents the strengths and limitations of the research in the context of the whole thesis.

8.2.1 Aim 1 - Evaluate the effectiveness of patient education interventions in clinical trials and assess their content, development and delivery

My systematic review and meta-analysis provides the most comprehensive and up-to-date review of the literature for the effectiveness of patient education on pain and function outcomes for people with knee osteoarthritis. The use of GRADE^{347,348} to assess the certainty of evidence should be seen as a strength of my review. However, only very low certainty evidence was identified using GRADE^{347,348}, limiting the ability to provide strong recommendations for clinical practice. Additionally, it is important to consider the large number of studies that were excluded as a result of being unable to retrieve appropriate data to include in meta-analyses³¹². A common reason for this was the pooling of people with knee osteoarthritis with people with hip osteoarthritis for education interventions. Providing group education to people with multiple chronic health conditions is not new, with studies using such methods dating back to the 1990s. This approach is based on the assumption that most healthy lifestyle and self-management education content will be applicable across multiple conditions^{491,492}. Therefore, it seems logical that people with knee and hip osteoarthritis may be provided with the same group education due to the similarities in risk factors for disease progression^{21,66} and their management¹⁴⁰. This is further evidenced by shared clinical practice guidelines^{41,42,116,118,125}. Improved accessibility of data for different populations, when pooled in clinical trials of multimorbidity education

interventions, will improve the ability of future reviews to investigate the effects of patient education in people with knee osteoarthritis specifically.

Determining the true effectiveness of patient education is challenging. For example, the World Health Organisation (WHO) Europe definition of ‘therapeutic patient education’²⁸³ (Box 8.1) indicates that patient education should aim to create a therapeutic effect to facilitate engagement in other treatments. For example, a positive outcome of a patient education intervention may be improved engagement in physical activity or exercise therapy participation. Therefore, it is difficult to determine if improvements in outcomes (i.e., pain or function) in these instances are a result of patient education, exercise therapy, or both.

Box 8.1 World Health Organisation (WHO) Europe definition of ‘therapeutic patient education’²⁸³

Health care providers tend to talk to patients about their disease rather than train them in the daily management of their condition. Therapeutic patient education is designed, therefore, to train patients in the skills of self-managing or adapting treatment to their particular chronic disease, and in coping processes and skills. It should also contribute to reducing the cost of long-term care to patients and to society. It is essential to the efficient self-management and to the quality of care of all long-term diseases or conditions, though acutely ill patients should not be excluded from its benefits. Therapeutic patient education is education managed by health care providers trained in the education of patients, and designed to enable a patient (or a group of patients and families) to manage the treatment of their condition and prevent avoidable complications, while maintaining or improving quality of life. Its principal purpose is to produce a therapeutic effect additional to that of all other interventions (pharmacological, physical therapy, etc.).

When considering Gregory’s definition of education²⁷⁷ (Box 8.2), people with knee osteoarthritis may also receive ‘education’ or ‘learn’ about their condition when engaging in other interventions. For example, an individual with knee osteoarthritis may learn that exercise is safe and not dangerous simply through engaging in an exercise therapy program and not experiencing

a flare-up of their symptoms. In this instance, the individual is learning by making sense of their experience through exercise therapy participation, rather than learning through a typical education intervention. Clearly, the interaction between patient education and other interventions is complex, making it extremely difficult to truly determine the effectiveness of individual interventions. Therefore, patient education may be best framed as an intervention to enhance experiential learning that occurs with other interventions, rather than a standalone modality. My systematic review finding indicating superior outcomes when patient education is provided in combination with exercise therapy compared to either intervention alone supports this assertion³¹².

Box 8.2 Gregory's definition of education²⁷⁷

Education is concerned with equipping minds to make sense of the physical, social and cultural world.

My ancillary analysis²⁹¹ of the content, development and delivery of education interventions in clinical trials, completed as part of this thesis, is the most comprehensive published analysis in the knee osteoarthritis field. There are no existing criteria to determine what defines a 'high-quality' education intervention for people with knee osteoarthritis. Thus, as part of this thesis I developed a criterion-based rubric in collaboration with my supervisory team to identify potentially important education content topics based upon recommendations from clinical practice guidelines^{116-118,331}, expert opinion³²⁰ and clinical research^{4,22,34,72,404-408}. Additionally, in collaboration with a health psychologist with experience and expertise in behaviour change (Associate Professor Paul O'Halloran) and my supervisory team, potentially important criteria

for the development of interventions were identified from educational and clinical research^{307,402,412,416,417,448}. Due to the overall poor reporting of education interventions in clinical trials that I identified, I was unable to gain deeper insights into the roles of content, context or methods to improve patient outcomes. These prevented any recommendations about ‘what’ education to provide or ‘how’ to provide it based on previous research in knee osteoarthritis as part of this thesis.

8.2.2 Aim 2 - Identify and appraise common publicly-accessed web-based resources for people with knee osteoarthritis

My systematic appraisal of web-based information about knee osteoarthritis presented in this thesis provides a greater level of analysis of the comprehensiveness, accuracy and clarity of content compared to previous analyses^{88,89,264}. However, only a relatively small sample of websites on the internet, as identified from one geographical location (Melbourne, Australia), were appraised. Therefore, my findings may not represent all resources on the internet and further research is warranted. In this study, the rubric developed in my ancillary analysis of clinical trials²⁹¹ was used to assess the comprehensiveness, accuracy and clarity of web-based information. Absences of validation of this should be taken into consideration when interpreting my findings. Additionally, this analysis did not evaluate people with knee osteoarthritis’ perceptions of the information presented or whether they knew what to do with or how to use the information. These are important considerations for the use of web-based information as an educational resource. I appraised the quality of web-based information about treatment options (DISCERN⁴²⁹), the credibility of web-based information (HONcode certification criteria⁴³¹) and its readability (Flesch Reading Ease and Flesch-Kincaid Grade Level⁴³²) using commonly

applied tools. However, the use of DISCERN is subject to assessor bias⁴⁹³. Additionally, HONcode was originally developed as a certification award for websites, and although it has been adopted in clinical research as a measure of credibility, its use for this purpose has not yet been fully validated⁴⁹⁴.

8.2.3 Aim 3 - Identify the educational priorities of physiotherapists and people with knee osteoarthritis

My mixed-methods concept mapping studies^{447,462} presented in this thesis provide detailed representations of the educational priorities of people with knee osteoarthritis seeking care and physiotherapists. A strength of this methodology is that participants are directly involved in both the generation and representation of ideas, rather than just ranking/prioritising pre-defined topics⁴⁴³. An important limitation of this work is that most people with knee osteoarthritis who participated were receiving/had previously received physiotherapy treatment⁴⁶². Notably in Australia, only 1 in 20 people with knee osteoarthritis presenting to a general practitioner for care are referred to physiotherapy¹⁷³ and one-third of people attending an orthopaedic consultation report not having engaged in first-line care²⁶⁹. Therefore, my findings related to the education priorities of people with knee osteoarthritis may not reflect those of all people presenting for care with the condition. For example, most participants were recruited from GLA:D® Australia and would have already received formal patient education sessions that covered topics including understanding the condition of knee osteoarthritis, risk factors, symptoms, general treatments, exercise, coping and self-help techniques⁴⁵². Exploration of other groups of people with knee osteoarthritis is encouraged and may reveal different education priorities to inform future interventions, resources and guideline recommendations. Finally,

although I identified key priorities in relation to ‘what’ content may be important to provide, I did not seek preferences about ‘how’ to provide it within these studies. However, ‘how’ best to address these important priorities within a web-based toolkit was investigated in the co-design workshops in Chapter 7.

8.2.4 Aim 4 - Use co-design methods to create a web-based toolkit to facilitate self-management and informed decision-making for people with knee osteoarthritis

The comprehensive and transparent steps used to co-design the ‘[My Knee](#)’ education and self-management toolkit should be considered a major strength of this thesis. This methodology aims to ensure that the broad educational priorities of people with knee osteoarthritis may be met. Importantly, the involvement of people with knee osteoarthritis in the co-design process through interactive workshops helps to identify ‘how’ this information is best presented. However, it is important to note that the effectiveness of the ‘[My Knee](#)’ toolkit as an educational resource has not yet been determined and must be prioritised in future research.

Due to the characteristics of participants involved in its development, the ‘[My Knee](#)’ toolkit in its current form may be most useful for older, English-speaking people with good health literacy who live in Australia. However, it may also be appropriate for younger people with knee osteoarthritis, considering they appear to value the convenience and flexibility of technology facilitated or web-based resources⁴⁹⁵⁻⁴⁹⁸. Further collaboration and co-design initiatives with other groups of people with knee osteoarthritis (i.e., younger, newly diagnosed, less digitally literate and CALD communities seeking health information) are warranted. This may identify differing education priorities and increase the applicability of the toolkit to a broader range of

people with knee osteoarthritis. To improve equity of access, it is also necessary to translate, revise and adapt content of the toolkit, plus enhance dissemination plans, to ensure that it is accessible to CALD communities within Australia and internationally.

Most health professionals involved in the co-design of the ‘[My Knee](#)’ toolkit were physiotherapists. However, physiotherapists are only one of a number of health professionals that may be involved in the care of people with knee osteoarthritis¹⁷³. To help address this limitation, other professions were involved in the creation of content (i.e., dietician, exercise physiologist with expertise in pharmacology, nutritionist, podiatrist). Additionally, experts invited to review the toolkit prior to finalising it were from a variety of professions (i.e. a dietician, exercise physiologist, general practitioner, rheumatologist and physiotherapists). However, as research evolves a continual improvement plan is needed to ensure content remains up to date and accurate ([Appendix 8A](#)). Finally, the use of web-based resources for patient education by health professionals is not common^{271,499,500}. Therefore, a comprehensive dissemination plan with or without additional training for health professionals has been developed and is required to facilitate use of the toolkit as a therapist-facilitated resource. This dissemination plan is in development ([Appendix 8A](#)), informed by previous chronic pain media campaigns⁴⁸⁵ and a framework for digital and social media knowledge translation⁴⁸⁴.

8.3 Implications of this thesis

The findings of the research contained within this thesis and the ‘[My Knee](#)’ education and self-management toolkit are applicable to both clinical practice and research. The remainder of this

section provides important considerations and future recommendations relating to research within this thesis and the ‘[My Knee](#)’ toolkit.

8.3.1 Clinical implications

I identified that patient education may have limited effectiveness when provided as a standalone intervention and that it should be provided alongside exercise therapy whenever possible³¹².

Providing patient education in combination with exercise therapy aligns with clinical practice guideline recommendations for people with knee osteoarthritis^{41,116-118,125}. However, currently, only the EULAR¹¹⁶ guidelines clearly recommend against providing patient education in isolation. Based on my review findings³¹², other international guidelines^{41,42,118,125} may consider providing similar more explicit recommendations against the provision of patient education as a standalone intervention.

My findings revealed that poor reporting of interventions in clinical trials²⁹¹ may act as a barrier to implementing effective evidence-based education interventions³¹². This limits the ability of health professionals to implement education interventions which might benefit their patients, and is concerning given the lack of recommendations within guidelines to facilitate ‘what’ patient education to provide or ‘how’ to provide it clinically^{41,116-118,125}. To address the challenge of deciding ‘what’ education content to provide, health professionals are encouraged to directly identify the learning priorities of their patients with knee osteoarthritis. Identifying an individual’s learning priorities is crucial considering my work indicates that a patient’s educational needs are broad and are often not aligned to what is contained within guidelines^{447,462}. Identifying education priorities of people presenting for care with knee

osteoarthritis may also build a strong therapeutic alliance^{75,85}, reduce barriers to engagement in first-line care⁸⁵, and offer opportunities to explore what information the individual has already been exposed to so that any misinformed beliefs can be addressed. However, not all health professionals may have the skills, knowledge or confidence to provide such patient-centred education^{269,270,461}. In these instances, the ‘[My Knee](#)’ toolkit may be used as a resource to guide patient education. Further, the content rubric ([Appendix 3A](#)) and development criteria ([Appendix 3D](#)) that was applied in this thesis to appraise education interventions and web-based information^{87,291} may guide development of future education resources for people with knee osteoarthritis. They are comprehensive, and were based upon clinical practice guidelines,^{116-118,331} expert opinion³²⁰ and clinical research^{4,22,34,72,404-408}. Additional guidance can also be provided by the education priorities of physiotherapists⁴⁴⁷ and people with knee osteoarthritis⁴⁶² that I identified in this thesis.

To better understand ‘how’ to provide patient education for people with knee osteoarthritis, health professionals should consider providing intentional learning opportunities to supplement experiential learning that occurs because of, and facilitates engagement with, first-line care. Provision of patient education with consideration of learning or behaviour change theories (for example, andragogy³⁰⁵, motivational interviewing²⁹⁹ or self-efficacy³⁰²) may assist with this and is recommended as a core competency for the effective provision of patient education by physiotherapists³⁰⁷. The development of the ‘[My Knee](#)’ patient education and self-management toolkit was informed by these theories, and thus, may serve as a useful resource to support the implementation of patient education in clinical practice.

Further research is required to understand how the ‘[My Knee](#)’ toolkit may be best incorporated into clinical practice (see Section 8.3.2). Nonetheless, it has great potential to enhance learning and facilitate longer-term engagement in first-line care. In the absence of other similar accurate, comprehensive and co-designed interventions, its use is encouraged. The toolkit may be particularly valuable to support health professionals to provide weight management education^{211,273,447,489,490} or for novice physiotherapists who often struggle to provide patient-centred education⁴⁶¹. For example, the tools within the personalised guide maker can facilitate implementation of personalised weight management goals, plus help identify educational needs of people with knee osteoarthritis to guide education content. The ‘[My Knee](#)’ toolkit also has potential to be used alongside, or following the completion of, osteoarthritis management programs in Australia (such as GLA:D^{®463} or the OsteoArthritis Chronic Care Program [OACCP]⁵⁰¹), and internationally (such as the Enabling Self-management and Coping with Arthritic Pain Using Exercise [ESCAPE-painTM]⁵⁰² or Better management of patients with OsteoArthritis [BOA]⁵⁰³).

Engagement with the ‘[My Knee](#)’ toolkit may be best viewed as a continuum, from a self-directed resource through to a complimentary resource to support in-person care. As a self-directed resource, the ‘[My Knee](#)’ toolkit may be particularly valuable for people who live in remote areas of Australia or are newly diagnosed with knee osteoarthritis and are seeking information about treatment options. The resources within this toolkit can help an individual with knee osteoarthritis to increase their knowledge about the condition, enhance self-efficacy for and implement first-line care, navigate the healthcare system, and facilitate effective communication with a health professional. The ability of a health professional to download resources directly

from the ‘[My Knee](#)’ toolkit also provides opportunities for people who are less digitally literate to still benefit from the toolkit when consulting with health professionals.

8.3.2 Future research priorities related to this thesis

Further research and development of the rubric that was used to assess the comprehensiveness, accuracy and clarity of the content of interventions in clinical trials²⁹¹ and web-based information⁸⁷ about knee osteoarthritis is needed. Additionally, research to identify and develop recommendations for what constitutes a ‘high-quality’ patient education intervention or resource is warranted and should include key development and implementation (i.e., how to provide) recommendations to guide clinical practice. Co-design^{401,402,471} and/or Delphi⁵⁰⁴ methods could be employed to identify potentially meaningful or important criteria for the content, development or implementation of high-quality educational interventions or resources. This work should consider incorporating the views of people with knee osteoarthritis, health professionals and researchers. Such criteria could be used by future systematic reviews to confidently determine the comprehensiveness, accuracy, clarity and quality of interventions.

The inadequate reporting of education interventions in clinical trials identified in Chapter 3 highlights the need to develop a tool to facilitate reporting of education interventions. This tool could be similar to the Consensus on Exercise Reporting Template (CERT)⁴²⁰ for exercise therapy or the Workgroup for Intervention Development and Evaluation Research (WIDER) checklist⁴²¹ for behaviour change interventions. Adherence to such a tool in the reporting of clinical trials may facilitate future systematic reviews to identify the most effective content, development or delivery of patient education interventions for people with knee osteoarthritis. It

could also be used as a framework to improve the standard of future education resources or interventions, especially for those that are used as control conditions in clinical research³¹².

Collectively, the further development and research of these criteria will assist researchers and clinicians to interpret future systematic review and meta-analysis findings in the field of patient education for knee osteoarthritis and other chronic diseases. Ultimately, this could also enhance the applicability of recommendations related to patient education for knee osteoarthritis within clinical practice guidelines, which is typically poor^{41,42,116,118,125,137,138}.

Development of an outcome or tool that can effectively assess the educational quality of web-based health information is warranted. Although DISCERN⁴²⁹, HONcode⁴³¹ and readability outcomes are often used to assess web-based resources, they may not account for all factors to judge ‘quality’ of an educational resource. For example, the DISCERN⁴²⁹ was originally developed to judge the quality of passive, written information about treatment choices and does not account for how web-based resources are able to engage the user in learning or decision-making. Additionally, people with knee osteoarthritis can judge credibility on factors not accounted for in HONcode (i.e., design/layout and inclusion of pictures or graphics^{438,439}).

Development of such a tool should include collaboration or co-design between people with knee osteoarthritis, health professionals, researchers and information technology specialists. The development and subsequent use of such a tool or outcome may facilitate greater trust in, and use of, web-based resources from both people with knee osteoarthritis and health professionals.

Research to determine the feasibility and effectiveness of the ‘[My Knee](#)’ toolkit, either as a self-directed or therapist-facilitated intervention, is warranted. To determine the feasibility of the ‘[My](#)

[Knee](#)' toolkit, exploring the barriers and enablers to using the toolkit in blended learning formats is warranted. Future co-design research involving different populations (i.e., younger, newly diagnosed, less digitally literate or CALD people seeking health information) would also offer opportunities for the continual improvement, and potential effectiveness, of the '[My Knee](#)' toolkit. Considering the aims of the '[My Knee](#)' toolkit, research to determine whether it can improve knowledge of an individual with knee osteoarthritis, or optimise self-efficacy and engagement in first-line care is warranted. Other important outcomes to consider include pain and function, the most common impairments reported by people with knee osteoarthritis, alongside physical activity participation, pain coping, desire to undergo surgery, and healthcare utilisation.

Further exploration of 'how' to best use the '[My Knee](#)' toolkit in clinical practice is warranted.

The key questions requiring exploration include:

- When should access to the toolkit be provided?
- What are the characteristics of people likely to benefit from engaging with the toolkit?
- Can specific resources (i.e., access to the personalised guide) be provided in advance of a clinical encounter to stimulate more meaningful discussions about educational needs or self-management options?
- Should health professionals signpost to, or directly implement, the toolkit in their patient education?

Combined, these important research considerations will not only influence how the '[My Knee](#)' toolkit may be used clinically but will also inform planned continual improvements to the toolkit.

8.4 Conclusion

This thesis investigated the effectiveness of patient education for people with knee osteoarthritis; the content, development and delivery of education interventions in clinical trials; the comprehensiveness, accuracy and clarity of web-based information about knee osteoarthritis and the educational priorities of people with knee osteoarthritis and physiotherapists. This culminated in the creation of the co-designed web-based TREK '[My Knee](#)' education and self-management toolkit. Very low certainty evidence indicated that patient education has limited effectiveness as a standalone intervention and that providing patient education in combination with exercise therapy is superior to patient education alone. Subsequently, providing patient education in combination with exercise therapy whenever possible is encouraged, and future guidelines may consider recommending against providing patient education as a standalone intervention. Poor reporting of education interventions in clinical trials limited the clinical interpretation of systematic review findings and prevented the identification of important features, including 'what' content to provide and 'how' to provide it.

In the absence of clear guideline recommendations for effective content or intervention development, my concept mapping studies identified key education content priorities of people with knee osteoarthritis and physiotherapists to inform future development of education resources and interventions. These priorities, alongside ancillary and web-content analysis findings, informed the development of a theory-informed, web-based education and self-management toolkit – '[My Knee](#)'. This freely available toolkit which was co-designed involving

people with knee osteoarthritis, health professionals and experts, has potential to facilitate the provision of patient education, independently or in collaboration with a health professional.

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Appendix 1

[Appendix 1A](#) – Confirmation of authorship for published, accepted or submitted manuscripts contained within this thesis

[Appendix 1B](#) – Replication and copyright permissions for published or accepted manuscripts

[Appendix 1C](#) – Invited editorial about knee osteoarthritis

Appendix 1A – Confirmation of authorship for published, accepted or submitted manuscripts contained within this thesis

Manuscript 1 (Chapter 2) - Published

Goff, A.J., De Oliveira Silva, D., Merolli, M., Bell, E.C., Crossley, K. & Barton, C.J. (2021). Patient education improves pain and function in people with knee osteoarthritis with better effects when combined with exercise therapy: a systematic review. *Journal of Physiotherapy*. 67 (3), 177-89. DOI: j.jphys.2021.06.011

As the primary supervisor, I certify that Anthony Goff has made the following contributions:

- PROSPERO registration
- Research question design
- Searches
- Screening of eligibility
- Data extraction
- Data analysis including risk of bias and certainty assessments
- Writing of the manuscript
- Study administration

Dr Christian Barton

22nd January 2022

Manuscript 2 (Chapter 3) – Accepted and available online

Goff, A.J., De Oliveira Silva, D., Merolli, M., Bell, E.C., Ezzat, A., O'Halloran, P., Crossley, K. & Barton, C.J. Knee osteoarthritis education interventions in published trials are typically unclear, not comprehensive enough, and lack robust development: Ancillary analysis of a systematic review. *Journal of Orthopaedic and Sports Physical Therapy*. available online ahead of print. DOI: jospt.2022.10771

As the primary supervisor, I certify that Anthony Goff has made the following contributions:

- Research question design
- Development of extraction criteria
- Data extraction
- Data analysis and visualisation
- Writing of the manuscript
- Study administration

Dr Christian Barton

22nd January 2022

Manuscript 3 (Chapter 4) – Accepted

Goff, A.J., Barton, C.J., Merolli, M., Quah, A.Q.S, Hoe, C.K.C, De Oliveira Silva, D. Comprehensiveness, accuracy, quality, credibility and readability of online information about knee osteoarthritis. Health Information Management Journal.

As the primary supervisor, I certify that Anthony Goff has made the following contributions:

- Research question design
- Development of extraction criteria
- Data extraction
- Data analysis and visualisation
- Writing of the manuscript
- Study administration

Dr Christian Barton

22nd January 2022

Manuscript 4 (Chapter 5) – Accepted

Goff, A.J., Donaldson, A., De Oliveira Silva, D., Crossley, K. & Barton, C.J. People with knee osteoarthritis attending physiotherapy have broad education needs, and prioritize information about surgery and exercise: A concept mapping study. Journal of Orthopaedic and Sports Physical Therapy.

As the primary supervisor, I certify that Anthony Goff has made the following contributions:

- Research question design
- Obtained ethical approval
- Recruitment
- Data collection and management
- Data analysis and visualisation
- Writing of the manuscript
- Study administration

Dr Christian Barton

22nd January 2022

Manuscript 5 (Chapter 6) – Accepted

Goff, A.J., Donaldson, A., De Oliveira Silva, D., Crossley, K. & Barton, C.J. Physiotherapists prioritise providing education about exercise therapy and to dispel misconceptions about radiology for people with knee osteoarthritis. A concept mapping study. Journal of Orthopaedic and Sports Physical Therapy.

As the primary supervisor, I certify that Anthony Goff has made the following contributions:

- Research question design
- Obtained ethical approval
- Recruitment
- Data collection and management
- Data analysis and visualisation
- Writing of the manuscript
- Study administration

Dr Christian Barton

22nd January 2022

Appendix 1B – Replication and copyright permissions for published or accepted manuscripts

Manuscript 1 (Chapter 2) – Published available open access

Goff, A.J., De Oliveira Silva, D., Merolli, M., Bell, E.C., Crossley, K. & Barton, C.J. (2021). Patient education improves pain and function in people with knee osteoarthritis with better effects when combined with exercise therapy: a systematic review. *Journal of Physiotherapy*. 67 (3), 177-89. DOI: j.jphys.2021.06.011

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Appendix 1C – Invited editorial about knee osteoarthritis

Journal of Physiotherapy 67 (2021) 240–241



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Editorial

Knee osteoarthritis

Anthony J Goff^{a,b}, Mark R Elkins^{c,d}

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This Editorial introduces another of *Journal of Physiotherapy's* article collections.^{1–3} These are collections of papers in a specific field of research, published in the *Journal of Physiotherapy* within the past decade and curated to alert readers to important findings and research trends in that field, while highlighting avenues for further research. This latest article collection examines physiotherapy research into knee osteoarthritis (OA). 'Knee' and 'osteoarthritis' were two of the top 20 search terms in an analysis of the searches conducted of the Physiotherapy Evidence Database (PEDro).⁴

Up to 25% of people over the age of 50 years have knee OA,^{5,6} with many progressing to knee replacement surgery.⁷ Current clinical practice guidelines recommend knee replacement surgery only after first-line and second-line management options have been exhausted.^{8,9} Such non-surgical management options include patient education, exercise therapy, weight management and advice about pharmacological management of symptoms.^{8,9}

Most of the recommended non-surgical interventions have been included in clinical practice guidelines because of robust evidence; however, education has often been recommended based on evidence related to OA of other joints or other forms of arthritis.¹⁰ To address this, a recent systematic review pooled the available evidence about education for knee OA.¹⁰ It found that patient education may reduce pain and improve function compared with usual care, although these effects may not be large enough to be clinically important in isolation. However, combining patient education with exercise therapy should be encouraged, given the statistically superior and clinically important improvements in function compared with patient education alone.¹⁰

Cryotherapy is another non-surgical intervention with unclear evidence in knee OA. Some guidelines recommend it,^{11,12} whereas others do not.^{8,13,14} A recent systematic review summarised the available evidence and determined that in people with symptomatic knee OA, any beneficial effect of the short-term application of cryotherapy on pain is so small that most would not consider it to be worthwhile.¹⁵ The effects of short-term cryotherapy on function and quality of life in people with symptomatic knee OA were unclear.

Conflicting advice exists within clinical practice guidelines about the use of manual therapies, including manipulation, mobilisation and massage, in the management of knee OA. Local¹⁶ and international¹¹ guidelines conditionally recommend the use of manual techniques but only as an adjunct to first-line management, whereas other international guidelines either conditionally recommend that manual techniques are not used¹² or have not included any recommendations about manual therapies due to insufficient evidence.^{8,13} A systematic review of the effects of massage¹⁷ identified three trials in knee OA. The pooled short-term effects on knee pain and function were each estimated to be clinically worthwhile, but the confidence intervals spanned both worthwhile and trivial effects. Overall, the certainty of this evidence was low, partly because only two of the three trials contributed to each meta-analysis.

A qualitative study examined the experiences of physiotherapists delivering care for people with knee OA and how these experiences aligned with a national clinical guideline.¹⁸ Physiotherapists reported that their management of knee OA was mostly consistent with the quality care standard. Nevertheless, the authors concluded that physiotherapists could improve their management by increasing the psychosocial focus of care, offering longer-term reviews, and being more proactive with advice and/or referral regarding weight loss, pain medications and knee surgery.¹⁸

Diet-induced weight loss improves function as a standalone intervention and improves pain when combined with exercise therapy for people with knee OA.¹⁹ These findings are similar to those of patient education and support guideline recommendations that patient education, exercise therapy and weight loss (when appropriate) should be provided in combination as first-line management for knee OA.^{8,9,11–14} Whilst physiotherapists regularly provide patient education and exercise therapy, they less frequently provide weight loss support for people with knee OA.^{18,20} The reasons for this are multifactorial; however, research from the *Journal of Physiotherapy* provides some key insights, with Teo et al identifying that physiotherapists can perceive weight loss as outside their professional role¹⁸ and Setchell et al identifying that many physiotherapists demonstrate weight stigma.²¹ Combined, these findings may impact the provision of guideline-recommended first-line management of knee OA and should be explored further in clinical research.

Although the benefits of exercise are well established, people with knee OA do not always adhere to a formal exercise regimen or maintain adequate levels of physical activity in the longer term.²² People with knee OA reported that lack of motivation, time, physical environment and monitoring were barriers to exercise and general physical activity.²² These barriers seemed similar, regardless of the levels of supervision, individualisation and progression that were provided when exercise was commenced. Instead, the presence and quality of a therapeutic alliance with a physiotherapist facilitated adherence to exercise and general physical activity. Another strategy that might assist with adherence to exercises is the use of an app with remote support to prescribe and monitor the formal home exercise program. Compared to merely having the exercise program prescribed on paper, patients who had a home exercise program for their musculoskeletal pain prescribed on an app with remote support adhered better to their home exercise program.²³ The randomised trial that established this beneficial effect on adherence did not have a precise enough estimate to prove that the effect on adherence is clinically worthwhile. Nevertheless, this should not discourage the use of the app for home exercise programs for knee OA because the app is freely available, has high user satisfaction, permits adherence monitoring and is quick and easy to use.²³

It may be particularly appropriate to consider use of the app with remote support²³ for people who have progressed to surgical knee

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replacement, given that they also struggle to maintain satisfactory exercise adherence. Patients with lower limb orthopaedic conditions in inpatient rehabilitation are relatively inactive and do not meet current physical activity guidelines. Given the importance of physical activity for general health and functional improvements following hospitalisation, it is important to develop methods to decrease sedentary behaviour and increase physical activity levels in rehabilitation.²⁴ After total knee arthroplasty, 42% of people were not active enough to maintain their health and fitness.²⁵ Physiotherapists should encourage people with a total knee arthroplasty to undertake the recommended exercise regimens to maintain health and fitness. Males, more educated participants and respondents living with family were found to have higher odds of meeting the health, fitness and both recommendations;²⁵ therefore, particular attention should be given to those people with characteristics known to be associated with poor adherence to the recommendations.

Despite general symptomatic improvement following knee replacement, up to one in five people remain dissatisfied with outcomes,²⁶ and can experience persistent muscle weakness, ongoing functional difficulties and pain when compared with healthy age-matched controls.²⁷ A large randomised controlled trial sought to determine whether outcomes related to these deficiencies could be improved by incorporating hip abductor strengthening exercises into a 6-week rehabilitation program.²⁸ However, similar improvements in muscle strength, functional performance and patient-reported outcomes were observed whether specific hip-strengthening exercises were incorporated or general functional exercises were continued instead as part of a postoperative rehabilitation program for participants after knee replacement.²⁸

In summary, this online article collection includes a range of important developments in the physiotherapy management of knee OA. The papers in the collection also highlight some important unanswered questions. For example, while education and exercise seem to be effective in the rehabilitation of knee OA, are there more effective approaches in the provision of patient education and self-management (eg, theory-based, co-designed)? Also, are the exercises that we currently use ideal or do we need to include other exercises, interventions or dosages (such as aerobic exercise or general increases in physical activity)? Finally, how can physiotherapists be better supported to provide weight loss for people with knee OA? These questions should be prioritised in future research with a focus on facilitating and improving longer-term behaviour change and patient outcomes.

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Provenance: Invited. Not peer reviewed.

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Websites

PEDro www.pedro.org.au

Appendix 2

[Appendix 2A](#) – Letter from Tian and Yuan to Journal of Physiotherapy about my review

[Appendix 2B](#) – Search strategy for systematic review

[Appendix 2C](#) – Upgrade and downgrade criteria for Grading of Recommendations, Assessment, Development and Evaluations (GRADE)

[Appendix 2D](#) – Reasons for exclusion

[Appendix 2E](#) – TIDieR table for included interventions

[Appendix 2F](#) – Detailed forest plots of the secondary outcomes

[Appendix 2G](#) – GRADE summary tables

[Appendix 2H](#) – Summary of unpooled data

[Appendix 2I](#) – Detailed forest plots for all comparisons that could be calculated as weighted mean difference

[Appendix 2J](#) – Detailed forest plots for Fig 2.3

[Appendix 2K](#) – Detailed forest plots for Fig 2.4

[Appendix 2L](#) – Detailed forest plots of the secondary outcomes

[Appendix 2M](#) – Explanation of when sensitivity analyses impacted outcome



Appraisal

Correspondence: Patient education in knee osteoarthritis

Knee osteoarthritis (OA) is the most common joint disease and affects millions of people worldwide.¹ Patient education, which is defined as 'any set of planned educational activities designed to improve patients' health behaviours and/or health status', has been recommended in many clinical practice guidelines as a first-line intervention for patients with knee OA;² however, there is a lack of clarity about the effectiveness of patient education interventions on pain and function outcomes in people with knee OA. With great interest, we read the article by Goff et al, which found that: patient education may reduce pain and improve function compared with usual care; these effects may not be large enough to be clinically important; and combining patient education with exercise therapy should be encouraged, given the statistically superior and clinically important improvements in function compared with patient education alone.³ We applaud the authors for addressing this important issue of identifying benefits for people with knee OA; however, there are two minor points that are worth further discussion.

First, the findings of this study are different from a newly published, evidence-based, clinical practice guideline.⁴ In this recently developed guideline by the American Academy of Orthopaedic Surgeons for the management of knee OA (non-arthroplasty), patient education programs are strongly recommended to improve pain, while the systematic review by Goff et al identified effects that may not be clinically important and questioned the value of patient education in isolation. Although focused on the same issue, they included different studies, which may have been the main cause of the inconsistent conclusions. The rationale of the guideline mentioned that patient education programs in studies overlap with self-management programs such as medication compliance, pain management, pain coping strategies and stress management techniques. Thus, it is possible that the clinical benefits of patient education manifest when combined with standard medical care and patient education is supplementary to standard medical care, which is consistent with Goff et al's questioning of the value of patient education in isolation.⁵ Therefore, further studies are needed to evaluate the actual

effects of patient education in isolation, which will help to determine whether it could be delivered alone or should be supplemented with other therapy (eg, exercise therapy, weight loss intervention).

Second, the authors included all kinds of educational interventions regardless of the intervention development process (eg, co-design, based on learning theory) or whether they were used as a control, which reduced selection bias and increased the generalisability of the results. However, it should be noted that some of the education programs were not disease-specific and that adherence to patient education varies with the delivery method, which further raises doubts over the achievement of meaningful benefits in patients who received the educational intervention. Therefore, due to these potential biases and confounding, the results of this review should be interpreted with caution.

The review also provides directions for future research. More well-designed robust trials are still warranted to determine best-practice patient education for reducing pain and improving function in people with knee OA. Aspects that require further clarification include the delivery method, which educational modules to include, the particular components of those modules and the amount of education needed to improve patient outcomes.

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<https://doi.org/10.1016/j.jphys.2021.12.002>

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Correspondence: Author response to Tian et al

We thank Tian and Yuan for their interest and positive comments about our systematic review.¹ They correctly identify that our conclusions differ from the recently developed American Academy of Orthopaedic Surgeons (AAOS) guideline,² which strongly recommended patient education programs for knee osteoarthritis. As suggested by Tian and Yuan, different recommendations may be due to the inclusion of different trials in the two pieces of work. Notably, we included control patient education interventions in our analysis and excluded trials when we were unable to retrieve outcome data for people with knee osteoarthritis only. The AAOS guidelines included trials for people with knee and hip osteoarthritis, but it is unclear if they based their recommendations on outcomes for people with knee osteoarthritis only.

Other methodological differences also require acknowledgement. We clearly defined and applied the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) criteria, outlined in our paper.¹ This led us to conclude 'very-low certainty evidence' supporting patient education as a stand-alone intervention. It is unclear how GRADE was applied in the AAOS guidelines to conclude 'strong evidence' for patient education. It is also unclear if the AAOS guideline patient education recommendations are based on meta-analyses, or if a minimal clinically important difference (MCID) threshold was applied. Mean differences from our meta-analyses for patient education compared to control interventions were considered in the context of their MCIDs.^{3,4} This led to our conclusion that 'although patient education produced statistically superior short-

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Appraisal

Correspondence 81

term pain and function outcomes compared with usual care, differences were small and may not be clinically important.' However, when education was combined with exercise therapy, findings were both statistically significant and greater than MCIDs.^{3,4} This led us to conclude that patient education 'should be combined with exercise therapy to provide statistically superior and clinically important short-term improvements in function compared with education alone.' We agree with Tian and Yuan, that the benefit of combining patient education with other interventions such as diet and weight-loss remains unclear and warrants further investigation.

The second point raised by Tian and Yuan was that education content and development varied in our included studies. Notably, clinical practice guidelines, including the AAOS,² provide no recommendations on how to develop education interventions, and provide limited guidance on what content to provide or how to deliver it. Our ancillary analysis of this review,⁵ summarised the development, content and delivery of included education interventions. This indicated that education interventions lack robust development and descriptions in published trials are typically broad and unclear. We did not investigate adherence to patient education interventions, and this should be a focus of future research.

Building on the points raised in this correspondence, we call for greater transparency in the content of patient education interventions in trials, and greater guidance from clinical practice

guidelines related to the specific content, methods of delivery and development of patient education interventions for people with knee osteoarthritis. Central to this 'call to action' should be consideration of the lived experience of people with knee osteoarthritis and their perceived educational needs.

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Appendix 2B – Search strategy for systematic review

Appendix 2B.i Search strategy CINAHL via EBSCO

S32 S19 AND S31 (576 results)

S31 S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30

S30 ((allocat* or allot* or assign* or divid*) N3 (condition* or experiment* or intervention* or treatment* or therap* or control* or group*))

S29 (cross?over* or (cross N1 over*))

S28 ((singl* or doubl* or trebl* or tripl*) N7 (blind* or mask*))

S27 (random* N7 (allocat* or allot* or assign* or basis* or divid* or order*))

S26 ((clinical or controlled or comparative or placebo or prospective* or randomi?ed) N3 (trial or study))

S25 TI trial

S24 AB randomly

S23 AB placebo

S22 AB randomized

S21 MH Randomized Controlled Trials

S20 MH clinical trials

S19 S11 AND S18

S18 S12 OR S13 OR S14 OR S15 OR S16 OR S17

S17 self care

S16 advice

S15 information

S14 self management

S13 patient education

S12 education

S11 S1 AND S10

S10 S8 AND S9

S9 S5 OR S6 OR S7

S8 S2 OR S3 OR S4
S7 AB knee
S6 TX knee
S5 TI knee
S4 AB (osteoarthr* or osteo-arthr*)
S3 TX (osteoarthr* or osteo-arthr*)
S2 TI (osteoarthr* or osteo-arthr*)
S1 osteoarthritis, knee/

Appendix 2B.ii Search strategy Embase via OVID

- 1 osteoarthritis, knee/
- 2 (osteoarthr\$ or osteo-arthr\$).ab,ot,ti,tw.
- 3 Knee.ab,ot,ti,tw.
- 4 2 and 3
- 5 1 or 4
- 6 education/
- 7 patient education.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
- 8 self management.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
- 9 information.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
- 10 advice.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
- 11 self care.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
- 12 6 or 7 or 8 or 9 or 10 or 11
- 13 5 and 12
- 14 Clinical trials as topic/
- 15 Randomized Controlled Trial/
- 16 Controlled Clinical Trials as Topic/
- 17 randomized.ab.
- 18 placebo.ab.
- 19 randomly.ab.
- 20 trial.ti.
- 21 ((clinical or controlled or comparative or placebo or prospective* or randomi#ed) adj3 (trial or study)).tw.
- 22 (random* adj7 (allocat* or allot* or assign* or basis* or divid* or order*)).tw.
- 23 ((singl* or doubl* or trebl* or tripl*) adj7 (blind* or mask*)).tw.
- 24 (cross?over* or (cross adj1 over*)).tw.
- 25 ((allocat* or allot* or assign* or divid*) adj3 (condition* or experiment* or intervention* or treatment* or therap* or control* or group*)).tw.
- 26 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
- 27 13 and 26

Appendix 2B.iii Search strategy MEDLINE via OVID

- 1 osteoarthritis, knee/
- 2 (osteoarthr\$ or osteo-arthr\$).af.
- 3 knee.af.
- 4 2 and 3
- 5 1 or 4
- 6 education/
- 7 patient education.af.
- 8 self management.af.
- 9 information.af.
- 10 advice.af.
- 11 self care.af.
- 12 6 or 7 or 8 or 9 or 10 or 11
- 13 5 and 12
- 14 Clinical trials as topic/
- 15 Randomized Controlled Trial/
- 16 Controlled Clinical Trials as Topic/
- 17 Randomized controlled trial.pt.
- 18 Controlled clinical trial.pt.
- 19 randomized.ab.
- 20 placebo.ab.
- 21 randomly.ab.
- 22 trial.ti.
- 23 ((clinical or controlled or comparative or placebo or prospective* or randomi#ed) adj3 (trial or study)).tw.
- 24 (random* adj7 (allocat* or allot* or assign* or basis* or divid* or order*)).tw.
- 25 ((singl* or doubl* or trebl* or tripl*) adj7 (blind* or mask*)).tw.
- 26 (cross?over* or (cross adj1 over*)).tw.
- 27 ((allocat* or allot* or assign* or divid*) adj3 (condition* or experiment* or intervention* or treatment* or therap* or control* or group*)).tw.
- 28 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27
- 29 13 and 28

Appendix 2B.iv Search strategy SPORTDiscus

S31 S19 AND S30
S30 S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29
S29 ((allocat* or allot* or assign* or divid*) N3 (condition* or experiment* or intervention* or treatment* or therap* or control* or group*))
S28 (cross?over* or (cross N1 over*))
S27 ((singl* or doubl* or trebl* or tripl*) N7 (blind* or mask*))
S26 (random* N7 (allocat* or allot* or assign* or basis* or divid* or order*))
S25 ((clinical or controlled or comparative or placebo or prospective* or randomi?ed) N3 (trial or study))
S24 TI trial
S23 AB randomly
S22 AB placebo
S21 AB randomized
S20 AB Clinical
S19 S11 AND S18
S18 S12 OR S13 OR S14 OR S15 OR S16 OR S17
S17 self care
S16 advice
S15 information
S14 self management
S13 patient education
S12 education
S11 S1 OR S10
S10 S8 AND S9
S9 S5 OR S6 OR S7
S8 S2 OR S3 OR S4
S7 AB Knee
S6 TX Knee
S5 TI Knee
S4 AB (osteoarthr* or osteo-arthr*)
S3 TX (osteoarthr* or osteo-arthr*)
S2 TI (osteoarthr* or osteo-arthr*)
S1 osteoarthritis, knee/

Appendix 2B.v Search strategy Web of Science

#26 #25 AND #13

DocType=All document types; Language=All languages;

#25 #24 OR #23 OR #22 OR #21 OR #20 OR #19 OR #18 OR #17 OR #16 OR #15 OR #14

DocType=All document types; Language=All languages;

#24 TS=((allocat* OR allot* OR assign* OR divid*) NEAR/3 (condition* OR experiment* OR intervention* OR treatment* OR therap* OR control* OR group*))

DocType=All document types; Language=All languages;

#23 TS=(cross?over* OR (cross NEAR/1 over*))

DocType=All document types; Language=All languages;

#22 TS=((singl* OR doubl* OR trebl* OR tripl*) NEAR/7 (blind* OR mask*))

DocType=All document types; Language=All languages;

#21 TS=(random* NEAR/7 (allocat* OR allot* or assign* OR basis* OR divid* OR order*))

DocType=All document types; Language=All languages;

#20 TS=((clinical OR controlled OR comparative OR placebo OR prospective* OR randomized OR randomised) NEAR/3 (trial OR study))

DocType=All document types; Language=All languages;

#19 TI=trial

DocType=All document types; Language=All languages;

#18 TS=randomly

DocType=All document types; Language=All languages;

#17 TS=placebo

DocType=All document types; Language=All languages;

#16 TI=(randomized OR randomised)

DocType=All document types; Language=All languages;

#15 TS=Randomized Controlled Trial

DocType=All document types; Language=All languages;

#14 TS=Clinical trials

DocType=All document types; Language=All languages;

#13 #12 AND #5

DocType=All document types; Language=All languages;

#12 #11 OR #10 OR #9 OR #8 OR #7 OR #6

DocType=All document types; Language=All languages;

#11 ALL=self care

DocType=All document types; Language=All languages;

#10 ALL=advice

DocType=All document types; Language=All languages;

#9 ALL= information

DocType=All document types; Language=All languages;

#8 ALL=self management

DocType=All document types; Language=All languages;

#7 ALL=patient education

DocType=All document types; Language=All languages;

#6 TS=education

DocType=All document types; Language=All languages;

#5 #4 OR #1

DocType=All document types; Language=All languages;
#4 #3 AND #2
DocType=All document types; Language=All languages;
#3 ALL=knee
DocType=All document types; Language=All languages;
#2 ALL=(osteoarthr* or osteo-arthr*)
DocType=All document types; Language=All languages;
#1 TS= osteoarthritis, knee
DocType=All document types; Language=All languages;

Appendix 2C – Summary of Grading of Recommendations, Assessment, Development and Evaluations (GRADE) upgrade and downgrade criteria.

	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations
Serious downgrade (–1) if:	Only included one study rated as low risk of bias	Heterogeneity 41 to 60%	Variation in one of: <ul style="list-style-type: none"> • outcome measures used • timepoints when outcome assessed • differences between education interventions delivered 	Size of CI between 0.5 and 1	Publication bias strongly suspected if < 10 studies included, which is the minimum recommended for funnel plot analysis
Very serious downgrade (–2) if:	Did not include any study rated as low risk of bias	Heterogeneity > 60%	Variation in two or more of: <ul style="list-style-type: none"> • outcome measures used • timepoints when outcome assessed • differences between education interventions delivered timeframes used 	Size of CI > 1	
Upgrade (+1) if:	All studies were low risk of bias	N/A	N/A	N/A	Effect size > 1

CI = confidence interval, - = minus, + = plus, N/A = not applicable, > = greater than, < = Less than

Appendix 2D – Reasons for exclusion

Study	Decision in manuscript	Additional notes
Ageberg et al 2013	Wrong study type	Non-randomised trial
Ahn et al 2020	Unable to acquire correct data from authors	Authors did not reply to emails
Beupre et al 2004	Wrong interventions	Total knee arthroplasty
Bennell et al 2017a	Unable to acquire correct data from authors	Unable to acquire data from authors – due to legal issues
Bennell et al 2017b	wrong study type - unable to assess education	Chronic knee pain rather than diagnosis of knee OA Additionally this was self-directed education (control) versus self-directed education + therapist-facilitated education + exercise therapy
Bezalel et al 2010	Unable to acquire correct data from authors	Authors did not reply to emails
Bossen et al 2013a	Wrong study type	Part of a randomised controlled trial. This paper only looked at intervention arm
Bossen et al 2013b	Unable to acquire correct data from authors	Authors did not reply to emails
Buszewicz et al 2006	Unable to acquire correct data from authors	Authors replied, but data no longer available due to retirement and change of staff. The authors did not think they would have the split of knee only data
Callaghan et al 1995	Unable to acquire correct data from authors	Authors replied, but data no longer available (on a floppy disk that is corrupt)
Coleman et al 2008	Wrong study type	Quality assurance study – no control
Cooke et al 2016	Unable to acquire correct data from authors	Authors replied, were unable to split data for knee only
Crossley et al 2015	Wrong study type (? interventions)	Interventions were multimodal physiotherapy interventions with therapist-facilitated education versus a different form of therapist-facilitated education
Crotty et al 2009	Unable to acquire correct data from authors	Authors did not reply to emails

Culliton et al 2018	Wrong interventions	Total knee arthroplasty
Da Silva et al 2015	Wrong intervention to assess effects of education	Removed since revision based on reviewer comments
da Silva et al 2017	Wrong study type	Longitudinal design
de Oliveira et al 2012	Wrong study type (? interventions)	Self-directed education + exercise therapy versus self-directed education + therapist-facilitated education
Doiron-Cardin et al 2020	Wrong study type (? interventions)	All exercise therapy focused
Dowsey et al 2014	Wrong study type	Protocol
Eschaliier et al 2017	Wrong study type (? interventions)	Different education + arthroplasty. Unable to assess effectiveness of education
Focht et al 2005	Wrong outcomes	Did not report WOMAC outcomes
Foy et al 2011	Wrong participants	Obese individuals – not necessarily knee OA
Gaines et al 2002	Wrong study type	Abstract only
Gaines et al 2004	Wrong outcomes	Did not use any of the current primary or secondary outcomes
Gay et al 2019	Wrong study type (? interventions)	SPA + self-directed education + exercise therapy versus SPA + self-directed education
Gwynne- Jones et al 2018	Wrong study type	Not a randomised controlled trial
Hansson et al 2010	Wrong outcomes	Emailed author for data – they broke down ASES rather than total
Hausmann et al 2018	Wrong intervention	Intervention was a positive psychological intervention rather than education
Hay et al 2006	Wrong study type (? interventions)	Pharmacy/medication based rather than true education
Heuts 2004	Unable to acquire correct data from authors	Authors did not reply to emails
Hinman et al 2018	Wrong study type	Cross-sectional design
Hinman et al 2017	Wrong study type	Protocol
Holm et al 2020	Wrong study type (? interventions)	ST + NMEX + EDU versus NMEX + EDU
Holsgaard Larsen et al 2017	Unable to acquire correct data from authors	Authors did not reply to emails
Holsgaard Larsen et al 2018	Unable to acquire correct data from authors	Authors did not reply to emails

Hopman-Rock and Westhoff 2000	Wrong study type (? interventions)	Education and exercise versus usual care
Huang et al 2000	Wrong interventions	Weight loss
Huang et al 2012	Wrong outcomes	Length of stay and total knee arthroplasty
Huber et al 2015	Wrong interventions - TKR	Interventions included total knee arthroplasty; therefore, could not assess the effects of education
Hunt et al 2013	Wrong intervention to assess effects of education	Removed since revision based on reviewer comments
Jenkins et al 2008	Wrong outcomes	Oxford knee score and ROM
Jenkinson et al 2009	Unable to acquire correct data from authors	Authors did not reply to emails
Jiminez et al 2014	Wrong population	
Jonsson et al 2018	Wrong study type	Not a randomised controlled trial
Keefe 1996	Inability to assess education	
Keefe 1999	Inability to assess education	
Kline et al 2019	Wrong study type	Protocol
Kloek et al 2018	Unable to acquire correct data from authors	Authors responded initially but were unable to provide data
Kwok et al 2016	Wrong population	Broad inclusion criteria not specific to knee OA
Leal-Blanket et al	Wrong study type	Involved total knee arthroplasty so could not tell effects of education
Lee et al 2012	Wrong outcomes	Did not assess any of the current primary or secondary outcomes
Lin et al 2014	Wrong study type	Reference control group – non-randomised
Linekar et al 2011	Wrong study type	Survey
Lluch et al 2018	Wrong interventions	Involved total knee arthroplasty; therefore, could not tell effects of education
Losina et al 2013	Wrong study type	Protocol rationale
Marconcin et al 2018	Wrong study type	Education interventions were too different to be able to assess with/without exercise therapy
Marra et al 2012	Unable to acquire correct data from authors	Authors replied with limited additional information that was unsuitable for the review. They no longer had access to full database
Martire et al 2007	Wrong population	Hip and knee OA, plus had additional criteria

Mazzuca et al 1997	Wrong outcomes	Did not include any of the current primary or secondary outcomes
Mazzuca et al 2004	Wrong intervention	Focused on medication use rather than true education
McKnight et al 2010	Unable to acquire correct data from authors	Authors did not reply to emails
Mecklenburg et al 2018	Wrong population	Young population with various forms of knee pain
Miller et al 2006	Wrong study type - unable to assess education	Weight loss included supplements/shakes in addition to exercise
Moe et al 2016	Unable to acquire correct data from authors	Authors initially replied but then did not provide additional information
Murphy et al 2016	Unable to acquire correct data from authors	Authors did not reply to emails
Nobi et al 2012	Wrong study type (? interventions)	NSAIDS + exercise therapy versus NSAIDS + exercise therapy + advice
Nunez et al 2006	Wrong study type (? interventions)	Combinations of education + medications + exercise therapy unable to tell effects of education
Omidi et al 2018	Wrong outcomes	Did not include any of the current primary or secondary outcomes
Palmer et al 2014	Wrong study type - unable to assess education	Combinations of TENS (real or sham) + education + exercise therapy – cannot assess education
Paz 2008	Wrong study type	Abstract only
Pelle et al 2020	Unable to acquire correct data from authors	Authors did not reply to emails
Peloquin et al 1999	Wrong outcomes	Did not include any of the current primary or secondary outcomes
Ravaud et al 2009	Unable to acquire correct data from authors	Authors did not reply to emails
Rene et al 1992	Wrong study type	Secondary analysis
Riddle et al 2011	Wrong study type	Non-randomised
Rini et al 2015	Unable to acquire correct data from authors	Authors did not reply to emails
Rooks et al 2006	Wrong interventions	Involved total knee arthroplasty
Roseman et al 2007	Unable to acquire correct data from authors	Authors did not reply to emails

Saffari et al 2018	Unable to acquire correct data from authors	Authors did not reply to emails
Skou et al 2015	Wrong study type	Therapist-facilitated education + exercise therapy versus self-directed education – interventions too different
Skou et al 2016	Wrong study type	Therapist-facilitated education + exercise therapy versus self-directed education – interventions too different
Somers et al 2012	Unable to acquire correct data from authors	Author responded to email; however, provided pooled results from various timepoints only
Talbot et al 2003	Wrong outcomes	Did not include any of the current primary or secondary outcomes
Timmers et al 2018	Wrong outcomes	Did not include any of the current primary or secondary outcomes
Tuzun et al 2012	Wrong study type	Appeared to be non-published Word document
Umapathy et al 2015	Wrong study type	Non-randomised controlled trial
van Baar et al 2001	Wrong interventions	Cannot assess effectiveness of education – usual care (which included education) versus exercise
Veenhoff et al 2006	Wrong intervention	Behavioural graded activity versus usual care
Vina et al 2016	Wrong outcomes	Investigated willingness to undergo surgery
Wang et al 2018	Wrong population	Population were aged 18 to 50 years
Wetzels et al 2008	Unable to acquire correct data from authors	Authors did not respond to emails
Williams et al 2011	Wrong interventions	Compared two different booklets, did not assess the primary or secondary outcomes
Williamson et al 2007	Wrong interventions	Acupuncture versus physiotherapy versus control – unable to assess effectiveness of education
Williamson et al 2017	Wrong study type	Commentary paper/abstract
Wu et al 2011	Wrong study type	Exercise + education versus usual care; therefore, could not assess effectiveness of education
Yip et al 2017a	Wrong study type	Education + tai chi versus usual care; therefore, could not assess effect of education
Yip et al 2007b	Wrong study type - unable to assess education	Education + exercise versus usual care; therefore, could not assess effect of education
Yip et al 2008	Wrong study type - unable to assess education	Education + exercise versus usual care; therefore, could not assess effect of education

ST= Strength, NEMEX = Neuromuscular exercise program, EDU = Education, OA = Osteoarthritis, WOMAC = Western Ontario and MacMaster Universities Osteoarthritis Index, TKR = Total knee replacement, NSIADS = Non-steroidal anti-inflammatories, TENS = Transcutaneous neuromuscular stimulation

Appendix 2E – Template for intervention description and replication (TIDieR) table for included interventions

Study	Intervention type	Provider	How	Where	When and how much	Tailoring	How well	What	Education used as control intervention?
Ackerman et al 2012	Patient education (therapist-facilitated)	'Peer leader' and health professional leader	Face-to-face + written materials	Community and hospital locations	6 x 2.5-hr weekly group classes	NR	Number of dropouts reported	Covered management of pain, fatigue, physical activity, emotions, health-related problem solving and communication with doctors. Plus provided with arthritis self-help book.	No
	Patient education (self-directed)	NA	Written materials	NA	NA	NA	NA	Provided with arthritis self-help book	Yes
Allen et al 2010 ^a	Patient education (therapist-facilitated)	Health educator	Telephone calls + written and audio materials	NA	Monthly telephone calls for 12 months	Individualised goals, opportunity to ask questions on telephone calls and ability to select ordering of modules	Log of goals	Covered managing OA symptoms, goal setting and action plans related to OA management. Plus provided with written and audio materials covering basic information on OA and self-management concepts, exercise, healthy eating and weight management, medications, joint injections and surgery, communication with healthcare providers, joint care and	No

								protection, complementary and alternative medicines, stress management, and relaxation and sleep. Plus provided with an exercise video designed for people with OA.	
	Usual care	NA	NA	NA	NA	NA	NA	NA	NA
Allen et al 2016	Patient education (therapist-facilitated)	Counsellor	Telephone calls + written and audio materials	NA	Twice-monthly telephone calls for first 6 months followed monthly for 6 months	Individualised goals and ability to focus on weight loss or physical activity	Log of telephone calls and goals	Covered basic information on OA, physical activity, weight management, healthy eating, pacing, breathing relaxation, cognitive behavioural pain management strategies, goal setting and action planning. Plus provided with written material relating to interventional topics, an exercise video and an audio CD for relaxation.	No
	Usual care	NA	NA	NA	NA	NA	NA	NA	NA
Allen et al 2019	Patient education (therapist-facilitated)	Counsellor	Telephone calls + written and audio materials	NA	11 x 30–45 min weekly telephone calls	Individualised goals	Log of goals	Covered cognitive behavioural and pain coping skills training, progressive muscle relaxation, communication with significant others about pain and coping, managing mood, activity pacing, pleasant activities, pleasant	N

								imagery + distraction techniques, physical activity, weight management, problem solving, and relapse prevention/maintenance.	
	Usual care	NA	NA	NA	NA	NA	NA	NA	NA
Ay et al 2013 ^a	Patient education (therapist-facilitated) + exercise therapy	Physician provided education	Face-to-face + written material	Clinic	1 x 1-hr group lecture	NA for booklet	NR	Therapist facilitated education covering basic information about knee OA, knee joint anatomy, risk factors (weight gain, occupational repetitive trauma, etc) and the ways to avoid them (losing weight, trauma and overuse prevention, modification in activities of daily living, etc), self-management strategies (eg, hot-cold applications).	No
		Physiotherapist provided exercise therapy			1 x individual session for exercise + home exercise program	Standardised progression for exercises			
	Exercise therapy	Physiotherapist	Face-to-face + written	Clinic	1 x individual session for exercise + home exercise program	Standardised progression for exercises	NR	Exercise therapy: isometric quads contraction, straight leg raise and seated knee extensions with weight.	NA

Baker et al 2001	Patient education (therapist-facilitated)	Physician	Face-to-face + written materials	Home	7 x home visits every 2 weeks for 4 months	Goal setting individualised	Food logs	Covered healthy eating using the food pyramid and goal setting	Yes
	Exercise therapy	NR	Face to face + written HEP	Home	Home visits 2 x per week for the first 3 weeks, once in week 4, and once every 2 weeks for a total of 12 visits in 16 weeks	Individualised	Logbooks	Squats, step-ups, knee extension, knee flexion, hip extension, hip abduction and hip adduction	NA
Bennell et al 2016	Patient education (therapist-facilitated)	Physiotherapist	Face-to-face + telephone calls	Clinic	10 x 45-min sessions over 12 weeks, plus a home-based program, plus telephone calls at weeks 22, 38 and 46	Individualised barriers	Logbooks	Covered pain education and training in cognitive and behavioural pain coping skills (activity-rest cycling, pleasant activity scheduling, problem solving, identifying and challenging negative thoughts, developing coping thoughts, pleasant imagery, counting backwards, and auditory stimulation) and their application	No

	Exercise therapy	Physiotherapist	Face-to-face + telephone calls	Clinic	10 x 25-min sessions over 12 weeks plus a home-based program Performed 4 x weekly for 12 weeks and 3 x weekly thereafter Plus telephone calls at weeks 22, 38 and 46	Individualised	Logbooks	Exercise comprised six exercises to strengthen the quadriceps, hamstrings, and hip abductor muscles	NA
	Patient education (therapist-facilitated) + exercise therapy	Physiotherapist	Face-to-face + telephone calls	Clinic	As above combined	As above combined	As above combined	Combination of therapist-facilitated education and exercise therapy interventions	No
Brosseau et al 2016 ^a	Patient education (self-directed)	NA	Written materials	NA	NA	NA	Pedometers and logbooks	Covered walking and OA	Yes
	Patient education (self-directed) + exercise therapy	NA for education Physical activity specialist for exercise therapy	Written materials + walking program	NA for education Community walking clubs for exercise therapy	NA for education 3 x weekly sessions for 12 months	NA Individualised	Pedometers and logbooks	Self-directed education Covered walking and OA Exercise therapy Walking intervention - warm-up, consisting of light aerobic exercises, aerobic walking phase	No

								and cooldown consisting of light aerobic exercises and stretching	
Chen et al 2019	Patient education (therapist- facilitated)	Physiotherapists	Face-to- face + telephone call	Community health centres	4 x 2-hr group sessions for 12 weeks	NR	Attendance and adherence of education recorded via telephone calls	Covered clinical manifestations, risk factors, clinical examination and diagnosis, treatment and nursing care for knee OA, the benefits of exercise, the home environment, and information about daily care for knee OA	Yes
	Patient education (therapist- facilitated) + exercise therapy	Physiotherapists	Face-to- face + telephone call	Community health centres	4 x 2-hr sessions over 12 weeks	NR	Attendance and adherence of education and exercise recorded via telephone calls	Therapist-facilitated education Covered clinical manifestations, risk factors, clinical examination and diagnosis, treatment and nursing care for knee OA, the benefits of exercise, the home environment, and information about daily care for knee OA. Plus provided with a paper version of material titled <i>Health Knowledge and Home Exercise Guide for KOA</i> in order to consolidate their	No

								memory of health knowledge and exercise programs.	
								Exercise therapy: isometric quads, supine straight leg lifts, leg lifts in prone position, passive knee flexion, passive knee extension, resistance knee extension, resistance knee flexion, shifting centre of gravity (left and right), shifting centre of gravity (forwards and backwards)	
Cheung et al 2017 ^b	Patient education (therapist-facilitated)	Research assistant	Telephone calls + written materials	NA	8 weekly telephone calls	NR	Attendance recorded	Phone calls asked participants about their OA symptoms and general health status; written information covered how to manage OA pain, and physical activity and exercise for OA.	Yes
	Exercise therapy (aerobic + resistance)	Certified arthritis instructor	Face-to-face + home exercise program	Community centre or senior housing complex	8 weekly group sessions 45 mins each	NR	Attendance and exercise adherence recorded	Mild aerobic exercise warm up, strengthening exercises including both isometric and isotonic exercises including head rotations, shoulder flexion/extension, torso 360° rotation (circles in both direction), shoulder	NA

								circles, marching in place, heel and toe raises, overhead arm reaches, side bends, torso twist (gentle 30°), seated side steps alternating sides, and ankle circles. Props such as elastic bands and chairs were used during the class.	
Cheung et al 2020	Patient education (therapist-facilitated)	Registered nurse	Face-to-face	NR	2 x 1.5-hr sessions a week for 6 weeks + 2 x weekly telephone calls	NR	Logbook for self-care strategies	Covered minimisation of weight bearing on the knee joints and avoidance of prolonged standing or walking. Plus provided with a written summary of the health education content and a progress log for recording the use of self-care strategies were distributed.	Yes
	Acupressure	Chinese Medicine practitioner	Face-to-face	NR	2 x 1.5-hr sessions a week for 6 weeks + 2 x weekly telephone calls	NR	Log book for acupressure	Warm-up, acupressure (of 8 points), rubbing the kneecap and moving the knee, based on traditional Chinese medicine meridian theory.	NA
Coleman et al 2012	Patient education (therapist-facilitated)	Nurses, physiotherapists and occupational therapists	Face-to-face	Community	6 x weekly 2.5-hr group sessions	Goal setting individualised	Attendance recorded	Covered OA (explanation and implications), self-management skills (goal-setting, problem-solving, modelling,	No

								positive thinking and improving self-efficacy), medications (types, interactions and current trends), correct use of analgesia (use, therapeutic dosing, types and side effects), pain management strategies (cognitive and pharmacologic), fitness and exercise (strength, flexibility, aerobic and balance), joint protection, nutrition and weight control, fall prevention (balance and proprioception), environmental risks, polypharmacy and coping with negative emotions.	
	Usual care	NA	NA	NA	NA	NA	NA	NA	NA
De Rezende et al 2016 ^b	Patient education (therapist-facilitated)	Orthopaedic surgeons, psychologists, social workers, nutritionist, occupational therapists, physiotherapists and physical educators	Face-to-face plus DVD	Acute hospital	2 days of lectures 1 month apart	NR	NR	Covered knee joint anatomy, the pathology of OA (causes, irreversibility and management), coping skills, exercise and the difference between exercise and physical labour, optimal ergonomics, altering energy expenditure, diet, leisure activities.	No

								The DVD had the three workshops (physical therapy, fitness, and occupational therapy and all seven explanatory lectures.	
	Patient education (self-directed)	NA	DVD viewing + written materials	Acute hospital	2.23 hrs DVD	NR	NA	The DVD had the three workshops (physical therapy, fitness, and occupational therapy and all seven explanatory lectures.	Yes
De Rezende et al 2017 ^b	Patient education (therapist-facilitated)	Orthopaedic surgeons, psychologists, social workers, nutritionist, occupational therapists, physiotherapists and physical educators	Face-to-face plus DVD	Acute hospital	2 days of lectures 1 month apart	NR	NR	Covered knee joint anatomy, the pathology of OA (causes, irreversibility and management), coping skills, exercise and the difference between exercise and physical labour, optimal ergonomics, altering energy expenditure, diet, leisure activities. The DVD had the three workshops (physical therapy, fitness, and occupational therapy) and all seven explanatory lectures.	No
	Patient education (self-directed)	NA	DVD viewing + written materials	Acute hospital	2.23 hrs DVD	NR	NA	The DVD had the three workshops (physical therapy, fitness, and occupational therapy) and all seven explanatory lectures.	Yes

Dias et al 2017	Patient education (therapist- facilitated)	Physiotherapist	Face-to- face + telephone calls	Classroom at Outpatient Physiotherapy Clinic at UFMG/Brazil + homes for calls	1 x group session + 1 x weekly telephone calls	Individualised - opportunity for discussion	NR	Covered the diagnosis, symptoms, prognosis, and basic care of knee OA during daily activities. Plus weekly advice via telephone about controlling knee loading during daily activities during six consecutive wks.	Yes
	Patient education (therapist- facilitated) + exercise therapy	Physiotherapist	Face-to- face	Classroom and pool at Outpatient Physiotherapy Clinic	1 x group session 2 x weekly for 6 weeks for 40 mins each session	Individualised - opportunity for discussion Individualised	NR	Therapist-facilitated education covered the diagnosis, symptoms, prognosis, and basic care of knee OA during daily activities. Exercise therapy: Hydrotherapy - warm- up exercises consisted of walking in the water in increasing velocity followed by stretching exercises of the anterior and posterior muscles of the lower limbs that included closed kinetic chain exercises using floats as well as multidirectional walking tasks. The cool-down session consisted of light walking followed by breathing exercises. Before leaving the pool,	No

								the participants also performed a relaxation exercise session using circular floats.	
Ettinger et al 1997 ^b	Patient education (therapist-facilitated)	Nurse delivered education + phone calls	Face-to-face + telephone calls	University	Months 1–3 monthly 1.5-hr education sessions Months 4 through 6, bi-weekly telephone calls Months 7 through 18 monthly telephone calls	Individualised - Opportunities to ask questions	NR	Face-to-face covering topics related to OA, including physical activity and exercise, a question and answer session and a social period. Plus participants were provided at each session with educational materials from the Arthritis Foundation pertinent to each of the monthly topics. Telephone calls: patients were asked about their arthritis, general health status, and any problems with medications, plus given an opportunity to ask questions or voice concerns about their disease.	Yes

	Exercise therapy (resistance)	NR	Face-to-face + telephone calls	University	Months 1 to 3 facility-based resistance program, 3 x weekly for 1 hr each Months 4 to 6 home-based resistance program, four home visits and six telephone calls Months 6 to 9 home-based resistance program and telephone calls every 3 weeks Months 10 to 18 home-based resistance program plus monthly telephone calls	Individualised	Logbooks	Warm-up, strengthening (nine exercises were leg extension, leg curl, step-up, heel raise, chest fly, upright row, military press, biceps curl, and a pelvic tilt) cool down.	No
Farr et al 2010	Patient education (therapist-facilitated)	NR	Face-to-face + telephone calls	Classroom	1 x 1.5-hr session per week for 12 weeks followed by 24 weeks of a structured telephone	NR	NR	Covered coping skills, promoting the use of more adaptive strategies and fewer avoidance or passive strategies based on existing self-help programs, self-efficacy skills (increasing	No

				intervention (no further details)			perceptions of control for physical functioning, pain management, and other ancillary arthritis symptoms), overview of OA, general exercise principles, physical activity recommendations, stress management, foot care, pain management, analgesic and anti- inflammatory medications, nutrition for health, coping mechanisms, communication with healthcare providers, and healthy lifestyle practices.	
Exercise therapy	Physical trainers	Face-to- face	NR	3 x 1-hr sessions a week for 9 months, with a minimum of 1 day of rest between training sessions	Individualised	Log books	Warm-up on either a bicycle ergometer or treadmill at 50% maximum heart rate, stretching and balance exercises, ROM exercises, resistance training exercises, and cool-down. Specific RT exercises included leg press, leg curl, hip abduction and adduction, straight leg lift, incline dumbbell press, seated row, and calf raise.	NA

	Patient education (therapist-facilitated) + exercise therapy	As above combined	As above combined	As above combined	As above combined	As above combined	As above combined	As above combined	No
Ganji et al 2018	Patient education (therapist-facilitated)	NR	Face-to-face (with or without telephone calls)	NR	2 x 1-hr sessions per week for 3 weeks followed by telephone calls	Opportunities to ask questions	NR	NR	Yes
	Usual care	NA	NA	NA	NA	NA	NA	NA	NA
Helminen et al 2015	Patient education (therapist-facilitated)	Psychologist and physiotherapist	Face-to-face	NR	2-hr session weekly for 6 weeks	Individualise: identification of own pain issues and problem solving	Attendance logged	Cognitive behavioural intervention. Sessions consisted of an outline of the sessions included an introduction, lecture (knowledge and insight), problem solving, skills training, homework assignments, and a résumé (feedback) of the session.	No
	Usual care	GP	NA	NA	NA	NA	NA	NA	NA
Hinman et al 2020	Patient education (therapist-facilitated)	Nurses	Telephone calls	NA	1 x telephone call with a nurse, plus additional calls if required	NR	NR	Covered information about OA, treatments and self-management strategies, community resources, assistance navigating services, emotional support and care escalation when needed	Yes

Patient education (therapist-facilitated) + exercise therapy	Nurses + physiotherapists	Telephone calls + written online materials	NA	1 x telephone call with a nurse, plus additional calls if required	NR	NR	Therapist-facilitated education covered information about OA, treatments and self-management strategies, community resources, assistance navigating services, emotional support and care escalation when needed.	No
				5 to 10 telephone calls with a physiotherapist over 6 months	Individualised	Exercise adherence	Exercise therapy: home-based strengthening exercise and physical activity. For strengthening, physiotherapists chose from a list of 14 exercises, aiming for five to six exercises performed three times per wk. Physiotherapists assisted participants to develop a physical activity plan aimed at increasing physical activity. To support the intervention, participants were provided with an information folder, exercise bands, and access to a bespoke website for exercise videos.	

Keefe et al 2004	Patient education (therapist-facilitated)	Psychologists	Face-to-face	NR	1 x 2-hr session weekly for 12 weeks	Individualised	Attendance tracked	Covered coping skills training, pain as a complex experience, that can be influenced by thoughts, feelings, and behaviours, importance of frequent practise.	No
	Exercise therapy	Exercise physiologist	Face-to-face	NR	3 x 1-hr sessions a week for 12 weeks	Individualised	Attendance tracked	Included cardiopulmonary endurance training, strength training and flexibility/range of motion training.	NA
	Patient education (therapist-facilitated) + exercise therapy	Psychologist + exercise physiologist	Face-to-face	NR	As above combined	Individualised	Attendance tracked	Combination of therapist-facilitated education and exercise therapy	No
	Usual care	NA	NA	NA	NA	NA	NA	NA	NA
Messier et al 2004 ^a	Patient education (therapist-facilitated) (healthy lifestyle group)	Health educator	Face-to-face + telephone calls	Older Americans Independence Centre of Wake Forest University	Months 1 to 3 1 x 1-hr session a month Months 4 to 6 telephone calls monthly (transition) Months 7 to 18 telephone calls every other month (maintenance)	Individualised Q & A sessions	Attendance recorded	Covered OA, obesity, and exercise. Patients were advised to follow the ACR and EULAR recommendations for weight loss and exercise as treatments for OA. During telephone calls, information on pain, medication use, illnesses, and hospitalisation was obtained	Yes

Patient education (therapist-facilitated, weight loss focus)	NR	Face-to-face + telephone calls	Older Americans Independence Centre of Wake Forest University	<p>1 x individual session</p> <p>16 x weekly sessions (three group sessions and one individual session each month)</p> <p>4 x sessions every other week for 8 weeks (three group sessions and one individual session) (transition)</p> <p>1 x session a month + telephone calls every other week (maintenance)</p>	Individualised weight loss targets	Attendance recorded	The goal of the dietary intervention was to produce and maintain an average weight loss of 5% during the 18-month intervention period. The major emphasis was to heighten awareness of the importance of and need for changing eating habits in order to lower calorie intake. Behaviour change was facilitated using self-regulatory skills including self-monitoring, goal setting, cognitive restructuring, problem solving, and environmental management. Food tasting was also performed.	No
Exercise therapy	NR	Face-to-face + telephone calls	NR	<p>Months 1 to 4</p> <p>3 x weekly faculty-based exercise program</p> <p>2 months transition phase</p>	Individualised	Exercise logs and attendance recorded	<p>Aerobic (walking), resistance-training, a second aerobic and a cooldown phase</p> <p>The resistance-training portion of the program consisted of two sets of 12 repetitions of the</p>	NA

				alternating attendance between the facility and the home (transition)			following exercises: leg extensions, leg curls, heel raises and step-ups. Cuff weights and weighted vests were used to provide resistance.	
				Telephone calls every other week during the first 2 months of home-based exercise, every third week during the following 2 months, and monthly thereafter (maintenance)				
Patient education (therapist-facilitated, weight loss focus) + exercise therapy	NR	Face-to-face + telephone calls	Older Americans Independence Centre of Wake Forest University	Combination of patient education (therapist-facilitated, weight loss focus) plus exercise therapy interventions	Combination of patient education (therapist-facilitated, weight loss focus) plus exercise therapy interventions	Combination of patient education (therapist-facilitated, weight loss focus) plus exercise therapy interventions	Combination of patient education (therapist-facilitated, weight loss focus) plus exercise therapy interventions	No

Murphy et al 2018	Patient education (therapist-facilitated)	Occupational therapist and videos of other health professionals	Face-to-face + web-based materials	NR	8 x 1-hr sessions weekly	Individualised goals	Attendance recorded	Face-to-face covered lifestyle changes to help manage OA symptoms through self-monitoring and goal setting, general information about OA. Web-based program covered exercise, sleep hygiene, pleasant activity scheduling, relaxation, activity pacing, problem solving, and a wrap-up session that focused on further goal attainment.	No
	Usual care	NA	NA	NA	NA	NA	NA	Usual care	NA
O'Brien et al 2018	Patient education (therapist-facilitated)	Allied health professionals	Telephone call + web-based coaching service	Phone calls + internet materials	Up to 10 individually tailored coaching calls over a 6-month period	Individualised	Adherence tracked	Telephone calls covered benefits of weight loss and physical activity for knee OA. Web-based coaching service provided weight loss support, diet, physical activity and achieving a healthy weight, and where appropriate, access to smoking cessation services. Coaching telephone calls provided ongoing support using motivational	No

interviewing and self-regulation principles to support participants to overcome barriers, set goals and make positive and sustainable lifestyle and behaviour changes.

	Usual care	NA	NA	NA	NA	NA	NA	NA	NA
O'Moore et al 2018	Patient education (self-directed)	NA	Web-based materials	NA	NA	Individualised - ability to ask questions on emails and homework assignments	Adherence logged	Web-based cognitive behavioural therapy program consisting of six web-based lessons representing best-practice CBT, as well as regular homework assignments and access to supplementary resources. Each lesson comprised a cartoon narrative in which a character gained mastery over depressive symptoms by learning and implementing CBT skills.	No
	Usual care	NA	NA	NA	NA	NA	NA	NA	NA
Oh et al 2020	Patient education (therapist-facilitated)	Doctors, physical education professionals, nurses,	Face-to-face	Community	1 x 1-hr session monthly for 5 months	NR	NR	Covered the prevention and management of OA, lifestyle modification for pain management, self-care strategies for	Yes

	nutritionists, and exercise experts						pain relief, nutrition for weight management and ways to improve health- related quality of life.	
Patient education (therapist- facilitated)+ exercise therapy	Doctors, physical education professionals, nurses, nutritionists, and exercise experts	Face-to- face	Community	1 x 1-hr session monthly for 5 months Home-based exercise sessions, plus monthly home visit	Standardised	Logbook	Therapist-facilitated education covered the prevention and management of OA, lifestyle modification for pain management, self-care strategies for pain relief, nutrition for weight management and ways to improve health- related quality of life. Exercise therapy: warm-up including basic sitting and standing exercises. Main exercises – resistance band seated abduction, knee extension, leg press plus floor-based bridge, sit up, abdominal crunches, leg raise, adduction clam and superman.	No

Qingguang et al 2017	Patient education (therapist-facilitated)	NR	Face-to-face	NR	1 x 1-hr session per week for 24 weeks	Individualised - discussion	NR	Covered health-related topics such as: diagnostic criteria for knee OA, diet and nutrition, pain management, therapies, and medications, physical and mental health, exercise, and wellness and lifestyle management.	Yes
	Exercise therapy	Taijiquan master	Face-to-face	Key Laboratory of Exercise and Health Sciences in the Shanghai University of Sport.	3 x 1-hr session per week for 24 weeks	Individualised	Logbook	Taijiquan exercises that involved stepping in various directions (anterior-posterior, medial-lateral, and rotational), bilateral weight shifting between substantial and insubstantial leg support, and knee extension and flexion, as well as dorsal flexion and plantar flexion.	NA
Taglietti et al 2018	Patient education (therapist-facilitated)	Physician, pharmacist, nurse, nutritionist, psychologist, physiotherapist, and physical educator	Face-to-face + written materials	Primary care unit	1 x 2-hr session per week for 8 weeks	NR	NR	Covered guidance on the disease and its complications, strategies for pain control (cognitive and pharmacological), physical exercise, nutrition, and weight control, medications (type, interactions, side effects, and updates), balance, proprioception,	No

								preventing falls, and how to deal with chronic pain. Plus provided with home exercise program	
	Exercise therapy	Physiotherapist	Face-to-face	Aquatic physiotherapy centre	2 x 1-hr sessions a week for 8 weeks	NR	NR	Hydrotherapy: warm-up with walking, patellar mobilisation; stretching the leg muscles (quadriceps, gluteus, adductors and abductors of hip, triceps surae, and hamstrings), knee and hip isometric and dynamic exercises with elastic bands (gluteus, adductors and abductors, quadriceps, hamstrings, and triceps surae), aerobic exercises (stationary running or deep water-running), step training and proprioceptive exercises; and 10 mins of cool down with massage and relaxation	NA
Victor et al 2005	Patient education (therapist-facilitated)	Nurse	Face-to-face + written materials	GP practice + home visit	4 x 1-hr session	Individual goals discussed	Dropouts reported	Covered clinical information (about the disease, medication and other treatments), participatory activities (exercise and relaxation) to promote	No

								increased function, and skills development in coping (balancing rest and activity and strategies for pain management). Plus provided with a booklet specifically written for the study.	
Patient education (self-directed)	NA		Written materials	NA	NA	NA	NA	Provided with a booklet specifically written for the study	Yes

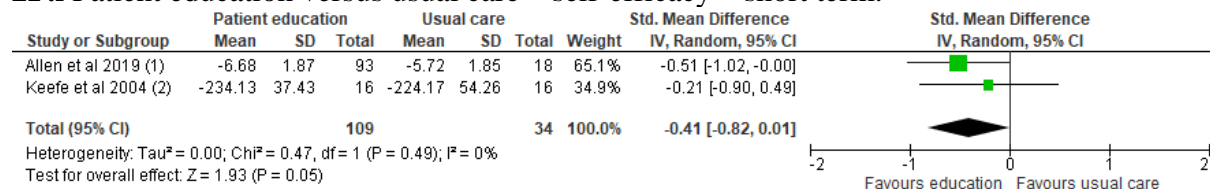
NR = not reported, NA = not applicable, OA = osteoarthritis

^a Trial included at least one other intervention group that was not used in analysis

^b Trial included at least one other intervention group that was used for sensitivity analysis

Appendix 2F – Detailed forest plots of the secondary outcomes (Fig 2.5 in app2.4)

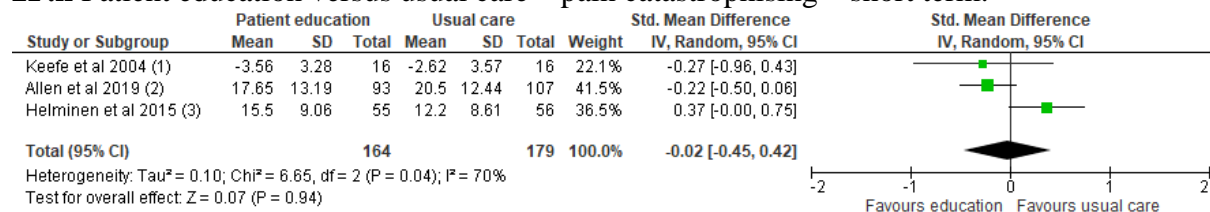
2F.i Patient education versus usual care – self-efficacy – short term.



Footnotes

- (1) ASES - 3 months - Inverted scoring
 (2) ASES - post intervention - Inverted scoring

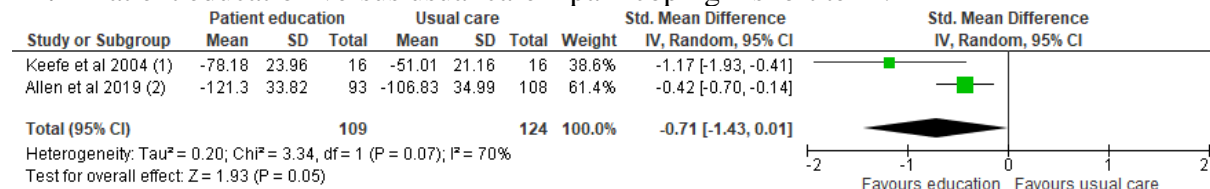
2F.ii Patient education versus usual care – pain catastrophising – short term.



Footnotes

- (1) CSQ - catastrophizing sub section - post intervention - Inverted scoring
 (2) PCS - 3 months
 (3) PCS - post intervention

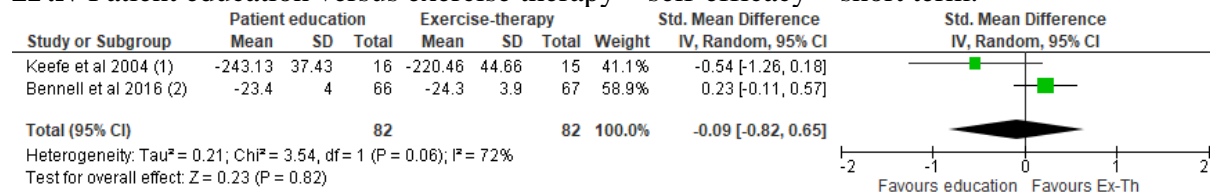
2F.iii Patient education versus usual care – pain coping – short term.



Footnotes

- (1) CSQ coping attempts - post intervention - inverted scoring
 (2) CSQ coping attempts - 3 months - inverted scoring

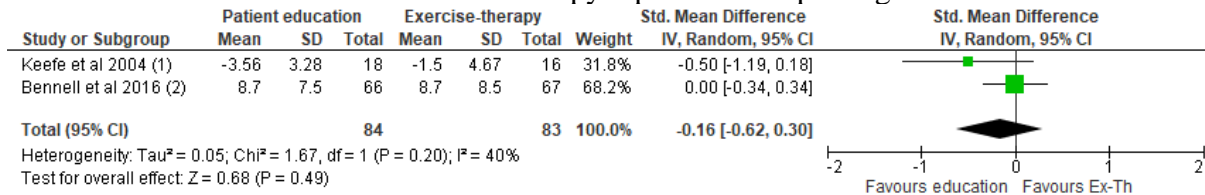
2F.iv Patient education versus exercise therapy – self-efficacy – short term.



Footnotes

- (1) ASES - post intervention - Inverted scoring
 (2) ASES - 3 months - Inverted scoring

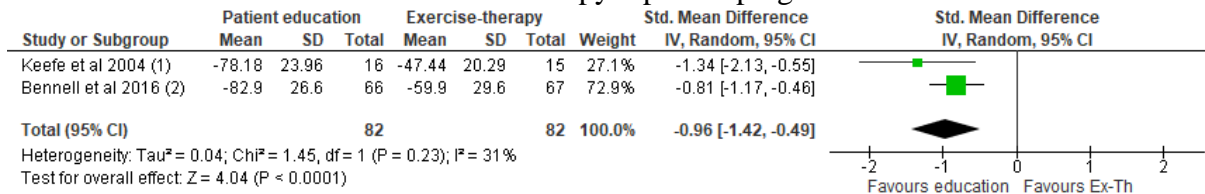
2F.v Patient education versus exercise therapy – pain catastrophising – short term.



Footnotes

- (1) CSQ - catastrophizing sub section - post intervention - inverted scoring
 (2) PCS - 3 months

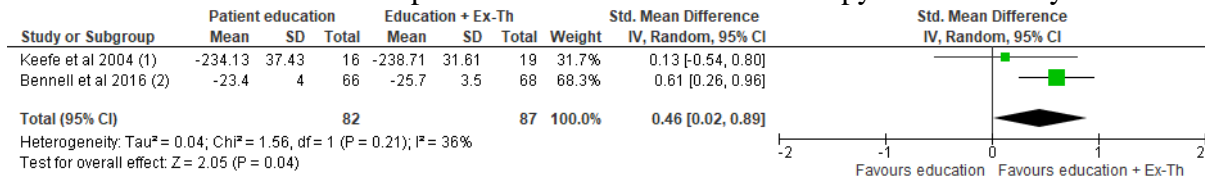
2F.vi Patient education versus exercise therapy – pain coping – short term.



Footnotes

- (1) CSQ coping attempts - post intervention - inverted scoring
 (2) CSQ coping attempts - 3 months - inverted scoring

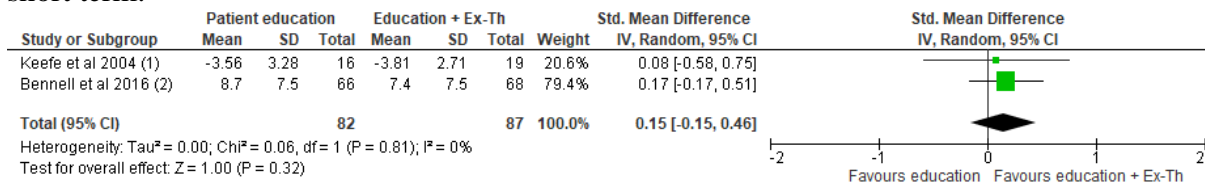
2F.vii Patient education versus patient education + exercise therapy – self-efficacy – short term.



Footnotes

- (1) ASES - post intervention - inverted scoring
 (2) ASES - 3 months - inverted scoring

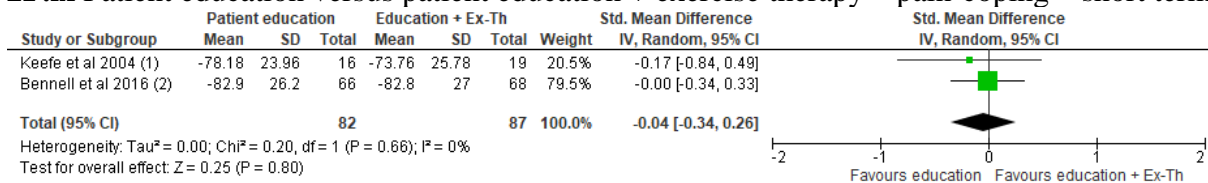
2F.viii Patient education versus patient education + exercise therapy – pain catastrophising – short term.



Footnotes

- (1) CSQ - catastrophizing sub section - Post intervention - inverted scoring
 (2) PCS - 3 months

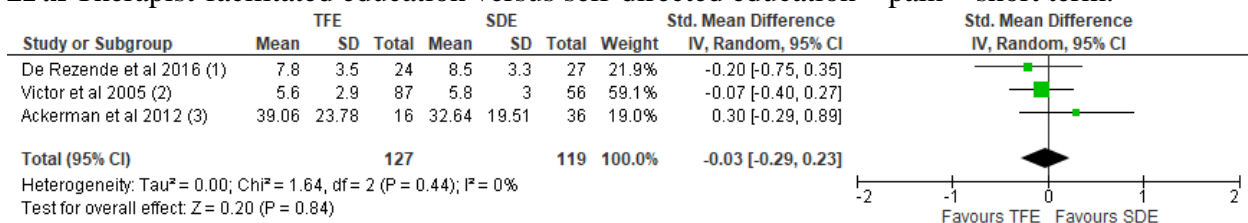
2F.ix Patient education versus patient education + exercise therapy – pain-coping – short term.



Footnotes

- (1) CSQ coping attempts - post intervention - inverted scoring
 (2) CSQ coping attempts - 3 months - Inverted scoring

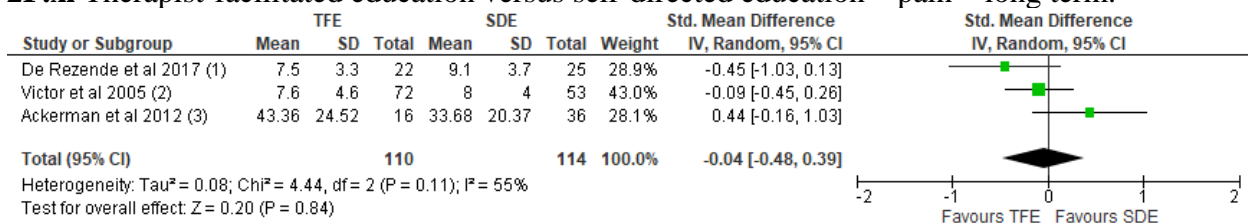
2F.x Therapist-facilitated education versus self-directed education – pain – short term.



Footnotes

- (1) WOMAC pain sub section - 4 months
 (2) WOMAC pain sub section - 1 month
 (3) WOMAC pain sub section - 3 months

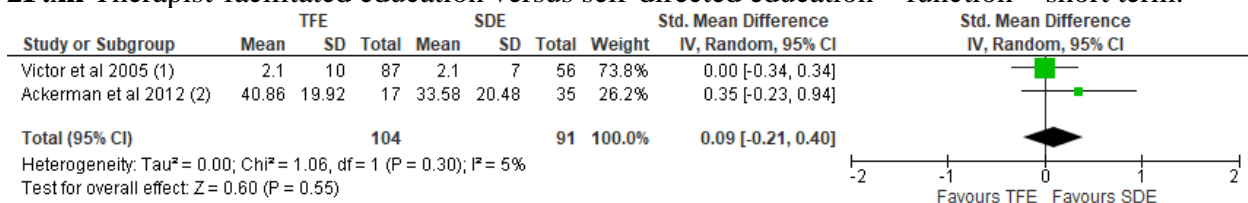
2F.xi Therapist-facilitated education versus self-directed education – pain – long term.



Footnotes

- (1) WOMAC pain sub section - 1 year
 (2) WOMAC pain sub section - 1 year
 (3) WOMAC pain sub section - 1 year

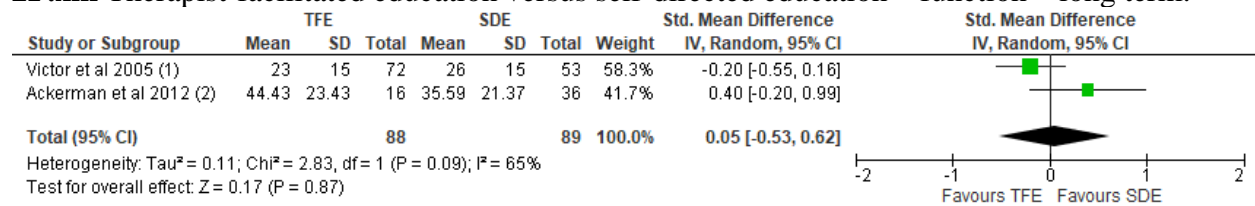
2F.xii Therapist-facilitated education versus self-directed education – function – short term.



Footnotes

- (1) WOMAC function sub section - 1 month
 (2) WOMAC function sub section - 3 months

2F.xiii Therapist-facilitated education versus self-directed education – function – long term.



Footnotes

(1) WOMAC function sub section - 1 year

(2) WOMAC function sub section - 1 year

WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, VAS = visual analogue scale, Ex-Th = exercise therapy, ASES = Arthritis Self-Efficacy Scale, PCS = Pain catastrophizing scale, CSQ = Coping Strategies Questionnaire, TFE = therapist-facilitated education, SDE = self-directed education

Appendix 2G – Grading of Recommendations, Assessment, Development and Evaluations (GRADE) summary tables

2G.i Patient education compared with usual care for people with knee osteoarthritis.

Certainty assessment							№ of patients		Effect	Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Education	Usual care	Absolute (95% CI)	
Pain - short term										
6	randomised trials	not serious	serious	very serious	not serious	publication bias strongly suspected	352	354	SMD 0.35 lower (0.56 lower to 0.14 lower)	⊕○○○ VERY LOW
Pain - medium term										
4	randomised trials	not serious	not serious	serious	not serious	publication bias strongly suspected	312	345	SMD 0.1 lower (0.26 lower to 0.05 higher)	⊕⊕○○ LOW
Pain - long term										
2	randomised trials	serious	not serious	serious	not serious	publication bias strongly suspected	250	255	SMD 0.12 lower (0.3 lower to 0.05 higher)	⊕○○○ VERY LOW
Function - short term										
6	randomised trials	not serious	very serious	serious	serious	publication bias strongly suspected	342	328	SMD 0.31 lower (0.62 lower to 0)	⊕○○○ VERY LOW

Certainty assessment							№ of patients		Effect	Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Education	Usual care	Absolute (95% CI)	
Function - medium term										
4	randomised trials	not serious	serious	serious	serious	publication bias strongly suspected	309	344	SMD 0.17 lower (0.4 lower to 0.07 higher)	⊕○○○ VERY LOW
Self-efficacy - short term										
2	randomised trials	very serious	not serious	serious	very serious	publication bias strongly suspected	109	34	SMD 0.41 lower (0.82 lower to 0.01 higher)	⊕○○○ VERY LOW
Pain catastrophising - short term										
3	randomised trials	serious	very serious	very serious	very serious	publication bias strongly suspected	164	179	SMD 0.02 lower (0.45 lower to 0.42 higher)	⊕○○○ VERY LOW
Pain coping - short term										
2	randomised trials	very serious	very serious	serious	very serious	publication bias strongly suspected	109	124	SMD 0.71 lower (1.43 lower to 0.01 higher)	⊕○○○ VERY LOW

95% CI = 95% Confidence interval, SMD = standardised mean difference

2G.ii Patient education compared with exercise therapy for people with knee osteoarthritis.

Certainty assessment							№ of patients		Effect	Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Education	Exercise therapy	Absolute (95% CI)	
Pain - short term										
5	randomised trials	not serious	very serious	serious	very serious	publication bias strongly suspected	198	201	SMD 0.77 higher (0.07 higher to 1.47 higher)	⊕○○○ VERY LOW
Pain - medium term										
4	randomised trials	not serious	not serious	serious	serious	publication bias strongly suspected	209	205	SMD 0.12 higher (0.11 lower to 0.36 higher)	⊕○○○ VERY LOW
Pain - long term										
3	randomised trials	serious	serious	very serious	serious	publication bias strongly suspected	255	245	SMD 0.18 higher (0.11 lower to 0.46 higher)	⊕○○○ VERY LOW
Function - short term										
3	randomised trials	serious	not serious	serious	serious	publication bias strongly suspected	112	118	SMD 0.33 higher (0.02 lower to 0.69 higher)	⊕○○○ VERY LOW

Certainty assessment							№ of patients		Effect	Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Education	Exercise therapy	Absolute (95% CI)	
Function - medium term										
2	randomised trials	serious	not serious	serious	serious	publication bias strongly suspected	82	83	SMD 0.23 higher (0.08 lower to 0.54 higher)	⊕○○○ VERY LOW
Self-efficacy - short term										
2	randomised trials	serious	very serious	serious	very serious	publication bias strongly suspected	82	82	SMD 0.09 lower (0.82 lower to 0.65 higher)	⊕○○○ VERY LOW
Pain catastrophising - short term										
2	randomised trials	serious	serious	very serious	serious	publication bias strongly suspected	84	83	SMD 0.16 lower (0.62 lower to 0.3 higher)	⊕○○○ VERY LOW
Pain coping - short term										
2	randomised trials	serious	not serious	serious	serious	publication bias strongly suspected	82	82	SMD 0.96 lower (1.42 lower to 0.49 lower)	⊕○○○ VERY LOW

95% CI = 95% Confidence interval, SMD = standardised mean difference

2G.iii Patient education + exercise therapy compared with exercise therapy for people with knee osteoarthritis.

Certainty assessment							№ of patients		Effect	Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Exercise	Education + exercise therapy	Absolute (95% CI)	
Pain - short term										
3	randomised trials	not serious	very serious	not serious	very serious	publication bias strongly suspected	139	143	SMD 0.61 higher (0.4 lower to 1.62 higher)	⊕○○○ VERY LOW
Pain - medium term										
2	randomised trials	not serious	serious	serious	serious	publication bias strongly suspected	113	122	SMD 0.1 higher (0.3 lower to 0.5 higher)	⊕○○○ VERY LOW
Function - short term										
2	randomised trials	serious	very serious	not serious	very serious	publication bias strongly suspected	87	88	SMD 1.32 higher (0.57 lower to 3.2 higher)	⊕○○○ VERY LOW

95% CI = 95% Confidence interval, SMD = standardised mean difference

2G.iv Patient education compared to patient education + exercise therapy for people with knee osteoarthritis.

Certainty assessment							№ of patients			Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Education	Education + exercise therapy	Absolute (95% CI)	
Pain - short term										
5	randomised trials	not serious	serious	serious	serious	publication bias strongly suspected	236	255	SMD 0.44 higher (0.19 higher to 0.69 higher)	⊕○○○○ VERY LOW
Pain - medium term										
4	randomised trials	not serious	not serious	serious	not serious	publication bias strongly suspected	271	268	SMD 0.14 higher (0.04 lower to 0.32 higher)	⊕⊕○○ LOW
Pain - long term										
3	randomised trials	not serious	not serious	serious	not serious	publication bias strongly suspected	178	188	SMD 0.13 higher (0.08 lower to 0.33 higher)	⊕⊕○○ LOW
Function - short term										
3	randomised trials	not serious	not serious	serious	serious	publication bias strongly suspected	109	122	SMD 0.81 higher (0.54 higher to 1.08 higher)	⊕○○○○ VERY LOW

Certainty assessment							№ of patients			Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Education	Education + exercise therapy	Absolute (95% CI)	
Function - medium term										
2	randomised trials	not serious	not serious	serious	not serious	publication bias strongly suspected	142	143	SMD 0.39 higher (0.15 higher to 0.62 higher)	⊕⊕○○ LOW
Function - long term										
3	randomised trials	not serious	serious	not serious	serious	publication bias strongly suspected	177	184	SMD 0.24 higher (0.06 lower to 0.54 higher)	⊕○○○ VERY LOW
Self-efficacy - short term										
2	randomised trials	serious	not serious	serious	serious	publication bias strongly suspected	82	87	SMD 0.46 higher (0.02 higher to 0.89 higher)	⊕○○○ VERY LOW
Pain catastrophising – short term										
2	randomised trials	serious	not serious	very serious	serious	publication bias strongly suspected	82	87	SMD 0.15 higher (0.15 lower to 0.46 higher)	⊕○○○ VERY LOW
Pain coping - short term										

Certainty assessment							№ of patients			Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Education	Education + exercise therapy	Absolute (95% CI)	
2	randomised trials	serious	not serious	serious	serious	publication bias strongly suspected	82	87	SMD 0.04 lower (0.34 lower to 0.26 higher)	⊕○○○ VERY LOW

95% CI = 95% Confidence interval, SMD = standardised mean difference

2G.v Therapist-facilitated education compared with self-directed education for people with knee osteoarthritis.

Certainty assessment							No of patients	Effect	Certainty
No of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Therapist-facilitated education	Self-directed education	Absolute (95% CI)
Pain - short term									
3	randomised trials	very serious	not serious	serious	serious	publication bias strongly suspected	127	119	SMD 0.03 lower (0.29 lower to 0.23 higher) ⊕○○○ VERY LOW
Pain - long term									
3	randomised trials	very serious	serious	not serious	serious	publication bias strongly suspected	110	114	SMD 0.04 lower (0.48 lower to 0.39 higher) ⊕○○○ VERY LOW
Function - short term									
2	randomised trials	very serious	not serious	serious	serious	publication bias strongly suspected	104	91	SMD 0.09 higher (0.21 lower to 0.4 higher) ⊕○○○ VERY LOW
Function - long term									
2	randomised trials	very serious	very serious	not serious	very serious	publication bias strongly suspected	88	89	SMD 0.05 higher (0.53 lower to 0.62 higher) ⊕○○○ VERY LOW

95% CI = 95% Confidence interval, SMD = standardised mean difference

Appendix 2H – Summary of unpooled data (2.6 in 2.5)

2H.i Summary of unpooled data for patient education as a stand-alone intervention – primary outcomes.

Trial	Comparator 1	Comparator 2	Short term	Medium term	Long term
Pain					
Cheung et al 2020 ³⁵⁹	Patient education	Acupressure	Similar outcomes –0.18 [–0.84, 0.49]	-	-
Function					
Allen et al 2016 ³⁵⁴	Patient education	Usual care	-	-	Similar outcomes 0.34 [–0.02, 0.70]
Bennell et al 2016 ²⁹²	Patient education	Exercise therapy	-	-	Similar outcomes 0.30 [–0.05, 0.66]
Cheung et al 2020 ³⁵⁹	Patient education	Acupressure	Similar outcomes –0.00 [–0.67, 0.66]	-	-

2H.ii Summary of unpooled data for patient education in combination with other interventions – primary outcomes.

Trial	Comparator 1	Comparator 2	Short term	Medium term	Long term
Pain					
Bennell et al 2016 ²⁹²	Patient education + exercise therapy	Patient education	-	-	Similar outcomes 0.06 [-0.29, 0.41]
Function					
Bennell et al 2016 ²⁹²	Patient education + exercise therapy	Exercise therapy	-	Similar outcomes 0.34 [-0.02, 0.70]	Similar outcomes 0.19 [-0.16, 0.55]

2H.iii Summary of unpooled data for patient education as a stand-alone intervention – secondary outcomes.

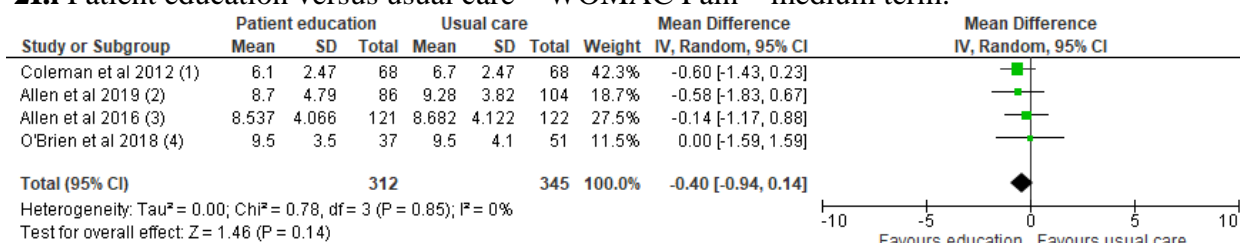
Trial	Comparator 1	Comparator 2	Short term	Medium term	Long term
Self-efficacy					
Allen et al 2019 ²⁹³	Patient education	Usual care	-	Similar outcomes -0.26 [-0.55, 0.03]	-
Allen et al 2016 ³⁵⁴	Patient education	Usual care	-	-	Similar outcomes 0.00 [-0.24, 0.25]
Catastrophising					
Allen et al 2019 ²⁹³	Patient education	Usual care	-	Similar outcomes -0.13 [-0.42, 0.16]	-
Bennell et al 2016 ²⁹²	Patient education	Exercise therapy	-	Similar outcomes -0.19 [-0.55, 0.16]	Similar outcomes -0.19 [-0.55, 0.16]
Pain coping					
Allen et al 2019 ²⁹³	Patient education	Usual care	-	Similar outcomes -0.27 [0.01, -0.56]	-
Bennell et al 2016 ²⁹²	Patient education	Exercise therapy	-	Favours patient education -0.78 [-1.15, -0.41]	Favours patient education -0.66 [-1.02, -0.29]

2H.iv Summary of unpooled data for patient education in combination with other interventions – secondary outcomes.

Trial	Comparator 1	Comparator 2	Short term	Medium term	Long term
Self-efficacy					
Bennell et al 2016 ²⁹²	Patient education + exercise therapy	Patient education	-	Favours patient education + exercise therapy 0.62 [0.25, 0.98]	Favours patient education + exercise therapy 0.51 [0.15, 0.87]
Catastrophising					
Bennell et al 2016 ²⁹²	Patient education + exercise therapy	Patient education	-	Similar outcomes 0.19 [-0.16, 0.55]	Similar outcomes 0.15 [-0.20, 0.50]
Bennell et al 2016 ²⁹²	Patient education + exercise	Exercise therapy	Similar outcomes 0.16 [-0.18, 0.50]	Favours patient education + exercise therapy 0.36 [0.00, 0.72]	Similar outcomes 0.33 [-0.02, 0.68]
Pain coping					
Bennell et al 2016 ²⁹²	Patient education + exercise therapy	Patient education	-	Similar outcomes 0.06 [-0.30, 0.42]	Similar outcomes 0.06 [-0.29, 0.42]
Bennell et al 2016 ²⁹²	Patient education + exercise therapy	Exercise therapy	Favours patient education + exercise therapy 0.80 [0.44, 1.16]	Favours patient education + exercise therapy 0.81 [0.44, 1.18]	Favours patient education + exercise therapy 0.72 [0.36, 1.08]

Appendix 2I – Detailed forest plots for all comparisons that could be calculated as weighted mean difference.

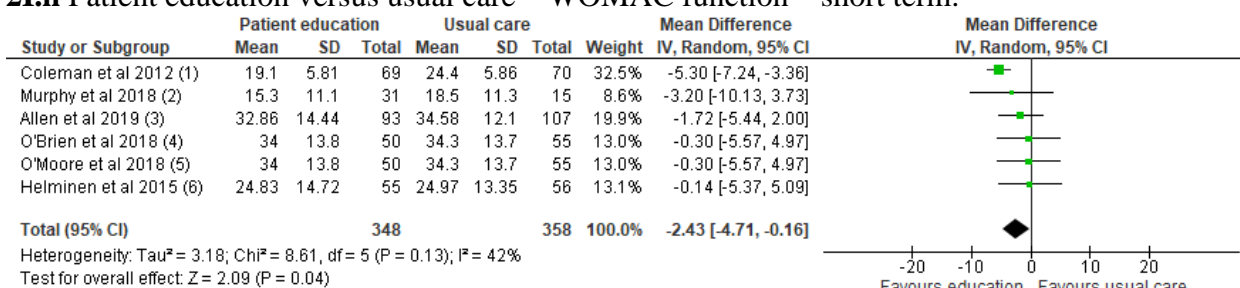
2I.i Patient education versus usual care – WOMAC Pain – medium term.



Footnotes

- (1) WOMAC pain sub section - 6 months
- (2) WOMAC pain sub section - 9 months
- (3) WOMAC pain sub section - 6 months
- (4) WOMAC pain sub section - 26 weeks

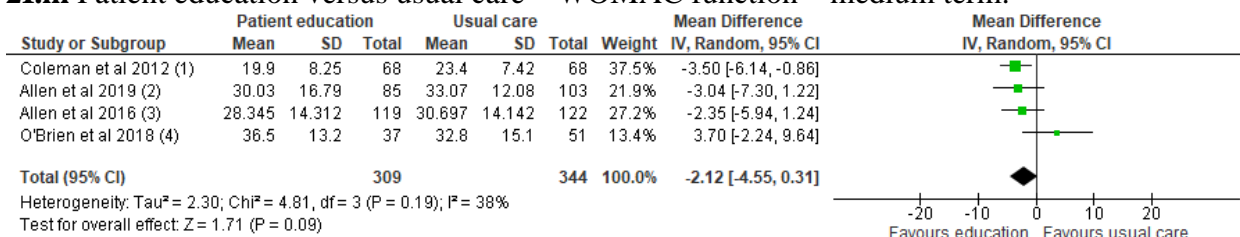
2I.ii Patient education versus usual care – WOMAC function – short term.



Footnotes

- (1) WOMAC function sub section - 8 weeks
- (2) WOMAC function sub section - post intervention
- (3) WOMAC function sub section - 3 months
- (4) WOMAC function sub section - 6 weeks
- (5) WOMAC function sub section - 3 months
- (6) WOMAC function sub section - 3 months

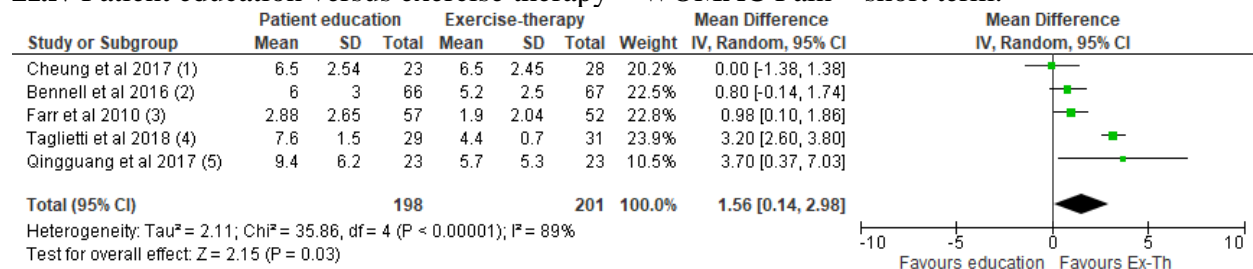
2I.iii Patient education versus usual care – WOMAC function – medium term.



Footnotes

- (1) WOMAC function sub section - 6 months
- (2) WOMAC function sub section - 9 months
- (3) WOMAC function subsection - 6 months
- (4) WOMAC function sub section - 26 weeks

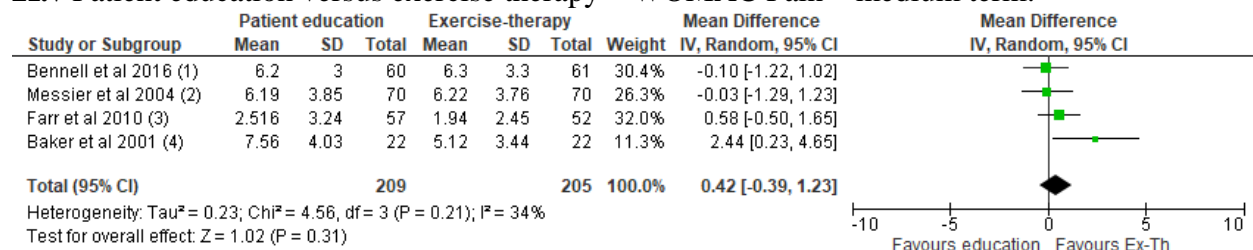
2I.iv Patient education versus exercise therapy – WOMAC Pain – short term.



Footnotes

- (1) WOMAC pain sub section - 8 weeks
- (2) WOMAC pain sub section - 3 months
- (3) WOMAC pain sub section - 3 months
- (4) WOMAC pain sub section - 3 months
- (5) WOMAC pain sub section - 24 weeks

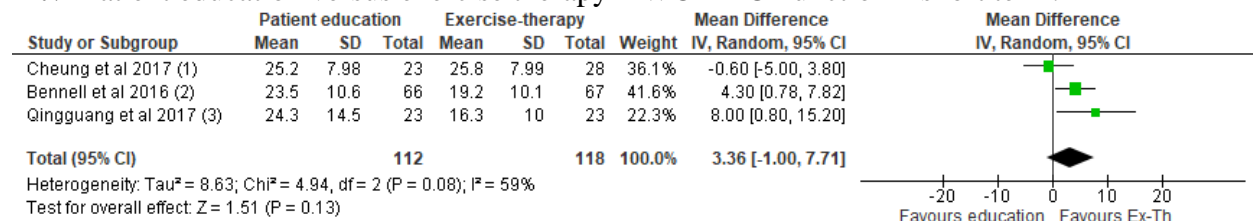
2I.v Patient education versus exercise therapy – WOMAC Pain – medium term.



Footnotes

- (1) WOMAC pain sub section - 7 months
- (2) WOMAC pain sub section - 6 Months
- (3) WOMAC pain sub section - 9 months
- (4) WOMAC pain sub section - 6 months

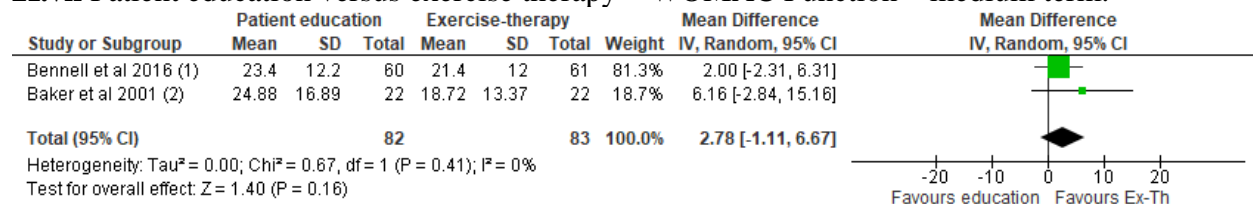
2I.vi Patient education versus exercise therapy – WOMAC Function – short term.



Footnotes

- (1) WOMAC function sub section - 8 weeks
- (2) WOMAC function sub section - 3 months
- (3) WOMAC function sub section - 24 weeks

2I.vii Patient education versus exercise therapy – WOMAC Function – medium term.

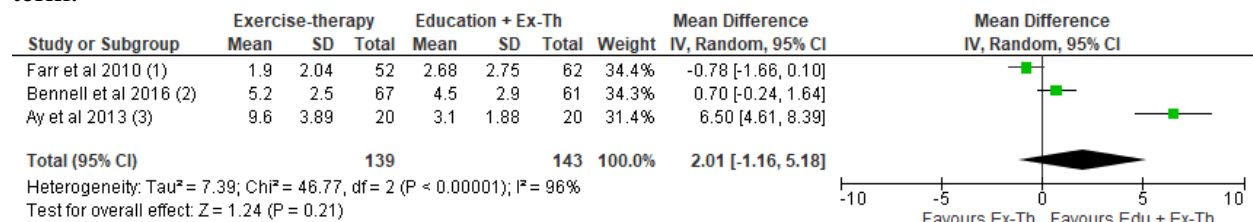


Footnotes

(1) WOMAC function sub section - 7 months

(2) WOMAC function sub section - 6 months

2I.viii Exercise therapy versus patient education + exercise therapy – WOMAC Pain – short term.



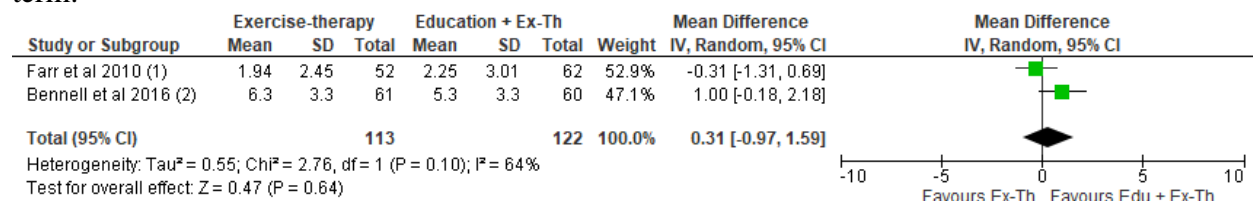
Footnotes

(1) WOMAC pain sub section - 3 months

(2) WOMAC pain sub section - 3 months

(3) WOMAC pain sub section - 3 months

2I.ix Exercise therapy versus patient education + exercise therapy – WOMAC Pain – medium term.

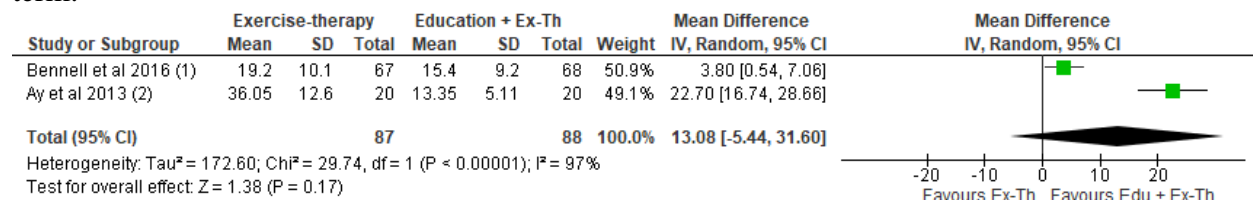


Footnotes

(1) WOMAC pain sub section - 9 months

(2) WOMAC pain subsection - 7 months

2I.x Exercise therapy versus patient education + exercise therapy – WOMAC Function – short term.

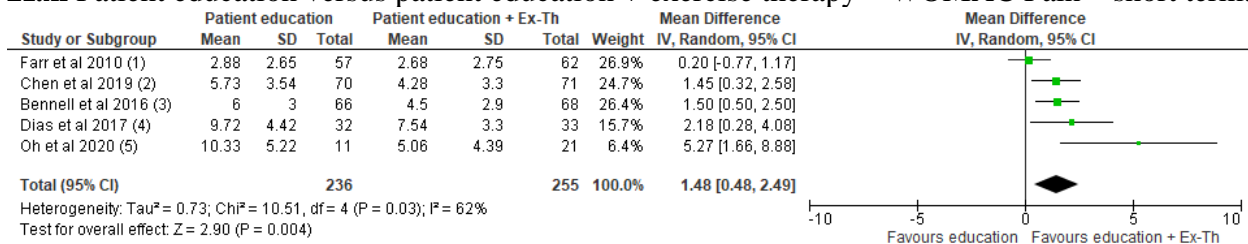


Footnotes

(1) WOMAC function sub section - 3 months

(2) WOMAC function sub section - 3 months

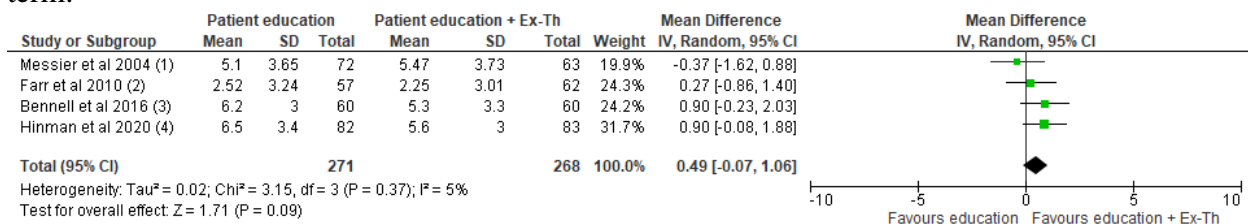
2I.xi Patient education versus patient education + exercise therapy – WOMAC Pain – short term.



Footnotes

- (1) WOMAC pain sub section - 3 months
- (2) WOMAC pain sub section - 12 weeks
- (3) WOMAC pain sub section - 3 months
- (4) WOMAC pain sub section - 6 weeks
- (5) WOMAC pain sub section - post intervention

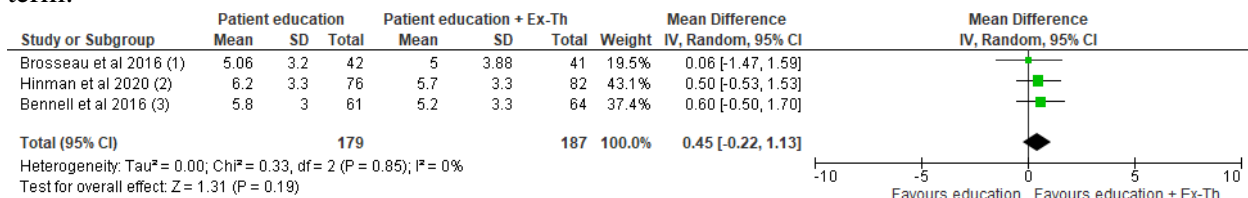
2I.xii Patient education versus patient education + exercise therapy – WOMAC Pain – medium term.



Footnotes

- (1) WOMAC pain sub section - 6 months
- (2) WOMAC pain sub section - 9 months
- (3) WOMAC pain sub section - 7 months
- (4) WOMAC pain sub section - 6 months

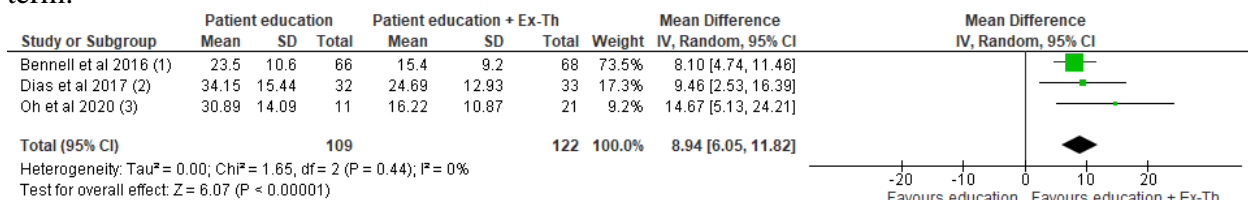
2I.xiii Patient education versus patient education + exercise therapy – WOMAC Pain – long term.



Footnotes

- (1) WOMAC pain sub section 12 months
- (2) WOMAC pain sub section - 12 months
- (3) WOMAC pain sub section - 1 year

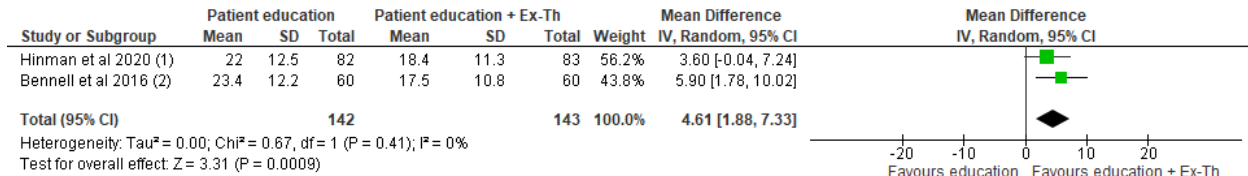
2I.xiv Patient education versus patient education + exercise therapy – WOMAC Function – short term.



Footnotes

- (1) WOMAC function sub section - 3 months
- (2) WOMAC function sub section - 6 weeks
- (3) WOMAC function sub section - post intervention

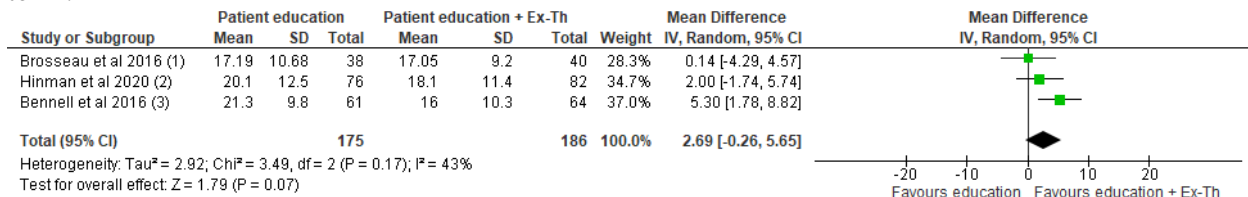
2I.xv Patient education versus patient education + exercise therapy – WOMAC Function – medium term.



Footnotes

- (1) WOMAC function sub section - 6 months
 (2) WOMAC function sub section - 7 months

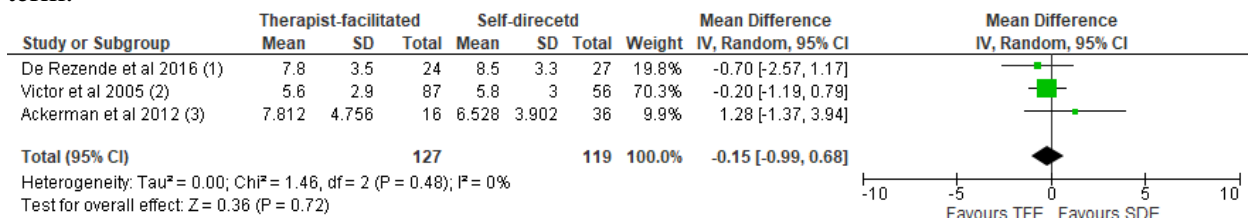
2I.xvi Patient education versus patient education + exercise therapy – WOMAC Function – long term.



Footnotes

- (1) WOMAC function sub section 12 months
 (2) WOMAC function sub section - 12 months
 (3) WOMAC function sub section - 1 year

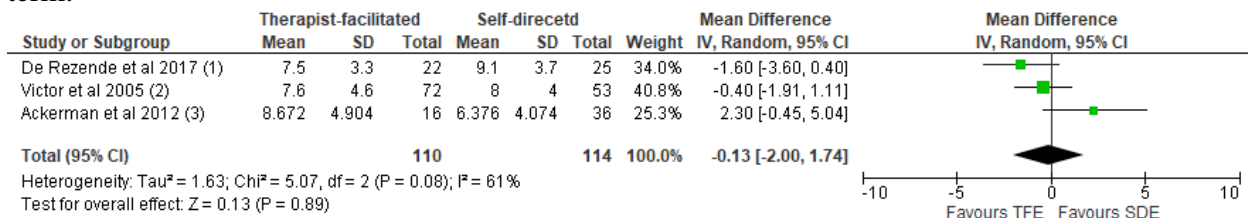
2I.xvii Therapist-facilitated education versus self-directed education – WOMAC Pain – short term.



Footnotes

- (1) WOMAC pain sub section - 4 months
 (2) WOMAC pain sub section - 1 month
 (3) WOMAC pain sub section - 3 months

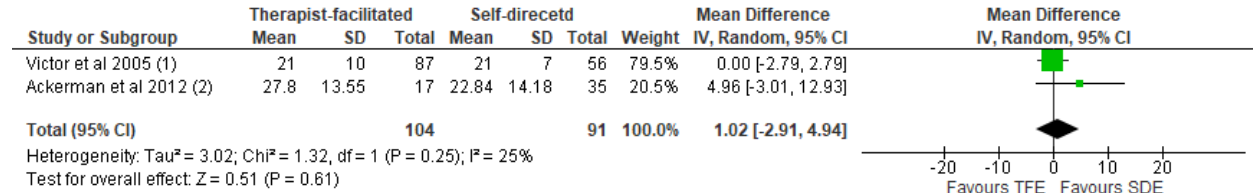
2I.xviii Therapist-facilitated education versus self-directed education – WOMAC Pain – long term.



Footnotes

- (1) WOMAC pain sub section - 1 year
 (2) WOMAC pain sub section - 1 year
 (3) WOMAC pain sub section - 1 year

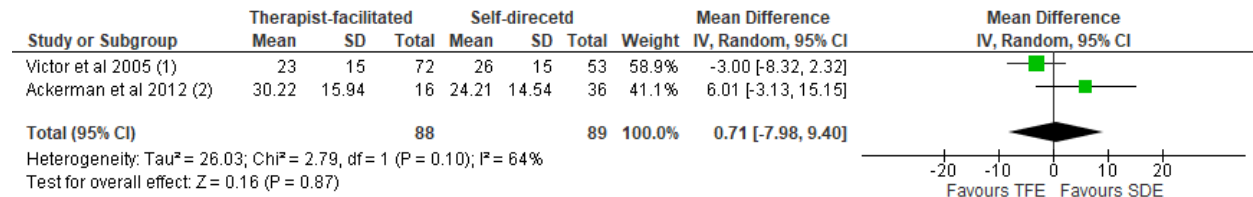
2I.xix Therapist-facilitated education versus self-directed education – WOMAC Function – short term.



Footnotes

- (1) WOMAC function sub section - 1 month
 (2) WOMAC function sub section - 3 months

2I.xx Therapist-facilitated education versus self-directed education – WOMAC Function – long term.



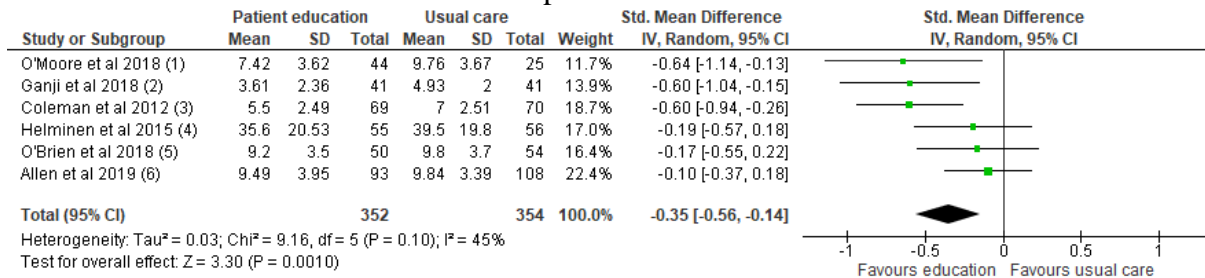
Footnotes

- (1) WOMAC function sub section - 1 year
 (2) WOMAC function sub section - 1 year

WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, Ex-Th = exercise therapy, TFE = therapist-facilitated education, SDE = self-directed education

Appendix 2J – Detailed forest plots for Fig 2.3

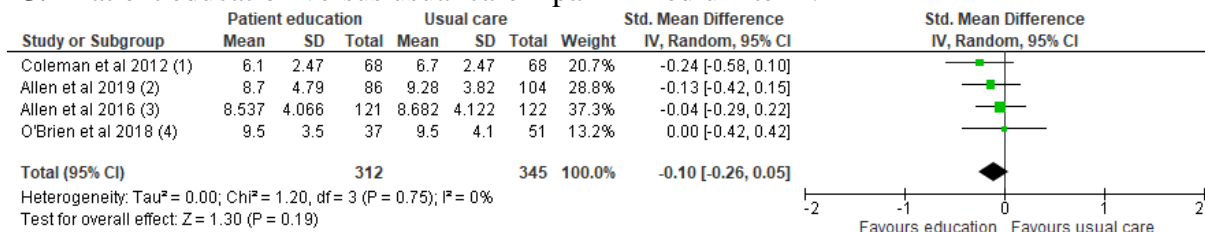
2J.i Patient education versus usual care – pain – short term.



Footnotes

- (1) WOMAC pain sub section - 3 months
- (2) VAS - 8 weeks
- (3) WOMAC pain sub section - 8 weeks
- (4) WOMAC pain sub section - 3 months
- (5) WOMAC pain sub section - 6 weeks
- (6) WOMAC pain sub section - 3 months

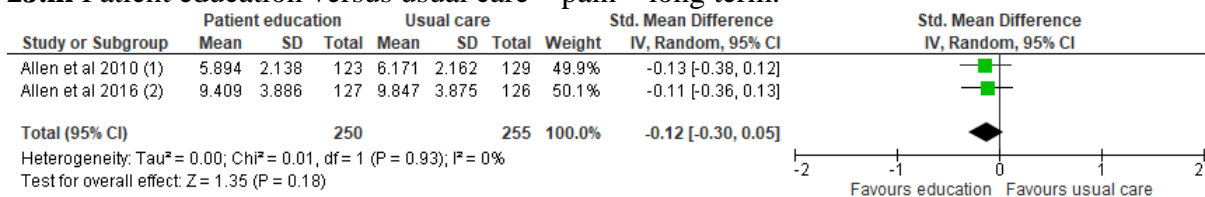
2J.ii Patient education versus usual care – pain – medium term.



Footnotes

- (1) WOMAC pain sub section - 6 months
- (2) WOMAC pain sub section - 9 months
- (3) WOMAC pain sub section - 6 months
- (4) WOMAC pain sub section - 26 weeks

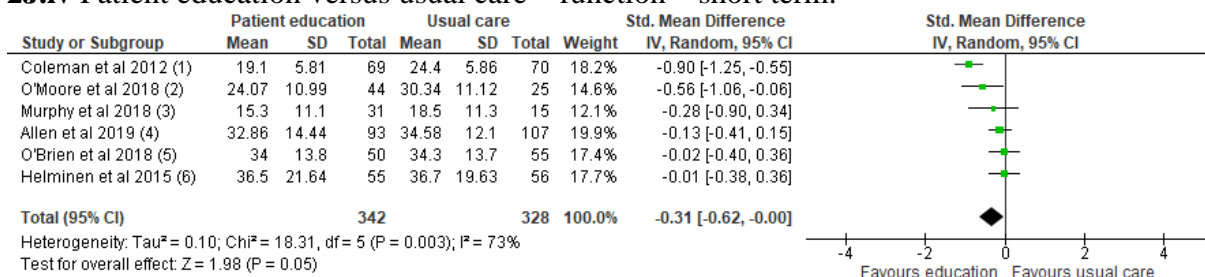
2J.iii Patient education versus usual care – pain – long term.



Footnotes

- (1) VAS - 12 months
- (2) WOMAC pain sub section - 12 months

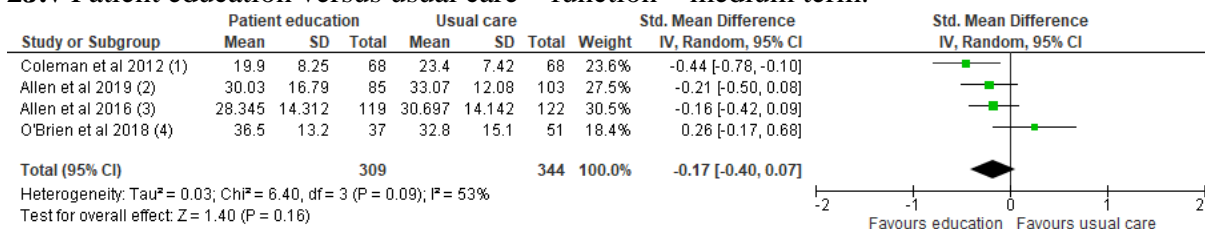
2J.iv Patient education versus usual care – function – short term.



Footnotes

- (1) WOMAC function sub section - 8 weeks
- (2) WOMAC function sub section - 3 months
- (3) WOMAC function sub section - post intervention
- (4) WOMAC function sub section - 3 months
- (5) WOMAC function sub section - 6 weeks
- (6) WOMAC function sub section - 3 months

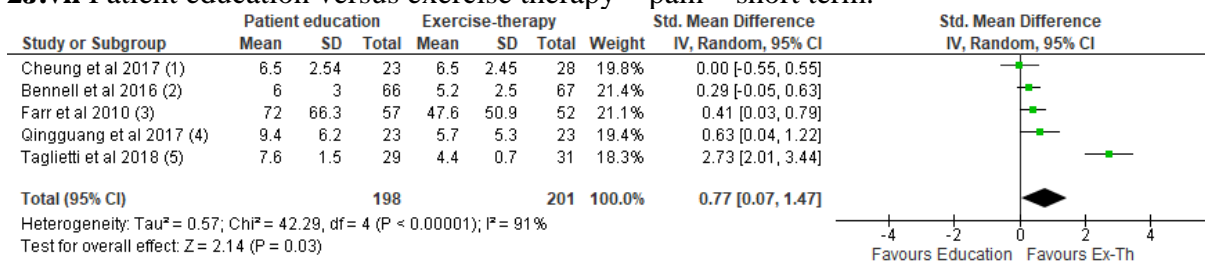
2J.v Patient education versus usual care – function – medium term.



Footnotes

- (1) WOMAC function sub section - 6 months
- (2) WOMAC function sub section - 9 months
- (3) WOMAC function subsection - 6 months
- (4) WOMAC function sub section - 26 weeks

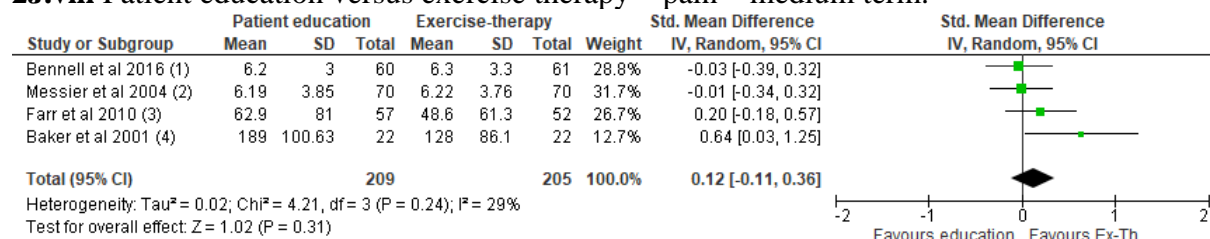
2J.vii Patient education versus exercise therapy – pain – short term.



Footnotes

- (1) WOMAC pain sub section - 8 weeks
- (2) WOMAC pain sub section - 3 months
- (3) WOMAC pain sub section - 3 months
- (4) WOMAC pain sub section - 24 weeks
- (5) WOMAC pain sub section - 3 months

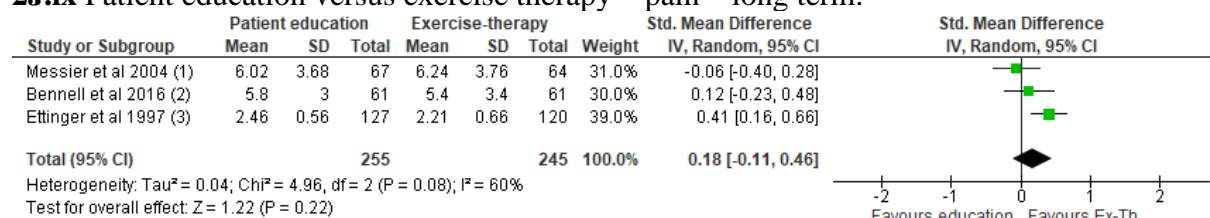
2J.viii Patient education versus exercise therapy – pain – medium term.



Footnotes

- (1) WOMAC pain sub section - 7 months
- (2) WOMAC pain sub section - 6 Months
- (3) WOMAC pain sub section - 9 months
- (4) WOMAC pain sub section - 6 months

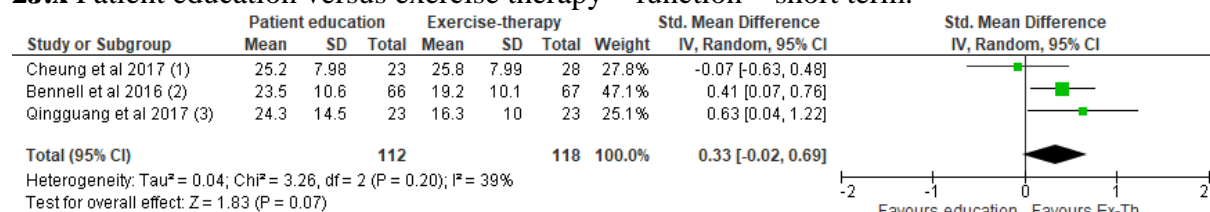
2J.ix Patient education versus exercise therapy – pain – long term.



Footnotes

- (1) WOMAC pain sub section - 18 Months
- (2) WOMAC pain sub section - 12 months
- (3) VAS - 18 months

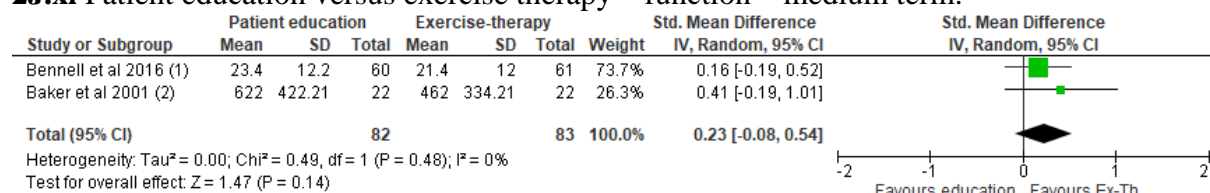
2J.x Patient education versus exercise therapy – function – short term.



Footnotes

- (1) WOMAC function sub section - 8 weeks
- (2) WOMAC function sub section - 3 months
- (3) WOMAC function sub section - 24 weeks

2J.xi Patient education versus exercise therapy – function – medium term.



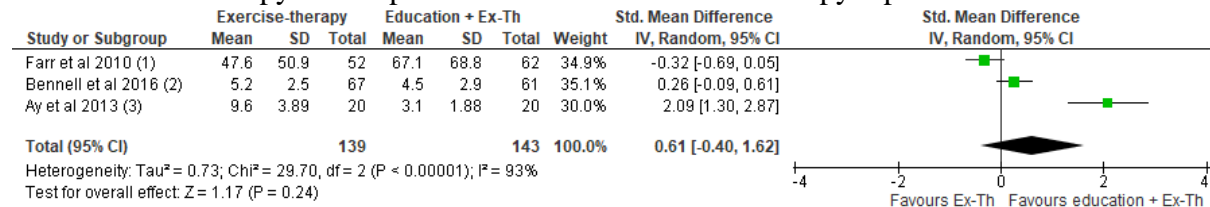
Footnotes

- (1) WOMAC function sub section - 7 months
- (2) WOMAC function sub section - 6 months

Ex-Th = exercise therapy, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, VAS = visual analogue scale

Appendix 2K – Detailed forest plots for Fig 2.4

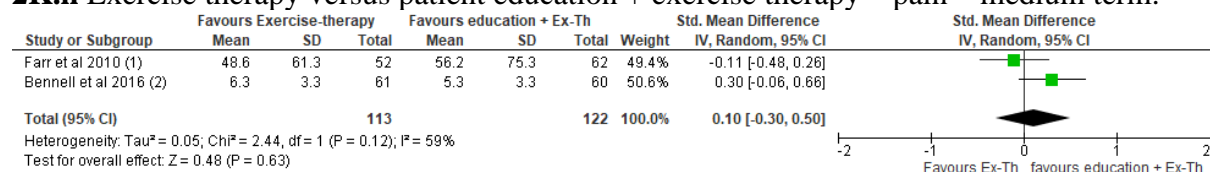
2K.i Exercise therapy versus patient education + exercise therapy – pain – short term.



Footnotes

- (1) WOMAC pain sub section - 3 months
 (2) WOMAC pain sub section - 3 months
 (3) WOMAC pain sub section - 3 months

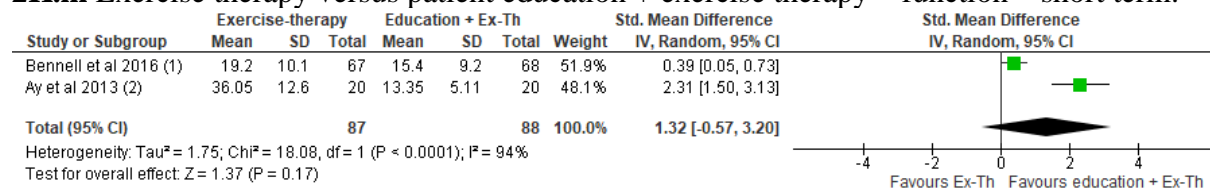
2K.ii Exercise therapy versus patient education + exercise therapy – pain – medium term.



Footnotes

- (1) WOMAC pain sub section - 9 months
 (2) WOMAC pain subsection - 7 months

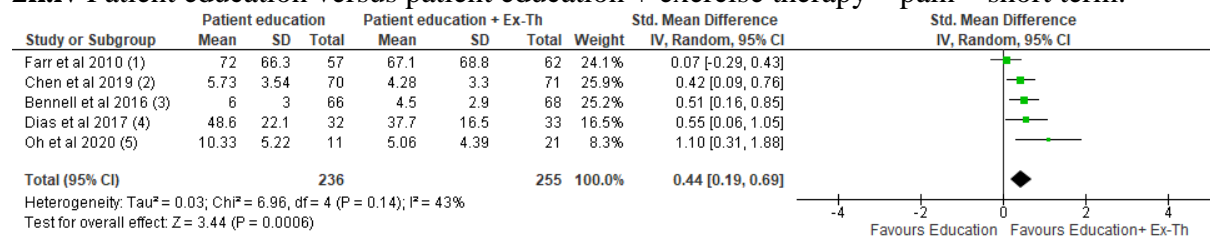
2K.iii Exercise therapy versus patient education + exercise therapy – function – short term.



Footnotes

- (1) WOMAC function sub section - 3 months
 (2) WOMAC function sub section - 3 months

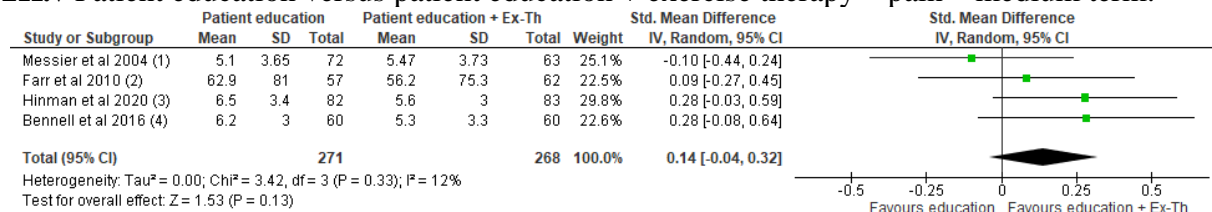
2K.iv Patient education versus patient education + exercise therapy – pain – short term.



Footnotes

- (1) WOMAC pain sub section - 3 months
 (2) WOMAC pain sub section - 12 weeks
 (3) WOMAC pain sub section - 3 months
 (4) WOMAC pain sub section - 6 weeks
 (5) WOMAC pain sub section - post intervention

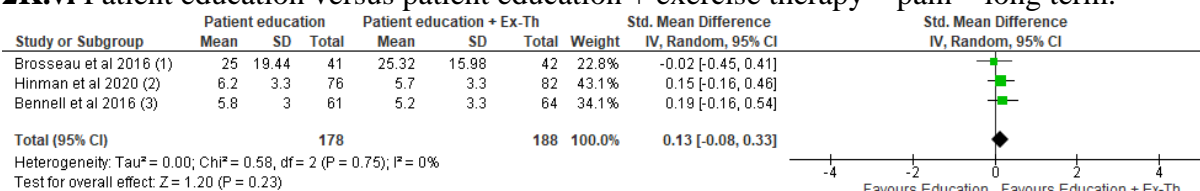
2K.v Patient education versus patient education + exercise therapy – pain – medium term.



Footnotes

- (1) WOMAC pain sub section - 6 months
- (2) WOMAC pain sub section - 9 months
- (3) WOMAC pain sub section - 6 months
- (4) WOMAC pain sub section - 7 months

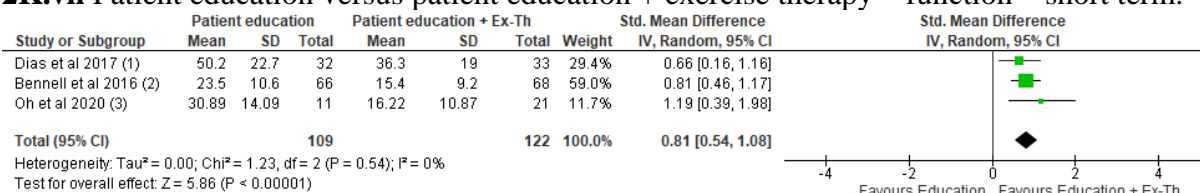
2K.vi Patient education versus patient education + exercise therapy – pain – long term.



Footnotes

- (1) WOMAC pain sub section - 12 months
- (2) WOMAC pain sub section - 12 months
- (3) WOMAC pain sub section - 12 months

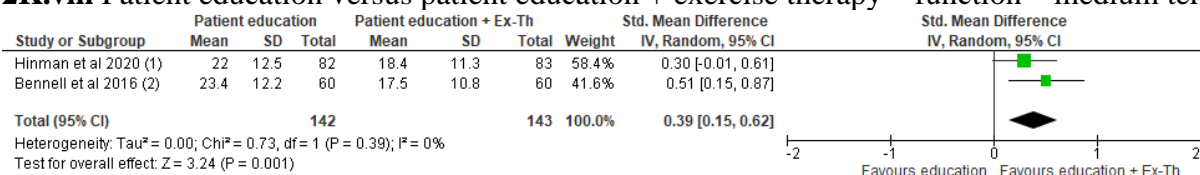
2K.vii Patient education versus patient education + exercise therapy – function – short term.



Footnotes

- (1) WOMAC function sub section - 6 weeks
- (2) WOMAC function sub section - 3 months
- (3) WOMAC function sub section - post intervention

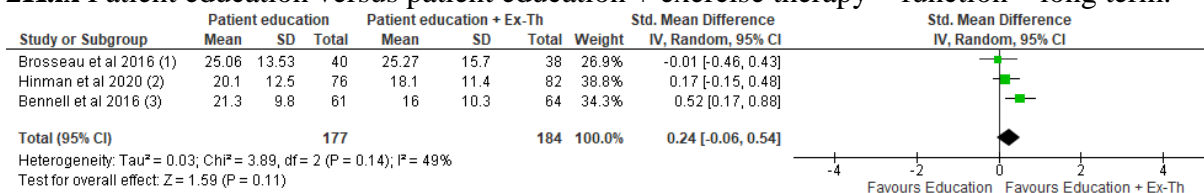
2K.viii Patient education versus patient education + exercise therapy – function – medium term.



Footnotes

- (1) WOMAC function sub section - 6 months
- (2) WOMAC function sub section - 7 Months

2K.ix Patient education versus patient education + exercise therapy – function – long term.



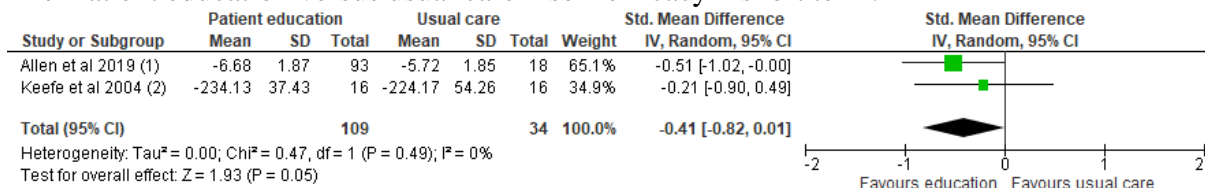
Footnotes

- (1) WOMAC function sub section - 12 months
 (2) WOMAC function sub section - 12 months
 (3) WOMAC function sub section - 12 months

Ex-Th = exercise therapy, WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, VAS = visual analogue scale

Appendix 2L – Detailed forest plots of the secondary outcomes

2L.i Patient education versus usual care – self-efficacy – short term.

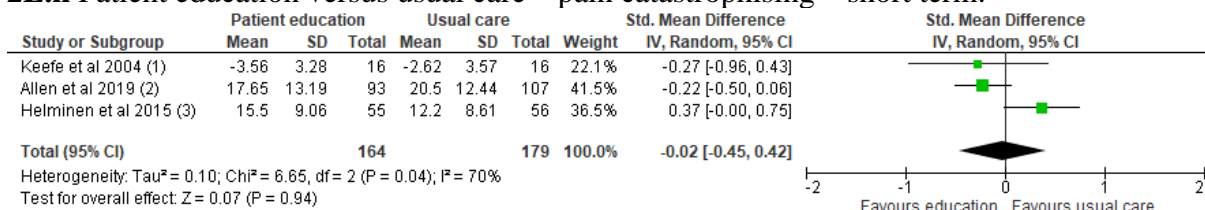


Footnotes

(1) ASES - 3 months - Inverted scoring

(2) ASES - post intervention - Inverted scoring

2L.ii Patient education versus usual care – pain catastrophising – short term.



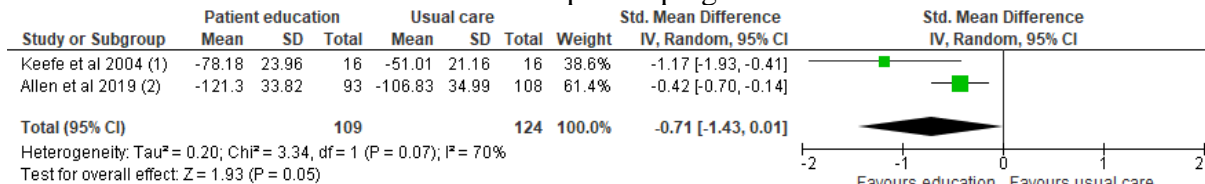
Footnotes

(1) CSQ - catastrophizing sub section - post intervention - Inverted scoring

(2) PCS - 3 months

(3) PCS - post intervention

2L.iii Patient education versus usual care – pain coping – short term.

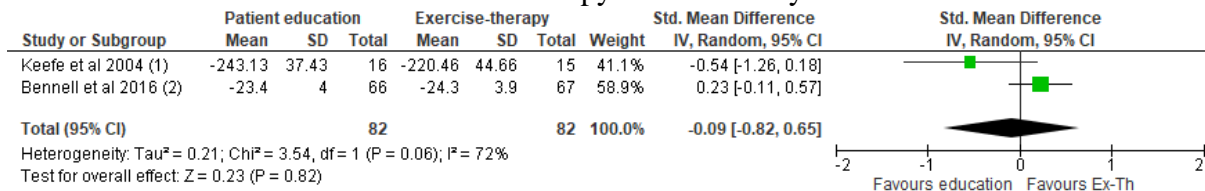


Footnotes

(1) CSQ coping attempts - post intervention - inverted scoring

(2) CSQ coping attempts - 3 months - inverted scoring

2L.iv Patient education versus exercise therapy – self-efficacy – short term.

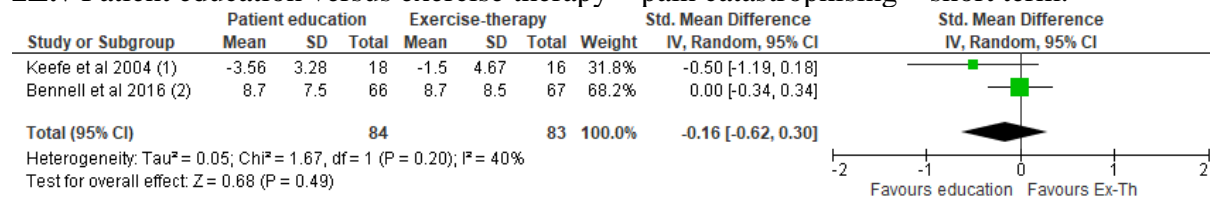


Footnotes

(1) ASES - post intervention - Inverted scoring

(2) ASES - 3 months - Inverted scoring

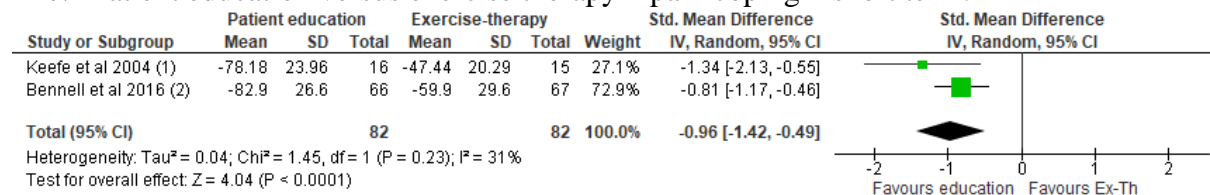
2L.v Patient education versus exercise therapy – pain catastrophising – short term.



Footnotes

- (1) CSQ - catastrophizing sub section - post intervention - inverted scoring
 (2) PCS - 3 months

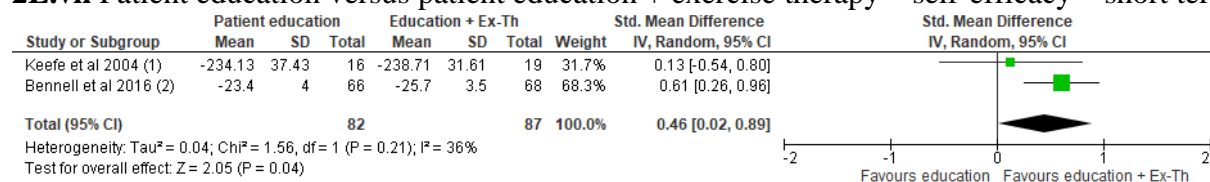
2L.vi Patient education versus exercise therapy – pain coping – short term.



Footnotes

- (1) CSQ coping attempts - post intervention - inverted scoring
 (2) CSQ coping attempts - 3 months - inverted scoring

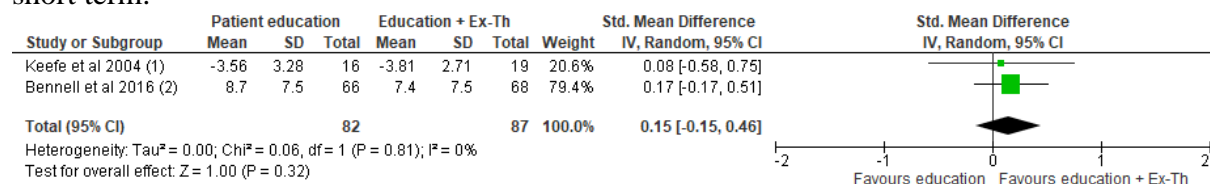
2L.vii Patient education versus patient education + exercise therapy – self-efficacy – short term.



Footnotes

- (1) ASES - post intervention - inverted scoring
 (2) ASES - 3 months - inverted scoring

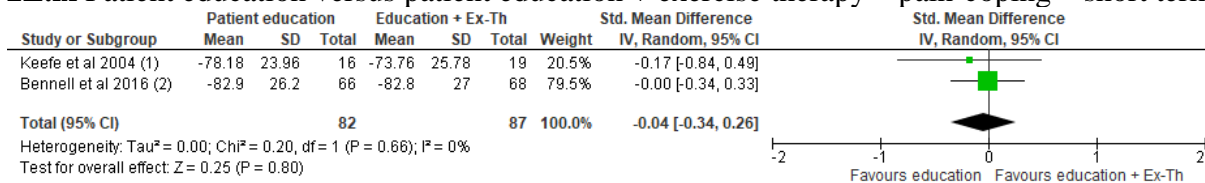
2L.viii Patient education versus patient education + exercise therapy – pain catastrophising – short term.



Footnotes

- (1) CSQ - catastrophizing sub section - Post intervention - inverted scoring
 (2) PCS - 3 months

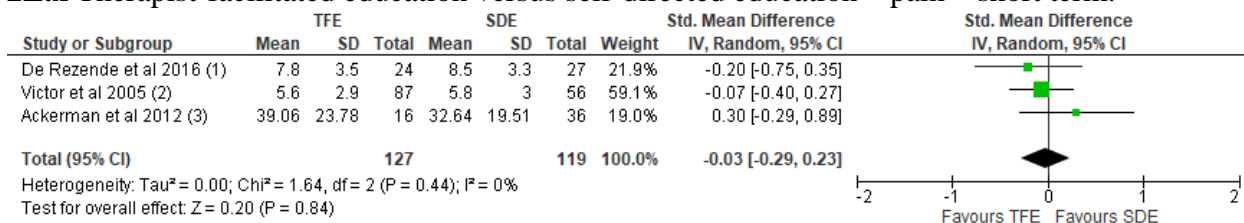
2L.ix Patient education versus patient education + exercise therapy – pain-coping – short term.



Footnotes

- (1) CSQ coping attempts - post intervention - inverted scoring
 (2) CSQ coping attempts - 3 months - Inverted scoring

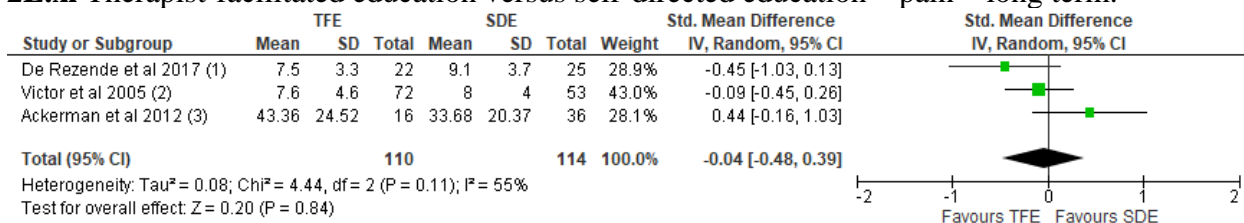
2L.x Therapist-facilitated education versus self-directed education – pain – short term.



Footnotes

- (1) WOMAC pain sub section - 4 months
 (2) WOMAC pain sub section - 1 month
 (3) WOMAC pain sub section - 3 months

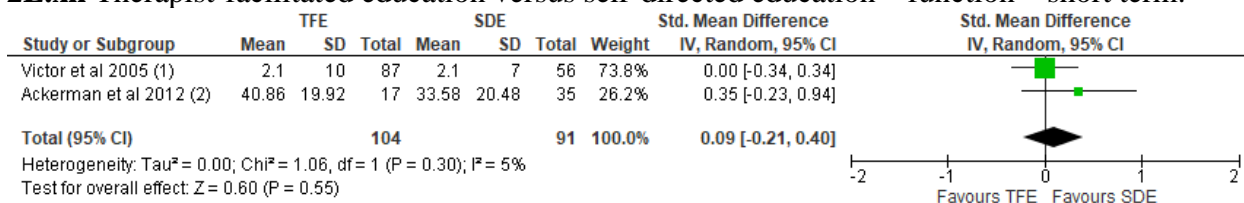
2L.xi Therapist-facilitated education versus self-directed education – pain – long term.



Footnotes

- (1) WOMAC pain sub section - 1 year
 (2) WOMAC pain sub section - 1 year
 (3) WOMAC pain sub section - 1 year

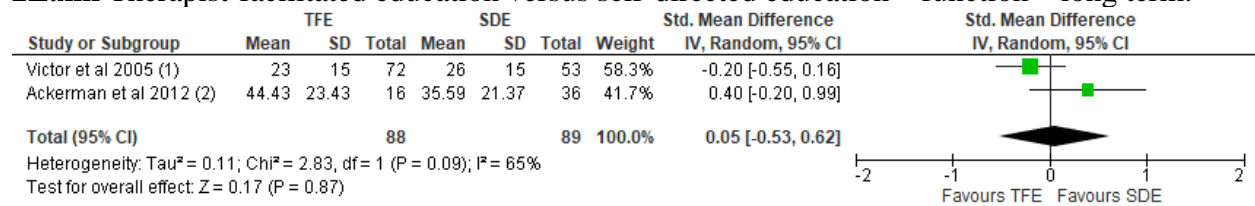
2L.xii Therapist-facilitated education versus self-directed education – function – short term.



Footnotes

- (1) WOMAC function sub section - 1 month
 (2) WOMAC function sub section - 3 months

2L.xiii Therapist-facilitated education versus self-directed education – function – long term.



Footnotes

(1) WOMAC function sub section - 1 year

(2) WOMAC function sub section - 1 year

WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index, VAS = visual analogue scale, Ex-Th = exercise therapy, ASES = Arthritis Self-Efficacy Scale, PCS = Pain catastrophizing scale, CSQ = Coping Strategies Questionnaire, TFE = therapist-facilitated education, SDE = self-directed education

Appendix 2M – Explanation of when sensitivity analyses impacted outcome

2M.i Patient education versus usual care - short-term pain.

This review reported that patient education produced moderate-sized, short-term improvements in pain compared with usual care using outcomes taken from Ganji et al¹ at 8 weeks, rather than post-intervention and using WOMAC outcomes from Coleman² and Helminen³, rather than VAS. See a breakdown of analyses below.

Grouping	SMD and 95% CI	Outcome
Ganji ¹ at 8 weeks	–0.35 (–0.56 to –	<u>Favoured patient education</u>
Coleman ² and Helminen ³ WOMAC (in review)	0.14)	with a <u>moderate</u> effect size
Ganji ¹ at 8 weeks	–0.40 (–0.73 to –	<u>Favoured patient education</u>
Coleman ² and Helminen ³ VAS	0.06)	with a <u>moderate</u> effect size
Ganji ¹ post-intervention	–0.27 (–0.47 to –	<u>Favoured patient education</u>
Coleman ² and Helminen ³ WOMAC	0.07)	with a <u>small</u> effect size
Ganji ¹ post-intervention	–0.31 (–0.64 to –	<u>Produced similar outcomes</u>
Coleman ² and Helminen ³ VAS	0.03)	

2M.ii Patient education versus exercise therapy - short-term pain.

This review reported that patient education was inferior to exercise therapy with a large effect in the short term for pain. This was based upon Taglietti's⁴ outcomes taken at 3 months rather than 8 weeks, and Cheung et al's⁵ exercise therapy intervention consisting of aerobic and resistance training rather than yoga. These were chosen due to comparability between the other pooled interventions. Additionally, three studies reported both WOMAC and VAS. WOMAC was used, as all studies reported this outcome and it is comparable between other analyses.

Grouping	SMD and 95% CI	Outcome
Taglietti ⁴ at 3 months Cheung ⁵ aerobic/resistance WOMAC bias	0.77 (0.07 to 1.47)	<u>Favoured exercise therapy</u> with a <u>large effect size</u>
Taglietti ⁴ at 3 months Cheung ⁵ yoga WOMAC bias	0.87 (0.20 to 1.54)	<u>Favoured exercise therapy</u> with a <u>very large effect size</u>
Taglietti ⁴ at 8 weeks Cheung ⁵ aerobic/resistance WOMAC bias	0.87 (0.07 to 1.67)	<u>Favoured exercise therapy</u> with a <u>very large effect size</u>
Taglietti ⁴ at 8 weeks Cheung ⁵ yoga WOMAC bias	0.97 (0.21 to 1.74)	<u>Favoured exercise therapy</u> with a <u>very large effect size</u>
Taglietti ⁴ at 3 months Cheung ⁵ aerobic/resistance VAS bias	0.48 (0.03 to 0.94)	<u>Favoured exercise therapy</u> with a <u>moderate effect size</u>
Taglietti ⁴ at 3 months Cheung ⁵ yoga VAS bias	0.58 (0.15 to 1.01)	<u>Favoured exercise therapy</u> with a <u>large effect size</u>
Taglietti ⁴ at 8 weeks Cheung ⁵ aerobic/resistance VAS bias	0.52 (0.02 to 1.02)	<u>Favoured exercise therapy</u> with a <u>large effect size</u>
Taglietti ⁴ at 8 weeks	0.62 (0.14 to 1.09)	<u>Favoured exercise therapy</u>

Cheung ⁵ yoga	with a <u>large effect size</u>
VAS bias	

2M.iii Patient education versus exercise therapy - short-term function.

This review reported that patient education was inferior to exercise therapy, with a moderate effect in the short term for function. This was based upon Cheung et al's⁵ exercise therapy intervention consisting of aerobic and resistance training, rather than yoga, due to comparability between the other pooled interventions.

Grouping	SMD and 95% CI	Outcome
Cheung ⁵ aerobic/resistance (in review)	0.33 (-0.02 to 0.69)	<u>Favoured exercise therapy</u> with a <u>moderate effect</u>
Cheung ⁵ yoga	0.55 (0.29 to 0.82)	<u>Favoured exercise therapy</u> with a <u>large effect</u>

2M.iv Exercise therapy versus patient education plus exercise therapy - short-term function.

This review reported that exercise therapy produces similar short-term outcomes for pain compared with a combination of therapist-facilitated education and exercise therapy. This is based upon Ay et al's⁶ outcomes at 3 months, to align with the outcome assessment time for the other trial included in the review. All three studies reported both VAS and WOMAC; WOMAC was chosen for alignment for other pain outcome assessments in this review.

Grouping	SMD and 95% CI	Outcome
Ay ⁶ 3 months	1.32 (-0.57 to 3.20)	<u>Similar outcomes between</u> <u>interventions</u>
Ay ⁶ 1 month	0.64 (0.03 to 1.25)	<u>Favoured patient education</u> <u>plus exercise therapy with a</u> <u>large effect size</u>

Appendix 3

[Appendix 3A](#) – Content rubrics to assess comprehensiveness, accuracy and clarity

[Appendix 3B](#) – Summary of comprehensiveness interventions

[Appendix 3C](#) – Delivery of interventions

[Appendix 3D](#) – Development of interventions

Appendix 3A – Content rubrics to assess comprehensiveness, accuracy and clarity

Content extraction criteria

Topic	Accurate and clear	Partially accurate/lacks clarity	Inaccurate	Not reported
Information about knee anatomy	<p>Accurately identifies/mentions (or labels if a diagram) contains all of the following:</p> <ul style="list-style-type: none"> Bone (femur, tibia and patella), Articular cartilage⁵⁰⁵ <p>If website provides specific details about function of articular cartilage it should be in line with the following:</p> <ul style="list-style-type: none"> Provides smooth, low-friction, gliding surfaces for free movement⁵⁰⁵ 	Does not fully align to full description in column 1	<p>Identifies/mentions (or labels if a diagram) some or all items in column 1, however either:</p> <p>Labels are placed incorrectly</p> <p>AND/OR</p> <p>Provides inaccurate/misleading description of cartilage</p>	Not mentioned
Information about pathophysiology knee of OA	<p>Provides description in line with either:</p> <p>Pathophysiology of knee OA is characterized by progressive deterioration and loss of articular cartilage with concomitant structural and functional changes in the entire joint, including the synovium, meniscus (in the knee), periarticular ligaments, and subchondral bone⁴⁰⁴</p> <p>OR</p> <p>Osteoarthritis is characterised pathologically by localised loss of cartilage, remodeling of adjacent bone and associated inflammation⁴¹</p>	Does not fully align to full description in column 1	<p>Provides an inaccurate description of the pathophysiology</p> <p>e.g. over time your cartilage disintegrates</p> <p>AND/OR</p> <p>Uses misleading wording e.g. ‘wear and tear’,</p> <p>AND/OR</p> <p>Inaccurate analogies e.g. comparing cartilage to car tires</p>	Not mentioned

	<p>OR</p> <p>Osteoarthritis is not just a disease of the cartilage but affects your whole joint including muscles and ligaments³²⁰</p>			
<p>Information about risk factors for knee OA</p>	<p>Must identify either all of the following:</p> <p><i>Non-modifiable</i> - Age typically 45+ but can be earlier, sex – more common in females, hereditary</p> <p><i>Modifiable</i> - Overweight/obese, physical inactivity, muscle weakness, sports/trauma related injuries²²</p> <p>OR</p> <p><i>Genetic</i></p> <p><i>Constitutional</i> - ageing, female, obesity</p> <p><i>Local</i> - largely biomechanical factors (e.g. reduced muscle strength, joint injury etc)⁴¹</p>	<p>Does not fully align to full description in column 1</p>	<p>Provides inaccurate or non-evidence-based risk factors</p>	<p>Not mentioned</p>
<p>Information about epidemiology of knee OA</p>	<p>Provides data regarding how common knee osteoarthritis is with credible reference</p> <p>e.g.</p> <ul style="list-style-type: none"> - Prevalence rises with age⁴ - Affects up to 1 in 4 people over the age of 50⁷² - Nearly 50% of people over the age of 75 (radiographic)⁷² <p>OR similar</p>	<p>Does not fully align to full description in column 1</p>	<p>Provides misleading information or data about knee OA</p> <p>e.g. suggesting that it is uncommon in those over 70</p>	<p>Not mentioned</p>
<p>Information about diagnosis of knee OA</p>	<p>For a <i>clinical diagnosis</i>:</p> <ul style="list-style-type: none"> • Aged 45 or over • Have activity-related joint pain 	<p>Does not fully align to full description in column 1</p>	<p>Provides an unsuitable/misleading criteria for diagnosis</p>	<p>Not mentioned</p>

	<ul style="list-style-type: none"> • Either no morning joint-related stiffness or morning stiffness that lasts no longer than 30 minutes⁴¹ <p>AND/OR</p> <ul style="list-style-type: none"> • Crepitus on active motion • Bony enlargement • No detectable warmth⁸ <p>OR</p> <p>For a <i>radiographic diagnosis</i>, classification of higher than 2 on the Kellgren-Lawrence scale⁹</p>			
<p>Information about symptoms of knee OA</p>	<p>Symptoms can vary from person to person³²⁰</p> <p>AND/OR</p> <ul style="list-style-type: none"> • Pain • Function limitation • Reduced quality of life⁴¹ <p>AND/OR</p> <ul style="list-style-type: none"> • Crepitus on active motion • Bony enlargement¹³⁵ 	Does not fully align to full description in column 1.	Provides details of symptoms that are not classically associated with knee osteoarthritis or suggests that all people with knee OA will have all of these symptoms	Not mentioned
<p>Information about biopsychosocial nature of pain</p>	Pain in itself is a complex biopsychosocial issue, related in part to individual's expectations and self-efficacy, and associated with changes in mood, sleep and coping abilities ⁴¹	Does not fully align to full description in column 1	Suggests that pain is directly related to deterioration of the cartilage	Not mentioned
<p>Information about self-</p>	Advocates and provides enough information for full replication of self-management strategies clinically using	Mentions self-management but does not provide enough	Strongly advocates self-management strategies that are proven ineffective	Not mentioned

management strategies	well referenced interventions: e.g. Lifestyle changes, pacing, relaxation, coping strategies and appropriate footwear ⁴¹	information for replication clinically		
Information about physical activity	<p>Provides information in line with either:</p> <p>Regular physical activity can reduce your pain, prevent worsening of your osteoarthritis, and improve your daily function³²⁰</p> <p>AND/OR</p> <p>Living a sedentary life could worsen your osteoarthritis and also increases your risk of other lifestyle-related diseases, such as diabetes and cardiovascular disease³²⁰</p> <p>AND/OR</p> <p>Reports ACSM or other accredited guideline suggesting a minimum of 5 x 30 mins per week of moderate intensity or 3 x 20 min vigorous intensity per week¹³</p>	Does not fully align to full description in column 1	States physical activity isn't important	Not mentioned
Information about exercise therapy	<p>Advise people with osteoarthritis to exercise as a core treatment irrespective of age, comorbidity, pain severity or disability. Exercise should include:</p> <ul style="list-style-type: none"> Local muscle/neuromuscular strengthening and general aerobic fitness⁴¹ 	Does not fully align to full description in column 1	States that exercise isn't important or is harmful for knee joint health ⁴⁰⁸	Not mentioned

Information about weight loss	If you are overweight and have osteoarthritis, it will be beneficial to lose weight and maintain a healthy weight through an individualized plan involving dietary changes and increased physical activity ³²⁰	Does not fully align to full description in column 1	States that weight loss isn't important	Not mentioned
Information about surgical management	<p>Describes that either:</p> <p>If you cannot achieve pain relief from your osteoarthritis, have under-taken a sustained period of recommended conservative management, and it is very difficult to perform activities of daily living, joint replacement surgery is an option³²⁰</p> <p>OR</p> <p><i>Risks</i>: revision, postoperative pain, satisfaction, mortality, complications (e.g. infections, blood clots, deep infection, heart attack, stroke)^{405,506}</p> <p>AND Benefits: improve QoL, improve cost per QALY⁴⁰⁶, improve pain and function⁴⁰⁵</p> <p>OR</p> <p>Keyhole surgery (arthroscopy) that involves washout of the joint and joint scraping should not be used to treat your pain unless there is a mechanical blocking of your joint³²⁰</p>	Does not fully align to full description in column 1	<p>Misleading information that total knee replacement surgery is suggested/suitable for most or all people with knee OA</p> <p>OR</p> <p>Indicate that success is guaranteed for all who have total knee replacement</p> <p>OR</p> <p>Suggests that keyhole surgery is effective even in the absence of mechanical blocking</p>	Not mentioned
Information about medical management	<p>Identifies the following:</p> <ul style="list-style-type: none"> You should avoid the use of nonsteroidal anti-inflammatory 	Does not fully align to full description in column 1	Promotes the use of other medications not recommended in guidelines or as in the first column	Not mentioned

	<p>drugs for your osteoarthritis over the long term³²⁰</p> <ul style="list-style-type: none"> You may get some pain relief from your osteoarthritis by using acetaminophen (paracetamol) medications³²⁰ <p>AND/OR</p> <ul style="list-style-type: none"> Intra-articular corticosteroid injections should be considered as an adjunct to core treatments for the relief of moderate to severe pain in people with osteoarthritis. Do not offer intra-articular hyaluronan injections for the management of osteoarthritis⁴¹ 		<p>Or states that medication eliminates pain?</p> <p>Or Advocates its use for the management of knee OA</p>	
Information about adjunct options	<p>Reports ALL of the following may be considered adjuncts which can be tried if required⁴¹</p> <ul style="list-style-type: none"> Hot and cold TENS Bracing, joint support or insoles 	Does not fully align to full description in column 1	<p>Either suggests adjuncts that are not recommended in NICE guidelines</p> <p>OR</p> <p>States that adjuncts will resolve pain or are a first line intervention</p>	Not mentioned

QoL = Quality of Life, QALY = quality-adjusted life-year, TENS = transcutaneous neuromuscular stimulation

Appendix 3B – Summarised comprehensiveness of interventions

	All patient education (n=38)	Provided as an intervention (n=23)	Provided as a control condition (n=15)
Total number of topics provided across all interventions/14	14	14	12
Mean number of topics provided/14	4	4	3
Median number of topics provided/14	3	4	3
Range of content topics provided amongst each intervention/14	0-11	0-11	0-11

Appendix 3C Delivery of interventions

Author	Intervention name	Method of facilitation	Who facilitates (if appropriate)	Number of sessions	Method of delivery						Are learning objectives identified?	Does it develop pain coping skills?
					Audio materials	Audio-visual materials	Face-to-face	Web-based	Telephone calls	Written materials		
Ackerman 2012	Intervention group	Group	'Peer leader' and health professional leader	6			Y			Y		Y
	*Control group	N.A	N.A	N.A						Y		Y
Allen 2010	OASMP	Individual	Health educator	12		Y			Y	Y	Y	Y
Allen 2016	Intervention group	Individual	Counsellor	18	Y	Y			Y	Y		Y
Allen 2019	PCST group	Individual	Counsellor	11	Y				Y	Y		Y
Ay 2013	Group 1	Mixed	Physician	2			Y			Y		
Baker 2001	*Control	Individual	Not Reported	7			Y			Y		
Bennell 2016	PCST only	Individual	Physiotherapist	13			Y		Y		Y	Y
	PCST + Ex-Th	Individual	Physiotherapist	13			Y		Y		Y	Y
Brosseau 2016	*Control AND Walking intervention	N.A	N.A	N.A						Y		
Chen 2019	*Control	Mixed	Physiotherapist and research assistant	9			Y		Y	Y		
	Education + Ex-Th	Mixed	Physiotherapist and research assistant	9			Y		Y	Y		
Cheung 2017	*Control	Individual	Research assistant	8					Y	Y		
Cheung 2020	*Control	Mixed	Registered nurse	14			Y		Y	Y		
Coleman 2012	OAK	Group	Nurses, physiotherapists	6			Y			Y	Y	Y

De Rezende 2016 & 2017	Group 1a		and occupational therapists							
		Group	Orthopaedic surgeons, psychologists, social workers, nutritionist, occupational therapists, physiotherapists and physical educators	2	Y	Y		Y		Y
	*Group 4b	N.A	N.A	N.A	Y			Y		Y
Dias 2017	Hydrotherapy	Group	Physiotherapist	1		Y				
	*Control	Mixed	Physiotherapist	7		Y		Y		
Ettinger 1997	*Control	Mixed	Nurses	16		Y		Y	Y	
Farr 2010	Self- management	Mixed	NR	36		Y		Y		Y
	Self- management + Ex-Th	Mixed	NR	13		Y		Y		Y
Ganji 2018	Intervention	Mixed	NR	6		Y		Y		
Helminen 2015	Intervention	Group	Psychologist and physiotherapist	6		Y		Y	Y	Y
Hinman 2020	*Control	Individual	Nurses	1				Y		
	Intervention	Individual	Nurse + physiotherapist	6			Y	Y	Y	Y
Keefe 2004	SA PCST	Group	Psychologists	12		Y			Y	Y
	SA PCST + Ex-Th	Group	Psychologists	12		Y			Y	Y
Messier 2004	*Healthy lifestyle control	Mixed	Health educator and Physician videos	12	Y	Y		Y		
	*Diet only AND	Mixed	NR	55		Y		Y	Y	Y

	Diet/exercise											
Murphy 2018	Intervention	Individual	Occupational therapist and videos of other health professionals	8		Y	Y					Y
O'Brien 2018	Intervention	Individual	Allied health professionals Trained telephone interviewer	11				Y		Y		Y
O'Moore 2018	Intervention	N.A	N.A	N.A				Y				Y
Oh 2020	*Control AND Intervention	Group	Doctors, physical education professionals, nurses, nutritionists, and exercise experts	5		Y						Y
Quingguang 2017	*Control	Group	NR	24		Y						
Taglietti 2018	Education group	Group	Physician, pharmacist, nurse, nutritionist, psychologist, physiotherapist, and physical educator	8		Y			Y			Y
Victor 2005	Patient education program	Group	Nurse	5		Y			Y	Y		Y
	*Control	N.A	N.A	N.A					Y			
				Mean – 11 Median – 9 Range –0-55	Y n= 2	Y n= 5	Y n= 26	Y n= 3	Y n= 19	Y n= 22	Y n= 13	Y n= 23

* identified as a control group

Y= Yes, Blank = not reported, N.A= Not Applicable, Ex-Th = Exercise therapy, SA = Spouse assisted, PCST = Pain Coping skills training

Appendix 3D – Full development characteristics of included patient education interventions

Author	Intervention name	Theory-based? (named)	Based on other research in chronic conditions?	Based on research in osteoarthritis?	Co- design?
Ackerman 2012	Intervention group	Y (Social learning theory Learned helplessness Personal constructs)	Y	Y	Y
	*Control group				
Allen 2010	OASMP	Y (Social cognitive theory)	Y	Y	
Allen 2016	Intervention group	Y (Social cognitive theory)	Y	Y	
Allen 2019	PCST group	Y (Pain coping skills training - derived from cognitive behavioural therapy)	Y	Y	Y
Ay 2013	Group 1				
Baker 2001	*Control				
Bennell 2016	PCST only	Y (Pain coping skills training - derived from cognitive behavioural therapy)	Y	Y	
	PCST + Ex- Th	Y (Pain coping skills training - derived from cognitive behavioural therapy)	Y	Y	
Brosseau 2016	*Control AND Walking intervention				
Chen 2019	*Control Education + Ex-Th				
Cheung 2017	*Control				
Cheung 2020	*Control				

Coleman 2012	OAK	Y (Social cognitive theory)	Y	Y
De Rezende 2016 & 2017	Group 1a			
	*Group 4b			
Dias 2017	Hydrotherapy			
	*Control			
Ettinger 1997	*Control			
Farr 2010	Self-management			
	Self-management + Ex-Th			
Ganji 2018	Intervention			
Helminen 2015	Intervention	Y (Pain coping skills training - derived from cognitive behavioural therapy)	Y	Y
Hinman 2020	*Control			
	Intervention	Y (‘Health change’ methodology)		Y
Keefe 2004	SA PCST	Y (Pain coping skills training - derived from cognitive behavioural therapy)	Y	Y
	SA PCST + Ex-Th	Y (Pain coping skills training - derived from cognitive behavioural therapy)	Y	Y
Messier 2004	*Healthy lifestyle control			
	*Diet only AND Diet/exercise	Y (Group dynamics literature and social cognitive theory)	Y	

Murphy 2018	Intervention	Y (Cognitive behavioural therapy)	Y		
O'Brien 2018	Intervention	Y (Motivational interviewing)	Y		
O'Moore 2018	Intervention	Y (Cognitive behavioural therapy)	Y		
Oh 2020	*Control AND Intervention		Y	Y	
Quinguan g 2017	*Control				
Taglietti 2018	Education group	Y (Social cognitive theory)	Y	Y	
Victor 2005	Patient education program		Y	Y	
	*Control				
	Intervention <i>n</i> = 27	Y <i>n</i> = 16	Y <i>n</i> = 17	Y <i>n</i> = 12	Y <i>n</i> = 4

*control intervention

Y= Yes, Blank = not reported, N.A= Not Applicable, Ex-Th = Exercise therapy, SA = Spouse assisted,
PCST = Pain Coping skills training

Appendix 4

[Appendix 4A](#) – Search results from web-content analysis

[Appendix 4B](#) – Comprehensiveness, accuracy and clarity

[Appendix 4C](#) – Quality of information about treatment choices, credibility and readability

[Appendix 4D](#) – Sensitivity analyses of web-content evaluation

Appendix 4A – Search results, extraction decisions and website characteristics

	URL form search	Included, excluded or pooled?	Reason for exclusion?	Website study ID	Australia-based?	Co-designed?	Selling/ advertising products?
20 URL's from Google search: Knee osteoarthritis							
1	https://www.arthritis-health.com/types/osteoarthritis/what-knee-osteoarthritis#:~:text=Knee%20osteoarthritis%20is%20a%20condition,from%20joint%20friction%20and%20impact.	Included	N.A	1	No	No	No
2	https://orthoinfo.aaos.org/en/diseases--conditions/arthritis-of-the-knee/	Included	N.A	2	No	No	No
3	https://arthritisaustralia.com.au/what-is-arthritis/areas-of-the-body/knees/	Included	N.A	3	Yes	No	No
4	https://www.mayoclinic.org/diseases-conditions/osteoarthritis/diagnosis-treatment/drc-20351930	Included	N.A	4	No	No	Yes
5	https://www.webmd.com/osteoarthritis/osteoarthritis-of-the-knee-degenerative-arthritis-of-the-knee	Included	N.A	5	No	No	No
6	https://www.healthline.com/health/osteoarthritis-stages-of-osteoarthritis-of-the-knee	Included	N.A	6	No	No	No
7	https://www.physio-pedia.com/Knee_Osteoarthritis	Included	N.A	7	No	No	No
8	https://www.ibji.com/blog/orthopedic-care/arthritis-in-knee-4-stages-of-osteoarthritis/	Included	N.A	8	No	No	No
9	https://www.ncbi.nlm.nih.gov/books/NBK507884/	Excluded	Peer-review article				
10	https://www.health.harvard.edu/pain/moving-away-from-knee-osteoarthritis	Included	N.A	9	No	No	No
11	https://www.safetyandquality.gov.au/standards/clinical-care-standards/osteoarthritis-knee-clinical-care-standard	Included	N.A	10	Yes	No	No
12	https://www.arthritis.org/diseases/osteoarthritis	Included	N.A	11	No	No	No
13	https://www.aihw.gov.au/reports/chronic-musculoskeletal-conditions/osteoarthritis/contents/what-is-osteoarthritis	Included	N.A	12	Yes	No	No
14	https://www.medicalnewstoday.com/articles/310579	Included	N.A	13	No	No	No

15	https://www.versusarthritis.org/about-arthritis/conditions/osteoarthritis-of-the-knee/	Included	N.A	14	No	No	No
16	https://www.parkclinic.com.au/knee-osteoarthritis	Included	N.A	15	Yes	No	Yes
17	https://physioworks.com.au/pain-injury/knee-pain/knee-arthritis/	Included	N.A	16	Yes	No	Yes
18	https://www.cdc.gov/arthritis/basics/osteoarthritis.htm	Included	N.A	17	No	No	No
19	https://www.racgp.org.au/clinical-resources/clinical-guidelines/handi/handi-interventions/musculoskeletal/exercise-for-knee-osteoarthritis	Included	N.A	18	Yes	No	No
20	https://www.sciencedirect.com/topics/medicine-and-dentistry/knee-osteoarthritis	Excluded	Peer-review article				
20 URL's from Google search: knee arthritis							
21	https://orthoinfo.aaos.org/en/diseases--conditions/arthritis-of-the-knee/	Excluded	Duplicate of website				
22	https://www.healthline.com/health/osteoarthritis/knee-arthritis-symptoms	Pooled with website 6					
23	https://arthritisaustralia.com.au/what-is-arthritis/areas-of-the-body/knees/	Excluded	Duplicate of website				
24	https://www.arthritis-health.com/types/general/6-types-arthritis-affect-knee	Pooled with website 1					
25	https://www.webmd.com/osteoarthritis/osteoarthritis-of-the-knee-degenerative-arthritis-of-the-knee	Excluded	Duplicate of website				
26	https://www.medicalnewstoday.com/articles/311138	Pooled with website 14					
27	https://physioworks.com.au/pain-injury/knee-pain/knee-arthritis/	Excluded	Duplicate of website				
28	https://www.mayoclinic.org/diseases-conditions/osteoarthritis/diagnosis-treatment/drc-20351930	Excluded	Duplicate of website				
29	https://www.versusarthritis.org/about-arthritis/conditions/osteoarthritis-of-the-knee/	Excluded	Duplicate of website				
30	https://health.clevelandclinic.org/whats-the-best-way-to-find-relief-from-your-knee-arthritis-pain/	Included	N.A	19	No	No	No

31	https://www.physio-pedia.com/Knee_Osteoarthritis	Excluded	Duplicate of website				
32	https://orthotrauma.com.au/knee-conditions/knee-arthritis/	Included	N.A	20	Yes	No	No
33	https://www.health.harvard.edu/pain/moving-away-from-knee-osteoarthritis	Excluded	Duplicate of website				
34	https://www.arthritis.org/health-wellness/healthy-living/physical-activity/other-activities/6-exercises-for-knee-oa-pain	Pooled with website 12					
35	https://www.arthritis.org/diseases/osteoarthritis	Excluded	Duplicate of website				
36	https://www.ibji.com/blog/orthopedic-care/arthritis-in-knee-4-stages-of-osteoarthritis/	Excluded	Duplicate of website				
37	https://www.cdc.gov/arthritis/basics/osteoarthritis.htm	Excluded	Duplicate of website				
38	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5638628/	Excluded	Peer-review article				
39	https://www.hss.edu/conditions_arthritis-of-the-knee-total-knee-replacement.asp	Included	N.A	21	No	No	No
40	https://www.nhs.uk/conditions/arthritis/	Included	N.A	22	No	No	No
20 URL's from Bing search: Knee osteoarthritis							
41	https://www.webmd.com/osteoarthritis/osteoarthritis-of-the-knee-degenerative-arthritis-of-the-knee	Excluded	Duplicate of website				
42	https://www.msk.org.au/osteoarthritis-knee/	Included	N.A	23	Yes	No	No
43	https://www.medicalnewstoday.com/articles/310579	Excluded	Duplicate of website				
44	https://arthritisaustralia.com.au/what-is-arthritis/areas-of-the-body/knees/	Excluded	Duplicate of website				
45	https://weimuscloskeletalinstitute.org/knee/	Included	N.A	24	No	No	Yes
46	https://www.nutreance.com/products/redimove?h=1&msclkid=67055a17ecd51182c106059ec76c285d&utm_source=bing&utm_medium=cpc&utm_campaign=RediMove%20-%20Search%20AU&utm_term=arthritis%20in%20knee&utm_content=arthritis%20knee%20%5Bexact%5D	Included	N.A	25	No	No	Yes
47	https://blueheronhealthnews.com/health/the-beat-arthritis-strategy-vsl-	Included	N.A	26	No	No	Yes

	cb/?utm_source=clickbank&utm_medium=affiliate&utm_campaign=surajsu&cba=cb						
48	https://conneli.com/AU-CBD-News/index.php?sxid=59pglfxid8g5&ttorigin=59pglfxid8g5	Excluded	Irrelevant				
49	https://artisanmed.com/product/artisan-alvarado-knee-positioner-boot-platform/	Included	N.A	27	No	No	Yes
50	https://www.mayoclinic.org/diseases-conditions/osteoarthritis/diagnosis-treatment/drc-20351930	Excluded	Duplicate of website				
51	https://www.versusarthritis.org/about-arthritis/conditions/osteoarthritis-of-the-knee/	Excluded	Duplicate of website				
52	https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/osteoarthritis	Included	N.A	28	Yes	No	No
53	https://www.healthdirect.gov.au/osteoarthritis	Included	N.A	29	Yes	No	No
54	https://www.arthritis-health.com/types/osteoarthritis/knee-osteoarthritis-treatment	Pooled with website 1					
55	https://www.healthline.com/health/osteoarthritis-stages-of-osteoarthritis-of-the-knee	Excluded	Duplicate of website				
56	https://radiopaedia.org/articles/osteoarthritis-of-the-knee	Included	N.A	30	No	No	No
57	https://www.aihw.gov.au/reports/chronic-musculoskeletal-conditions/osteoarthritis/contents/treatment-management	Excluded	Duplicate of website				
58	https://www.mayoclinic.org/diseases-conditions/osteoarthritis/diagnosis-treatment/drc-20351930	Excluded	Duplicate of website				
59	https://www.pronto.com/au/shopping?qo=semQuery&ad=semA&q=treatment%20of%20osteoarthritis%20of%20the%20knee&o=765336&ag=fw4&an=msn_s&adid=79371119414630&agid=1269936534930681&campaignid=389468356&clickid=78403b3457a0186ecc5364bd7a308acc&clid=aj-au4&kwid=kwd-79371371995735%3Aloc-9&msclkid=78403b3457a0186ecc5364bd7a308acc&rch=intl1690&rtb=29535&utm_medium=bcpc&utm_source=b	Excluded	Irrelevant				
60	https://www.simpli.com/web?qo=semQuery&ad=semA&q=osteo%20arthritis%20of%20knee&o=780179&ag=fw4&an=msn_s&adid=76003875905859&agid=1216060219088200&campaignid=355686188&clickid=0e1aafa1bb9113ec8bf0f028960173db&clid=aj-teoma-jp&kwid=kwd-76003992303266%3Aloc-	Excluded	Irrelevant				

	9&msslkid=0e1aafa1bb9113ec8bf0f028960173db&rch=intl95&utm_medium=bcpc&utm_source=b						
20 URL's from Bing search: knee arthritis							
61	https://conneli.com/AU-CBD-News/index.php?sxid=59pglfxid8g5&ttorigin=59pglfxid8g5	Excluded	Duplicate of website				
62	http://www.stemcelltherapyplus.com/?msslkid=43d70860a75b16c1c98d57e9881cd8aa	Included	N.A	31	No	No	Yes
63	https://www.pronto.com/au/shopping?qo=semQuery&ad=semA&q=treatment%20of%20osteoarthritis%20of%20the%20knee&o=765336&ag=fw4&an=msn_s&adid=79371119414630&agid=1269936534930681&campaignid=389468356&clickid=78403b3457a0186ecc5364bd7a308acc&clid=aj-au4&kwid=kwd-79371371995735%3Aloc-9&msslkid=78403b3457a0186ecc5364bd7a308acc&rch=intl1690&rtb=29535&utm_medium=bcpc&utm_source=b	Excluded	Irrelevant				
64	https://www.simpli.com/web?qo=semQuery&ad=semA&q=osteo%20arthritis%20of%20knee&o=780179&ag=fw4&an=msn_s&adid=76003875905859&agid=1216060219088200&campaignid=355686188&clickid=0e1aafa1bb9113ec8bf0f028960173db&clid=aj-teoma-jp&kwid=kwd-76003992303266%3Aloc-9&msslkid=0e1aafa1bb9113ec8bf0f028960173db&rch=intl95&utm_medium=bcpc&utm_source=b	Excluded	Irrelevant				
65	https://www.healthline.com/health/osteoarthritis-stages-of-oa-of-the-knee	Excluded	Duplicate of website				
66	https://arthritisaustralia.com.au/what-is-arthritis/areas-of-the-body/knees/	Excluded	Duplicate of website				
67	https://www.webmd.com/osteoarthritis/osteoarthritis-of-the-knee-degenerative-arthritis-of-the-knee	Excluded	Duplicate of website				
68	https://www.msk.org.au/osteoarthritis-knee/	Excluded	Duplicate of website				
69	https://www.info.com.au/serp?q=i%20have%20arthritis%20in%20my%20knee&segment=infoau.016&s1aid=149356716&s1cid=371059648&s1agid=1156686546860082&s1kid=kwd-72293172962900:loc-9&utm_source=adcenter&msslkid=d1dc5136f4fb15df6c530ebfdbbc6de6	Excluded	Irrelevant				

70	https://www.verywellhealth.com/knee-arthritis-2548572	Included	N.A	32	No	No	No
71	https://www.medicalnewstoday.com/articles/310579	Excluded	Duplicate of website				
72	https://physioworks.com.au/pain-injury/knee-pain/knee-arthritis/	Excluded	Duplicate of website				
73	https://www.versusarthritis.org/about-arthritis/conditions/osteoarthritis-of-the-knee/	Excluded	Duplicate of website				
74	https://www.mayoclinic.org/diseases-conditions/osteoarthritis/diagnosis-treatment/drc-20351930	Excluded	Duplicate of website				
75	https://www.healthdirect.gov.au/osteoarthritis	Excluded	Duplicate of website				
76	https://orthosports.com.au/knee/knee-arthritis/	Included	N.A	33	Yes	No	No
77	https://www.thephysioco.com.au/exercises-for-managing-knee-osteoarthritis/	Included	N.A	34	Yes	No	No
78	https://www.knee-pain-explained.com/arthritis-pain-in-knee.html	Included	N.A	35	No	No	No
79	https://www.arthritis-health.com/types/osteoarthritis/knee-osteoarthritis-treatment	Excluded	Duplicate of website				
80	https://www.arthritis.org/health-wellness/about-arthritis/where-it-hurts/when-knee-pain-may-mean-arthritis	Pooled with website 12					
		Included = 35	Peer review article = 3		Yes = 12	Yes = 0	Yes = 8
		Excluded = 9	Irrelevant = 6		No = 23	No = 35	No = 27

N.A = Not applicable

Appendix 4B – Comprehensiveness, accuracy and clarity

Website study ID and hyperlink*	INFORMATION ABOUT KNEE OSTEOARTHRITIS							INFORMATION ABOUT FIRST-LINE CARE OPTIONS				INFORMATION ABOUT OTHER TREATMENT OPTIONS			Comprehensiveness n=14
	Knee anatomy	Pathophysiology of knee OA	Risk factors	Epidemiology of knee OA	Diagnosis of knee OA	Symptoms of knee OA	Details about the biopsychosocial nature of pain	Self-management strategies	Physical activity	Exercise therapy	Weight loss	Pharmacological management	Surgical management	Adjunct options	
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
2	1	1	1	1	1	1		1	1	1	1	1	1	1	13
3		1	1	1	1	1	1	1	1	1	1	1	1	1	13
4		1	1	1	1	1	1	1	1	1	1	1	1	1	13
5	1	1	1	1	1	1			1	1	1	1	1	1	12
6		1	1	1	1	1		1	1	1	1	1	1	1	12
7	1	1	1	1	1	1	1	1		1	1	1	1	1	13
8	1	1	1	1	1	1		1	1	1	1	1	1		12
9		1	1	1		1		1	1	1	1				8
10		1	1	1	1	1	1	1	1	1	1	1	1		12
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14

<u>12</u>	1	1	1	1		1	1		1	1	1	1	1		11
<u>13</u>	1	1	1	1	1	1		1	1	1	1	1	1	1	13
<u>14</u>	1	1	1	1		1	1	1	1	1	1	1	1	1	13
<u>15</u>								1	1	1	1	1		1	6
<u>16</u>	1	1	1	1	1	1				1			1	1	9
<u>17</u>		1	1	1	1	1		1	1	1	1	1	1	1	12
<u>18</u>										1					1
<u>19</u>	1	1	1	1		1		1	1	1	1	1	1	1	12
<u>20</u>		1	1		1	1			1	1		1	1		8
<u>21</u>	1	1	1	1	1	1		1		1	1	1	1	1	12
<u>22</u>		1	1	1	1	1		1	1	1	1	1	1	1	12
<u>23</u>	1		1	1	1	1		1		1	1	1	1	1	11
<u>24</u>		1				1						1	1	1	5
<u>25</u>		1				1								1	3
<u>26</u>															0
<u>27</u>															0
<u>28</u>		1	1		1	1		1	1	1	1	1	1		10
<u>29</u>	1	1	1	1	1	1		1	1	1	1	1	1	1	13

30	1			1	1										3
31															0
32	1	1	1	1	1	1		1	1	1	1	1	1	1	13
33	1		1		1					1	1	1	1		7
34		1				1	1			1	1	1	1		7
35	1	1	1	1	1	1		1	1	1	1	1	1	1	13

**hyperlinks live and created on 4.8.21

OA = Osteoarthritis

Key

	Australia-based
Red text	Advertising product or service
	Accurate and clear
	Partially accurate/lacks clarity
	Inaccurate
	Not reported

Appendix 4C – Quality of information about treatment choices, credibility and readability

4C.i Quality of information about treatment options

Website study ID**	Assessor AJG = 1 MM = 2	DISCERN item* (score 1-5)																Total composite	Mean composite
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
1	1	2	2	4	5	5	4	4	4	4	4	2	2	1	5	3	3	54	53
	2	2	2	4	4	4	4	3	4	4	5	2	2	1	4	4	3	52	
2	1	1	1	4	2	5	2	2	2	3	3	3	1	1	4	3	2	39	39
	2	1	1	3	2	4	3	2	2	3	4	2	1	1	4	4	2	39	
3	1	3	4	5	2	2	4	3	5	4	4	4	2	2	5	3	3	55	53
	2	4	3	4	2	2	3	3	4	4	3	3	2	2	4	4	3	50	
4	1	1	1	4	1	4	3	2	2	3	3	3	1	3	4	2	2	39	38
	2	1	1	3	1	3	2	3	2	2	4	3	1	2	4	3	2	37	
5	1	2	3	4	1	5	3	2	2	3	3	2	1	2	4	2	3	42	40
	2	2	2	3	1	4	4	3	2	2	2	2	1	2	4	2	2	38	
6	1	1	1	3	2	5	3	4	2	2	2	2	1	1	3	2	2	36	37
	2	1	1	3	2	4	3	3	2	2	3	3	1	1	4	3	2	38	
7	1	1	1	5	5	2	4	4	3	4	4	2	2	2	5	2	3	49	48
	2	1	1	4	4	2	4	4	3	4	4	2	2	2	5	2	3	47	
8	1	1	1	4	1	5	2	2	1	2	2	1	2	1	3	2	2	32	32
	2	1	1	3	1	4	2	2	1	3	3	1	2	1	3	2	2	32	
9	1	1	1	4	2	5	3	2	1	2	2	1	2	1	2	3	2	34	35
	2	1	1	4	2	4	4	2	1	2	3	1	2	1	3	2	2	35	
10	1	4	4	4	2	3	4	4	3	4	5	3	2	4	5	5	4	60	56
	2	3	3	4	2	4	4	4	2	3	3	3	2	3	4	5	3	52	
11	1	2	2	5	1	1	4	2	3	4	4	3	3	3	5	3	3	48	44
	2	2	2	3	1	1	3	2	2	3	3	2	2	4	4	3	2	39	
12	1	1	1	5	4	5	4	3	4	4	4	2	2	2	5	3	3	52	50
	2	1	1	4	4	4	4	3	3	3	4	2	2	2	4	3	3	47	
13	1	1	1	3	2	5	3	4	3	2	2	2	2	3	3	2	3	41	41
	2	1	1	3	2	4	4	3	2	3	3	2	2	3	3	3	3	42	
14	1	1	1	5	1	1	5	4	3	5	5	4	4	3	5	2	3	52	50

	2	1	1	4	1	1	4	3	3	4	4	3	3	5	4	3	3	47	
<u>15</u>	1	1	1	4	2	1	2	1	2	2	3	2	1	3	4	2	2	33	36
	2	1	1	4	2	1	3	1	3	3	4	3	1	3	4	2	2	38	
<u>16</u>	1	1	1	4	1	1	3	3	1	3	3	1	2	1	3	2	2	32	31
	2	1	1	3	1	1	3	3	1	3	2	1	2	1	3	3	2	31	
<u>17</u>	1	1	1	4	1	5	4	3	3	3	3	1	2	2	4	2	3	42	42
	2	1	1	4	1	4	4	3	2	3	3	1	2	3	4	3	3	42	
<u>18</u>	1	1	1	5	3	4	3	4	4	4	5	4	1	4	2	3	3	51	51
	2	1	1	4	3	5	4	4	4	5	5	4	1	3	2	2	3	51	
<u>19</u>	1	1	1	3	1	5	3	3	3	3	3	3	1	1	4	3	3	41	38
	2	1	1	3	1	4	2	2	2	2	4	3	1	1	4	3	2	36	
<u>20</u>	1	1	1	3	1	1	2	1	4	2	3	1	1	2	3	2	2	30	31
	2	1	1	4	1	1	3	1	4	2	3	1	1	2	3	2	2	32	
<u>21</u>	1	1	1	3	1	5	2	2	3	3	3	3	2	3	3	3	3	41	39
	2	1	1	2	1	4	2	2	2	3	3	3	2	4	4	2	2	38	
<u>22</u>	1	1	1	4	1	5	4	3	4	4	4	2	2	3	5	4	3	50	47
	2	1	1	3	1	4	4	3	3	3	3	2	2	3	4	4	3	44	
<u>23</u>	1	1	1	4	1	1	4	5	4	4	4	3	3	4	5	4	3	51	51
	2	1	1	5	1	1	4	4	5	3	4	2	2	5	4	5	3	50	
<u>24</u>	1	1	1	3	1	1	4	4	5	2	3	2	2	5	3	5	3	45	47
	2	1	1	5	1	1	4	4	5	3	4	2	2	5	4	5	3	50	
<u>25</u>	1	1	1	2	1	2	1	1	2	2	3	1	2	2	1	1	2	25	24
	2	1	1	2	1	2	1	1	2	2	2	1	2	2	1	1	1	23	
<u>26</u>	1	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	18	18
	2	1	1	1	1	1	1	1	1	1	2	1	1	2	1	1	1	18	
<u>27</u>	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	17	17
	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	17	
<u>28</u>	1	1	1	4	2	3	4	4	3	4	4	2	3	3	4	4	3	49	45
	2	1	1	4	2	2	3	3	3	3	3	2	2	2	4	4	3	42	
<u>29</u>	1	3	4	4	2	4	4	5	3	4	4	2	2	3	4	4	3	55	51
	2	2	3	4	2	3	5	4	3	3	4	2	2	2	4	4	3	47	
<u>30</u>	1	1	1	2	3	2	2	2	1	1	1	1	1	1	1	1	1	22	22
	2	1	1	2	3	2	2	2	1	1	1	1	1	1	1	1	1	22	
<u>31</u>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	16
	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16	

32	1	1	1	4	2	5	4	2	2	3	4	1	2	2	4	2	3	42	41
	2	1	1	3	2	4	4	2	2	3	3	1	2	3	4	3	3	41	
33	1	1	1	3	1	1	3	2	3	4	4	2	2	1	4	3	2	37	36
	2	1	1	2	1	1	3	2	3	3	3	3	2	1	4	3	2	35	
34	1	2	3	3	1	5	2	1	2	3	3	1	1	2	2	2	2	35	34
	2	2	3	2	1	4	2	1	2	3	2	1	1	3	2	2	2	33	
35	1	2	3	3	1	5	4	3	2	3	4	2	2	2	4	3	3	46	43
	2	2	2	2	1	4	3	2	2	3	3	2	2	2	4	3	2	39	
Mean score for each item		1.33	1.41	3.34	1.69	2.97	3.04	2.59	2.53	2.84	3.17	2.00	1.71	2.24	3.40	2.69	2.46		
Rank (highest = 1)		16	15	2	14	5	4	8	9	6	3	12	13	11	1	7	10		
																		Mean	39
																		Median	40
																		Min	16
																		Max	56

**hyperlinks live and created on 4.8.21

AJG = Anthony James Goff, MM = Mark Merolli

Key

	Australia-based
Red text	Advertising product or service
DISCERN item	
1	Are the aims clear?
2	Does it achieve its aims?
3	Is it relevant?
4	Is it clear what sources of information were used to compile the publication (other than the author or producer)?
5	Is it clear when the information used or reported in the publication was produced?
6	Is it balanced and unbiased?
7	Does it provide details of additional sources of support and information?
8	Does it refer to areas of uncertainty?
9	Does it describe how each treatment works?
10	Does it describe the benefits of each treatment?

11	Does it describe the risks of each treatment?
12	Does it describe what would happen if no treatment is used?
13	Does it describe how the treatment choices affect overall quality of life?
14	Is it clear that there may be more than one possible treatment choice?
15	Does it provide support for shared decision-making?
16	Based on the answers to all of the above questions, rate the overall quality of the publication as a source of information about treatment choices

4C.ii Credibility of websites

Website study ID and hyperlink*	1 - Authoritative - Indicate the qualifications of the authors	2 - Complementarity - Information should support, not replace, the doctor-patient relationship	3 - Privacy - Respect the privacy and confidentiality of personal data submitted to the site by the visitor	4 - Attribution - Cite the source(s) of published information, date medical and health pages	5 - Justifiability - Site must back up claims relating to benefits and performance	6 - Transparency - Accessible presentation, accurate email contact	7 - Financial Disclosure - Identify funding sources	8 - Advertising Policy - Clearly distinguish advertising from editorial content	Is the overall website HONcode certified?	Date of initial review? (MMM-YY or N.A)	When is the certification valid until? (MMM-YY or N.A)"
1									Y	Dec-13	Jul-20
2									N	N.A	N.A
3									Y	Jul-11	Dec-15
4									Y	Mar-97	Apr-21
5									Y	Feb-00	Aug-21
6									Y	Nov-07	Jan-21
7									N	N.A	N.A
8									N	N.A	N.A
9									N	N.A	N.A
10									N	N.A	N.A
11									N	N.A	N.A
12									N	N.A	N.A
13									Y	Sep-14	Feb-20
14									N	N.A	N.A
15									Y	N.A	N.A
16									N	N.A	N.A
17									N	N.A	N.A
18									N	N.A	N.A
19									N	N.A	N.A
20									N	N.A	N.A

21									N	N.A	N.A
22									N	N.A	N.A
23									N	N.A	N.A
24									N	N.A	N.A
25									N	N.A	N.A
26									N	N.A	N.A
27									N	N.A	N.A
28									Y	Dec-01	Oct-20
29									Y	Feb-02	Jul-21
30									N	N.A	N.A
31									N	N.A	N.A
32									Y	Jun-16	Sep-20
33									N	N.A	N.A
34									N	N.A	N.A
35									Y	Dec-18	Feb-20

N.A = Not available

Key

	Australia-based
Red text	Advertising product or service
	Present and clear
	Present but unclear
	Not present

4C.iii Readability of websites

	Webpage URL	Flesch Reading Ease per webpage	Flesch Reading ease for analysis	Flesch Kincaid Grade Level per page	Final Flesch Kincaid Grade Level for analysis
1	https://www.arthritis-health.com/types/osteoarthritis/what-knee-osteoarthritis#:~:text=Knee%20osteoarthritis%20is%20a%20condition,from%20joint%20friction%20and%20impact.	54.6	47.3	7	8
	https://www.arthritis.org/health-wellness/healthy-living/physical-activity/other-activities/6-exercises-for-knee-oa-pain	46.4		8.3	
	https://www.arthritis.org/health-wellness/about-arthritis/where-it-hurts/when-knee-pain-may-mean-arthritis	40.8		9.2	
2	https://orthoinfo.aaos.org/en/diseases--conditions/arthritis-of-the-knee/	49	49	10.5	11
3	https://arthritisaustralia.com.au/what-is-arthritis/areas-of-the-body/knees/	51.3	51.3	7.5	8
4	https://www.mayoclinic.org/diseases-conditions/osteoarthritis/diagnosis-treatment/drc-20351930	55.2	55.2	7.2	7
5	https://www.webmd.com/osteoarthritis/ostearthritis-of-the-knee-degenerative-arthritis-of-the-knee	54.6	54.6	7.8	8
6	https://www.healthline.com/health/osteoarthritis-stages-of-oa-of-the-knee	58.9	63	7.4	7
	https://www.healthline.com/health/osteoarthritis/knee-arthritis-symptoms	67.1		5.9	
7	https://www.physio-pedia.com/Knee_Osteoarthritis	43.5	43.5	8.9	9
8	https://www.ibji.com/blog/orthopedic-care/arthritis-in-knee-4-stages-of-osteoarthritis/	55.9	55.9	6.6	7

9	https://www.health.harvard.edu/pain/moving-away-from-knee-osteoarthritis	64.7	64.7	5.6	6
10	https://www.safetyandquality.gov.au/standards/clinical-care-standards/osteoarthritis-knee-clinical-care-standard	20.8	20.8	10.2	10
11	https://www.arthritis.org/diseases/osteoarthritis	60.6	61.1	6.7	7
	https://www.arthritis.org/health-wellness/healthy-living/physical-activity/other-activities/6-exercises-for-knee-oa-pain	64.7		5.9	
	https://www.arthritis.org/health-wellness/about-arthritis/where-it-hurts/when-knee-pain-may-mean-arthritis	58.1		6.9	
12	https://www.aihw.gov.au/reports/chronic-musculoskeletal-conditions/osteoarthritis/contents/what-is-osteoarthritis	48.4	48.4	7.9	8
13	https://www.medicalnewstoday.com/articles/310579	61.3	58.2	7.4	8
	https://www.medicalnewstoday.com/articles/311138	55.1		7.7	
14	https://www.versusarthritis.org/about-arthritis/conditions/osteoarthritis-of-the-knee/	74.2	74.2	5.8	6
15	https://www.parkclinic.com.au/knee-osteoarthritis	44.6	44.6	10.4	10
16	https://physioworks.com.au/pain-injury/knee-pain/knee-arthritis/	49.5	49.5	7.6	8
17	https://www.cdc.gov/arthritis/basics/osteoarthritis.htm	45.9	45.9	8.4	8
18	https://www.racgp.org.au/clinical-resources/clinical-guidelines/handi/handi-interventions/musculoskeletal/exercise-for-knee-osteoarthritis	33.5	33.5	10	10
19	https://health.clevelandclinic.org/whats-the-best-way-to-find-relief-from-your-knee-arthritis-pain/	60.7	60.7	6.6	7
20	https://orthotrauma.com.au/knee-conditions/knee-arthritis/	48.6	48.6	8.6	9
21	https://www.hss.edu/conditions_arthritis-of-the-knee-total-knee-replacement.asp	55.5	55.5	9.2	9
22	https://www.nhs.uk/conditions/arthritis/	51.8	51.8	8.4	8
23	https://www.msk.org.au/osteoarthritis-knee/	61.6	61.6	7.1	7
24	https://weimusculoskeletalinstitute.org/knee/	44.2	44.2	9.4	9

25	https://www.nutreance.com/products/redimove?h=1&msclkid=67055a17ecd51182c106059ec76c285d&utm_source=bing&utm_medium=cpc&utm_campaign=RediMove%20-%20Search%20AU&utm_term=arthritis%20in%20knee&utm_content=arthritis%20knee%20%5Bexact%5D	60.7	60.7	6.8	7
26	https://blueheronhealthnews.com/health/the-beat-arthritis-strategy-vsl-cb/?utm_source=clickbank&utm_medium=affiliate&utm_campaign=surajsu&cba=cb	58.1	58.1	7.9	8
27	https://artisanmed.com/product/artisan-alvarado-knee-positioner-boot-platform/	47.1	47.1	7.9	8
28	https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/osteoarthritis	34.4	34.4	10.6	11
29	https://www.healthdirect.gov.au/osteoarthritis	53.2	53.2	8.1	8
30	https://radiopaedia.org/articles/osteoarthritis-of-the-knee	26.5	26.5	10.6	11
31	http://www.stemcelltherapyplus.com/?msclkid=43d70860a75b16c1c98d57e9881cd8aa	43.8	43.8	9.7	10
32	https://www.verywellhealth.com/knee-arthritis-2548572	54.9	54.9	7.2	7
33	https://orthosports.com.au/knee/knee-arthritis/	53.2	53.2	8	8
34	https://www.thephysioco.com.au/exercises-for-managing-knee-osteoarthritis/	69.3	69.3	5.2	5
35	https://www.knee-pain-explained.com/arthritis-pain-in-knee.html	64.1	64.1	5.8	6
	Mean		52		8
	Median		53		8
	Min		21		5
	Max		74		11

Key

	Australia-based
Red text	Advertising product or service

Appendix 4D – Sensitivity analyses of web-content evaluation

4D.i Sensitivity analyses – Comprehensiveness

	Australia-based	Non Australia-based	Advertising product or service	Not advertising product or service
<i>n</i> =	12	23	8	27
Median	9	12	4	12
Mean	8	10	5	11
Min	1	0	0	3
Max	13	14	13	14

4D.ii Sensitivity analyses – Accuracy and clarity

Comparison	INFORMATION ABOUT KNEE OSTEOARTHRITIS							INFORMATION ABOUT FIRST-LINE CARE OPTIONS				INFORMATION ABOUT OTHER TREATMENT OPTIONS		
	Knee anatomy	Pathophysiology of knee OA	Risk factors	Epidemiology of knee OA	Diagnosis of knee OA	Symptoms of knee OA	Details about the biopsychosocial nature of pain	Self-management strategies	Physical activity	Exercise therapy	Weight loss	Pharmacological management	Surgical management	Adjunct options
<i>Australia-based (Y n=12) vs Non Australia-based (N n=23), Proportion (%) per category</i>														
Y	33	8	25	42	8	58	8	42	25	42	67	17	50	0
N	43	9	30	39	9	9	4	30	17	26	52	0	26	0
Y	8	42	50	8	58	17	25	8	33	50	8	58	8	33
N	13	26	26	39	43	43	17	35	48	48	22	52	26	30

Y	0	25	0	0	0	0	0	0	0	8	0	8	25	8
N	0	48	17	0	13	30	0	4	0	0	0	22	22	43
Y	58	25	25	50	33	25	67	50	42	0	25	17	17	58
N	43	17	26	22	35	17	78	30	35	26	26	26	26	26
<i>Advertising product or service (Y n=8) vs not advertising product or service (N n=27), Proportion (%) per category</i>														
Y	0	13	25	0	0	25	0	25	13	0	25	0	13	0
N	41	7	33	52	11	26	7	37	22	41	67	4	41	0
Y	13	13	13	38	38	25	13	0	13	38	0	25	25	25
N	22	33	41	26	52	37	22	33	52	48	22	63	19	33
Y	0	38	0	0	0	13	0	0	0	0	0	13	13	38
N	0	41	11	0	11	22	0	4	0	4	0	19	26	30
Y	88	38	63	63	63	38	88	75	75	63	75	63	50	38
N	37	19	15	22	26	15	70	26	26	7	11	15	15	37

OA = Osteoarthritis, Y = Yes, N = No

Key

	Accurate and clear
	Partially accurate/lacks clarity
	Inaccurate
	Not reported

4D.iii Sensitivity analyses – Quality of information about treatment choices using DISCERN (mean composite scores)

	Australia-based	Non Australia-based	Advertising product or service	Not advertising product or service
n=	12	23	8	27
Median	45	39	28	41
Mean	40	36	29	42
Min	31	16	16	22
Max	56	53	47	56

4D.iv Sensitivity analyses – Credibility of websites using HONcode

Comparison	Authoritative	Complementarity	Privacy	Attribution	Justifiability	Transparency	Financial Disclosure	Advertising Policy
<i>Australia-based (Y, n=12) vs Non Australia-based (N, n=23), Proportion (%) per category</i>								
Y	8	58	75	42	42	92	25	17
N	30	78	96	39	35	96	26	52
Y	33	8	0	0	8	8	8	25
N	26	13	0	17	9	4	35	4
Y	58	33	25	58	50	0	67	58
N	43	9	4	43	57	0	39	43
<i>Advertising product or service (Y n=8) vs not advertising product or service (N n=27), Proportion (%) per category</i>								
Y	25	50	75	25	25	75	13	25
N	22	78	93	44	41	100	30	44
Y	13	25	0	0	0	25	13	13
N	33	7	0	15	11	0	30	11
Y	63	25	25	75	75	0	75	75
N	44	15	7	41	48	0	41	44

Y = Yes, N = No

Key

	Present and clear
	Present but unclear
	Not present

4D.v – Sensitivity analyses – Readability

	Australia-based	Non Australia-based	Advertising product or service	Not advertising product or service
<i>n=</i>	12	23	8	27
<i>Flesch Reading Ease</i>				
Median	49	55	41	52
Mean	47	54	51	53
Min	21	27	44	21
Max	69	74	58	74
<i>Flesch-Kincaid Grade Level</i>				
Median	8	8	8	8
Mean	8	8	8	8
Min	5	6	7	5
Max	11	11	10	11

Appendix 5

[Appendix 5A](#) – Education specific content recommendations from guidelines

[Appendix 5B](#) – Lived experience – original brainstorming responses, edits and final priorities

[Appendix 5C](#) – Cluster map of people with knee osteoarthritis original through to final version

[Appendix 5D](#) – Educational priority and rating question 3 (frequency (%)) of likely source of information)

Appendix 5A – Education specific content recommendations from guidelines

Recommendation ID from guideline when possible	Recommendation	Recommendation ID for matching
<i>ACR¹¹⁸</i>		
n/a	Education about the condition	1.1
n/a	Education about medication effects	1.2
n/a	Education about medication side effects	1.3
n/a	Education about joint protection measures	1.4
n/a	Education about fitness and exercise goals and approaches	1.5
<i>EULAR¹¹⁶</i>		
3	All people with knee/hip OA should receive an individualised management plan (a package of care) that includes the core non-pharmacological approaches, specifically: a information and education regarding OA b addressing maintenance and pacing of activity c addressing a regular individualised exercise regimen d addressing weight loss if overweight or obese e reduction of adverse mechanical factors (e.g., appropriate footwear) f consideration of walking aids and assistive technology	2.1
4	When lifestyle changes are recommended, people with hip or knee OA should receive an individually tailored program, including long-term and short-term goals, intervention or action plans, and regular evaluation and follow-up with possibilities for adjustment of the program	2.2
5	To be effective, information and education for the person with hip or knee OA should: a be individualised according to the person's illness perceptions and educational capability b be included in every aspect of management	2.3

- c specifically address the nature of OA (a repair process triggered by a range of insults), its causes (especially those pertaining to the individual), its consequences and prognosis
d be reinforced and developed at subsequent clinical encounters;
e be supported by written and/or other types of information (eg, DVD, website, group meeting) selected by the individual
- 6 f include partners or carers of the individual, if appropriate
The mode of delivery of exercise education (e.g., individual 1 : 1 sessions, group classes, etc.) and use of pools or other facilities should be selected according both to the preference of the person with hip or knee OA and local availability
Important principles of all exercise include:
a ‘small amounts often’ (pacing, as with other activities)
b linking exercise regimens to other daily activities (e.g., just before morning shower or meals) so they become part of lifestyle rather than additional events 2.4
c starting with levels of exercise that are within the individual’s capability, but building up the ‘dose’ sensibly over several months
- 7 People with hip and/or knee OA should be taught a regular individualised (daily) exercise regimen that includes:
a strengthening (sustained isometric) exercise for both legs, including the quadriceps and proximal hip girdle muscles (irrespective of site or number of large joints affected)
b aerobic activity and exercise 2.5
c adjunctive range of movement/stretching exercises
Although initial instruction is required, the aim is for people with hip or knee OA to learn to undertake these regularly on their own in their own environment
- 8 Education on weight loss should incorporate individualised strategies that are recognised to effect successful weight loss and maintenance*—for example:
a regular self-monitoring, recording monthly weight
b regular support meetings to review/discuss progress
c increase physical activity 2.6
d follow a structured meal plan that starts with breakfast
e reduce fat (especially saturated) intake; reduce sugar; limit salt; increase intake of fruit and vegetables (at least ‘5 portions’ a day)
f limit portion size;

g addressing eating behaviours and triggers to eating (e.g., stress)
h nutrition education
i relapse prediction and management (e.g., with alternative coping strategies)

11	People with hip or knee OA at risk of work disability or who want to start/return to work should have rapid access to vocational rehabilitation, including counselling about modifiable work-related factors such as altering work behaviour, changing work tasks or altering work hours, use of assistive technology, workplace modification, commuting to/from work and support from management, colleagues and family towards employment	2.7
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*NICE*⁴¹

1.2.4	Discuss the risks and benefits of treatment options with the person, taking into account comorbidities. Ensure that the information provided can be understood.	3.1
1.2.5	Offer advice on the following core treatments to all people with clinical OA: access to appropriate information, activity and exercise, and interventions to achieve weight loss if the person is overweight or obese.	3.2
1.3.1	Offer accurate verbal and written information to all people with OA to enhance understanding of the condition and its management, and to counter misconceptions, such as that it inevitably progresses and cannot be treated. Ensure that information sharing is an ongoing, integral part of the management plan rather than a single event at time of presentation.	3.3
1.3.2	Agree on individualized self-management strategies with the person with OA. Ensure that positive behavioural changes, such as exercise, weight loss, and use of suitable footwear and pacing, are appropriately targeted.	3.4
1.3.3	Ensure that self-management programs for people with OA, either individually or in groups, emphasize the recommended core treatments, especially exercise.	3.5
1.4.1	Advise people with OA to exercise as a core treatment, irrespective of age, comorbidity, pain severity, or disability. Exercise should include local muscle strengthening and general aerobic fitness.	3.6
1.4.7	Offer advice on appropriate footwear (including shock-absorbing properties) as part of core treatments for people with lower-limb OA.	3.7

1.6.6	When discussing the possibility of joint surgery, check that the person has been offered at least the core treatments for OA, and give him or her information about the benefits and risks of surgery and the potential consequences of not having surgery, recovery and rehabilitation after surgery, how having a prosthesis might affect him or her, and how care pathways are organized in his or her local area.	3.8
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*OARSI*¹²⁵

n/a	Information about disease progression	4.1
n/a	Education about self-care techniques	4.2
n/a	Promote hope, optimism, and a positive expectation of benefit from treatment	4.3

Appendix 5B – Lived experience – original brainstorming responses, edits and final priorities

5B.i Round 1 - Original brainstorming responses from people with knee osteoarthritis with splitting to represent one idea only

Response number from download	Original priority response	Revised priority as question	Priority ID after R1
1	what the best fix?	What is the best fix?	1
2	How can I regrow my cartilage	Can I regrow my cartilage?	2
3	Why is GLAD Australia the best Option for knee OA?	Why are education and exercise programs the best option for knee OA?	3
4	Is exercise good for my knee, even when it hurts?	Is exercise good for my knee even when it hurts?	4
5	Should I exercise when my knee is swollen?	Should I exercise when my knee is swollen?	5
6	What are the best exercises to increase strength in the knee and surrounding muscles?	What are the best exercises to increase strength in the knee and surrounding muscles?	6
7	I need to know how far I can bend my knee as in kneeling as to avoid "locking" of the knee which I experienced in yoga and have no wish to repeat that experience .	How far to bend my knee to avoid "locking"?	7
8	I had to relearn riding a bike and find I just have to get through the initial clicking in my knee and then I'm fine.		Excluded after initial review
9	what are the best exercises to do and what to avoid?	What are the best exercises to do?	8
		What are the exercises to avoid?	9
10	What specific exercises should I do and what to avoid?	What specific exercises should I do?	10
		What specific exercises should I avoid?	11
11	What benefits exercise will provide patients in the form of pain relief.	Will exercise provide pain relief?	12
12	How to get relief in bed	How to get pain relief in bed?	13
13	Is the PAR treatment likely to assist with knee osteoarthritis? I understand there is a Melbourne based study to assist people who still want to run and participate in other sports.	Are injections likely to assist with knee osteoarthritis?	14
14	I tried prolotherapy and found it very helpful		Excluded after initial review

15	My knee pain has decreased since attending physio sessions. I am not totally sure that having a knee replacement will be very beneficial as I have osteoarthritis .	Will having a knee replacement be beneficial?	95
16	best ways to sleep at night to relieve pain	What are the best ways to sleep at night to relieve pain?	15
17	how to manage pain	How to manage pain?	16
17	How to strengthen a joint	How to strengthen the joint?	17
18	Is surgery really necessary	Is surgery really necessary?	18
19	how to manage pain	How to manage pain?	19
20	Simple Ways of relieving ongoing pain	What are the simple ways of relieving ongoing pain?	20
21	The likely causes of the pain.	What are the likely causes of the pain?	21
22	Current research in improving pain	What is the current research for improving pain?	22
23	Benefits of tumeric for osteoarthritis	What are the benefits of turmeric for osteoarthritis?	23
24	More info on latest research into glucosamine, turmeric and things like that.	What is the latest research into glucosamine?	24
		What is the latest research into turmeric?	25
25	Will medication really make a difference to my pain or am I better off continuing to exercise and put up with the pain?	Will medication really make a difference to my pain?	26
		Am I better off continuing to exercise with pain rather than take medications?	27
26	Can continuing to exercise despite with pain make the knee worse.	Can continuing to exercise despite with pain make the knee worse?	28
27	What is the success rate of pain reduction	What is the success rate of pain reduction?	29
28	Is GLAD useful post total knee replacements	Is education and exercise useful post total knee replacements?	30
29	What exercise can I do beyond the GLAD program	What exercise can I do beyond the GLAD program?	31
30	What are my options beyond exercise	What are my options beyond exercise?	32
31	How long will it take to remove pain if I exercise	How long will it take to remove pain if I exercise?	33
32	Will exercise improve my pain	Will exercise improve my pain?	34
33	What exercise will help	What exercise will help?	35
34	Where you can join with others to keep exercising after Glad is over	Where can you join with others to keep exercising after treatment is over?	36

35	can it be reversed	Can osteoarthritis be reversed?	37
36	why did Glad increase pain	Why did an education and exercise program increase my pain?	38
37	This is a very difficult site. I am not sure what I'm required to do. I'd like to see what answers you have to some of the questions as I don't want to repeat anything but nothing happens. I want to know why my knees 'crunch' and lock and what I can	Why knees 'crunch'?	39
		Why knees lock?	40
38	Difficulty standing from a sitting position. Is it possible to strengthen leg muscles to help?	Is it possible to strengthening leg muscles to improve ability to move from sitting to standing?	41
39	Can my physical activity be improved?	Can I do more physical activity?	42
40	What best sleep position for knees.	What best sleep position for knees?	43
41	The best exercises	What are the best exercises?	44
42	Is there a point at which I should stop exercising?	Is there a point at which I should stop exercising?	45
43	How much exercise should I do?	How much exercise should I do?	46
44	Will my knee improve with exercise?	Will my knee improve with exercise?	47
45	What does have to feel like before I had surgery?	What does it have to feel like before I have surgery?	48
46	Is there any point in strapping the knee and if so how should I do it?	Is there any point in strapping the knee?	49
		How should I strap my knee?	50
47	What is the long term prognosis?	What is the long term prognosis?	51
48	How do I manage the pain without medication?	How do I manage the pain without medication?	52
49	How to get rid of pain 15 months after surgery.	How to get rid of pain a long time after surgery?	53
		How to avoid medication use?	54
50	How to avoid medication and utilising exercise as a panacea	Is exercise as a panacea or cure all?	55
51	Exercises online via Youtube	Can I find exercises online?	96
52	Will I be able to avoid surgery by committing to the program after the Physio sessions have ended	Will I be able to avoid surgery by committing to an education and exercise program?	56
53	I already have had my knees replaced. Can the GLAD program still help to keep my knees in good condition?	Can specific osteoarthritis education and exercise programs (e.g. GLA:D) still help to keep my knees in good condition after total knee replacement?	57

54	I would like there to be an ongoing group post glad to continue the exercise program.	Are there any exercise groups that I can join after completing a specific osteoarthritis education and exercise program (e.g. GLA:D)?	97
55	I find glucosamine with chondroitin helpful with lessening stiffness and related pain .	Is glucosamine helpful with lessening stiffness?	98
		Is glucosamine helpful with lessening pain?	99
		Is chondroitin helpful with lessening stiffness?	100
		Is chondroitin helpful with lessening pain?	101
56	What is the best way to manage pain in one knee without creating excessive strain on the other one	What is the best way to manage pain in one knee without creating excessive strain on the other one?	58
57	I want to know the best way to manage/minimise pain, and when (if) it is time to accept the need for knee surgery (replacement)	what is the best way to manage pain?	59
		what is the best way to minimise pain?	102
		How do I know when/if it is time to accept the need for knee surgery (replacement)?	60
58	That with the program easing of symptoms does normally occur	Do most people's symptoms improve when completing an education and exercise program	103
59	The latest methods used to treat debilitating knee osteoarthritis to prevent or delay surgery	What are the latest methods used to treat debilitating knee osteoarthritis?	61
		What are the latest methods used to delay surgery?	62
60	I have tried to strengthen the muscles around my knee without success, if I was able to strengthen the muscles would this help	Does strengthening muscles around my knee help with osteoarthritis?	104
61	I have OA in my right knee. I was told to rest for 2 yrs. I was afraid to move, pain was constant. Booked in for an operation but then referred to Christian & GLA-D. Pain occurs but I manage. No operation. Right exercise the key. Move with confidence		Excluded after initial review
62	will i need surgery eventually? is GLAD just buying me time?	Will i need surgery eventually?	63
		Is education and exercise just buying me time?	64
63	My knee gives very little trouble now, after the GLAD program. Am I likely to free of commitment to knee related exercise in the future.	If I complete an education and exercise program, am I likely to be free of commitment to knee related exercise in the future?	105
64	In addition to what I have hear, what can I do to help the situation eg, lose weight, walk more, take supplement?	What can I do to help my situation?	65
		Will losing weight help?	66
		Will walking more help?	67

		Will taking supplements help?	68
65	Will the GLA:D program replace the need for knee replacement surgery permanently?	Will education and exercise programs replace the need for knee replacement surgery permanently?	69
66	why did I get knee osteoarthritis?	Why did I get knee osteoarthritis?	70
67	Will I need surgery. will it get better. What can I do?	Will I need surgery?	71
		Will it get better?	72
		What can I do to help?	73
68	Best methods to increase strength.	What are the best methods to increase strength?	74
69	Best methods to control and manage condition and pain.	What are the best methods to control and manage condition ?	75
		What are the best methods to control and manage pain?	76
70	Expected progression of knee arthritis. Methods to assist mobility and lessen pain and to improve balance and confidence that I will not fall	What is the expected progression of knee arthritis?	77
		What methods will assist mobility?	78
		What methods will lessen pain?	79
		What methods will improve balance?	80
		What methods will improve confidence that I will not fall	81
71	I am very positive about the GLAD program, I would like to see it more readily available		Excluded after initial review
72	Will it ever be 100% - too much to ask for but perhaps 90%	Will it ever be 100% - or perhaps 90% ?	82
73	Expected progression of knee arthritis. Methods to assist mobility and lessen pain.	What is the expected progression of knee arthritis?	83
		What methods will assist mobility?	84
		What methods will lessen pain?	85
74	I have OA in both knees and one hip (the other hip has already been replaced). The MRI scan shows that I also have it in both shoulders, elbows, wrists and a little bit in my hands; but, I don't have it in my ankles or feet.		Excluded after initial review
75	I have some joint pain all the time but so long as it's bearable, I manage. The problem is when it gets too high, it can be very hard to get it under control again. So, I do not take so-called	Are there medications that will help with the pain in the longer-term without side effects?	106

	‘pain killers’ unless I have a really serious pain issue but, when I do have an issue, there is really nothing available that’s effective without side effects, some of them quite serious. For example, in the over the counter range of so-called ‘anti-inflammatories’ there is IBProfen or Neuofen, both of which turn my insides into chocolate custard. Then there are the medical prescription only tablets, such as: Moxicam or Celbrex both of which have the exact opposite effect AND can cause stomach bleeds. (Whilst this has not happened to me - probably because I never take them consecutively for more than a week). As I understand it, Panadol works on the brain, not the inflammation, so it’s only a short-term fix for a pain that varies in intensity and can last for a long time (days or weeks).		
76	I don’t know whether or not there are any foods or drinks that can affect OA but, it would be good to know if there is anything I should be avoiding. I do take fish oil (omega 3), curcumin (turmeric) and Cartia (a mild Asprin) as supplements but, I don’t really think they help me. (I am certain Glucosamine and Chondroitin don't help me.)	Are there any food or drinks that I should be avoiding?	86
		What impact can my diet have on my knee osteoarthritis?	107
		Are there supplements that can help (e.g. fish oil, turmeric, glucosamine)?	108
77	I have found it very difficult to get an over the counter supportive knee brace that fits, stays in place over the patella, is cool (i.e. not too hot) and doesn't cost a lot. At the end of the day, it’s just a fancy bandage - How hard can it be to design a brace for a full range of leg sizes, made in a light, supportive fabric?	Are there inexpensive over the counter knee braces that help?	109
78	I don’t usually have pain first thing in the morning but, sometimes when I am asleep, I am wakened by bad pain (aches and cramps) in my knee joint or calf muscles. This can make me very restless as I have to change my position frequently. For this reason, it would be good to know the best position for sleep. (NB: I don’t get pain in the last 30 minutes to an hour of my normal sleep pattern, i.e. when waking.)	What are the best position for sleep?	87
79	Why do I have the pain? Why is it worse some days than others for no apparent reason?	Why do I have the pain?	88
		Why is it worse some days than others for no apparent reason?	89

80	Nothing	Nothing	Excluded after initial review
81	Nothing	Nothing	Excluded after initial review
82	Do you recommend a slow jog if there is no pain while jogging or post jogging?	Can I run if I don't get pain during or after?	90
83	What makes it worse, is it going to worsen despite my efforts, does diet help, is pain the only indication of worsening arthritis	What will make my knee osteoarthritis worse?	91
		Is it going to worsen despite my efforts?	92
		Does diet help?	93
		Is pain the only indication of worsening arthritis?	94
84	I can be pain free until I have a period of time when I do not move it. E.g. driving a long distance. It becomes stiff !	Why does it become stiff and painful when I don't move (e.g. driving a long distance)?	110

52.ii Round 2 - condensing priorities from round 1 when they represent similar ideas

Priority ID after R1	Revised priority from R1	Other R1 priorities that are the same/similar	Final priority after R2	Priority ID after R2
2	Can I regrow my cartilage?		Can I regrow my cartilage?	1
3	Why are education and exercise programs the best option for knee OA?		Why are education and exercise programs the best option for knee OA?	2
4	Is exercise good for my knee even when it hurts?	5 - Should I exercise when my knee is swollen?	Is exercise good for my knee even when its painful or swollen?	3
6	What are the best exercises to increase strength in the knee and surrounding muscles?	74 - What are the best methods to increase strength?	What are the best exercises to increase strengthen the muscles around the knee?	5
7	How far to bend my knee to avoid "locking"?		How far to bend my knee to avoid locking?	6
8	What are the best exercises to do?	10 - What specific exercises should I do? 35 - What exercise will help? 44 - What are the best exercises?	What are the best exercises to do?	7
9	What are the exercises to avoid?	11 - what specific exercises should I avoid?	What are the exercises to avoid?	8
12	Will exercise provide pain relief?	34 - Will exercise improve my pain?	Will exercise provide pain relief?	9
14	Are injections likely to assist with knee osteoarthritis?		Are injections likely to assist with knee osteoarthritis?	10
15	What are the best ways to sleep at night to relieve pain?	13 - How to get pain relief in bed? 43 - What best sleep position for knees? 87 - What are the best position for sleep?	What are the best ways to sleep at night to relieve pain?	11
16	How to manage pain?	19 - how to manage pain 59 - What is the best way to manage pain?	What are the best ways manage pain?	12

		76 - What are the best methods to control and manage pain?		
17	How to strengthen the joint?		How to strengthen the joint?	63
		69 - Will education and exercise programs replace the need for knee replacement surgery permanently? 63 - Will i need surgery eventually? 64 - Is education and exercise just buying me time?		
18	Is surgery really necessary?	71 - Will I need surgery?	Will i need surgery eventually?	13
		79 - What methods will lessen pain? 85 - What methods will lessen pain?		
20	What are the simple ways of relieving ongoing pain?	102 - What is the best way to minimise pain?	What are the best ways to minimise pain?	4
21	What are the likely causes of the pain?	88 Why do I have the pain?	What causes my knee pain?	14
22	What is the current research for improving pain?		What is the current research for improving pain?	15
23	What are the benefits of turmeric for osteoarthritis?	25 - What is the latest research into turmeric?	What are the benefits of turmeric for osteoarthritis?	16
24	What is the latest research into glucosamine?		What is the latest research into glucosamine?	17
26	Will medication really make a difference to my pain?		Will medication make a difference to my pain?	18
27	Am I better off continuing to exercise with pain rather than take medications?		Am I better off continuing to exercise with pain rather than take medications?	19
28	Can continuing to exercise despite with pain make the knee worse?		Can continuing to exercise despite pain make the knee worse?	20
29	What is the success rate of pain reduction?		What is the success rate of pain reduction?	21

30	Is education and exercise useful post total knee replacements?	42 - Can specific osteoarthritis education and exercise programs (e.g. GLA:D) still help to keep my knees in good condition after total knee replacement?	Is education and exercise useful post total knee replacements?	22
31	What exercise can I do beyond the GLAD program?		What exercise can I do beyond the GLAD program?	23
32	What are my options beyond exercise?		What are my options beyond exercise?	24
33	How long will it take to remove pain if I exercise?		How long will it take to remove pain if I exercise?	25
36	Where can you join with others to keep exercising after treatment is over?	97 - Are there any exercise groups that I can join after completing a specific osteoarthritis education and exercise program (e.g. GLA:D)?	Where can you join with others to keep exercising after treatment is over?	26
37	Can osteoarthritis be reversed?		Can osteoarthritis be reversed?	27
38	Why did an education and exercise program increase my pain?		Why did an education and exercise program increase my pain?	28
39	Why knees 'crunch'?		Why knees 'crunch'?	29
40	Why knees lock?		Why knees lock?	30
41	Is it possible to strengthen leg muscles to improve ability to move from sitting to standing?		Is it possible to strengthen leg muscles to improve ability to move from sitting to standing?	31
42	Can I do more physical activity?		Can I do more physical activity?	32
45	Is there a point at which I should stop exercising?		Is there a point at which I should stop exercising?	33
46	How much exercise should I do?		How much exercise should I do?	34
47	Will my knee improve with exercise?		Will my knee improve with exercise?	35
48	What does it have to feel like before I have surgery?	60 - How do I know when/if it is time to accept the need for knee surgery (replacement)?	How do I know when/if it is time to accept the need for knee surgery (replacement)?	36
49	Is there any point in strapping the knee?		Is there any point in strapping the knee?	37
50	How should I strap my knee?		How should I strap my knee?	38
52	How do I manage the pain without medication?	54 - How to avoid medication use?	How do I manage the pain without medication?	39

53	How to get rid of pain a long time after surgery?		How to get rid of pain a long time after surgery?	40
55	Is exercise as a panacea or cure all?		Is exercise as a panacea or cure all?	65
56	Will I be able to avoid surgery by committing to an education and exercise program?		Will I be able to avoid surgery by committing to an education and exercise program?	41
58	What is the best way to manage pain in one knee without creating excessive strain on the other one?		What is the best way to manage pain in one knee without creating excessive strain on the other one?	42
61	What are the latest methods used to treat debilitating knee osteoarthritis?		What are the latest methods used to treat debilitating knee osteoarthritis?	43
62	What are the latest methods used to delay surgery?		What are the latest methods used to delay surgery?	44
65	What can I do to help my situation?	73 - What can I do to help? 1 - what is the best fix	What is the best thing I can do to help my situation?	45
66	Will loosing weight help?		Will losing weight help?	46
67	Will walking more help?		Will walking more help?	47
68	Will taking supplements help?	108 - Are there supplements that can help (e.g. fish oil, turmeric, glucosamine)?	Will taking supplements help?	48
70	Why did I get knee osteoarthritis?		Why did I get knee osteoarthritis?	49
75	What are the best methods to control and manage condition?		What are the best methods to control and manage the condition?	50
77	What is the expected progression of knee arthritis?	51 - What is the long-term prognosis? 83 - What is the expected progression of knee arthritis?	What is the expected progression of knee arthritis?	51
78	What methods will assist mobility?	84 - What methods will assist mobility?	What methods will assist mobility?	52
80	What methods will improve balance?		What methods will improve balance?	53
81	What methods will improve confidence that I will not fall		What methods will improve confidence that I will not fall	54
82	Will it ever be 100% - or perhaps 90%?	72 - Will it get better?	Will it ever be 100% - or perhaps 90%?	64

86	Are there any food or drinks that I should be avoiding?		Are there any food or drinks that I should be avoiding?	55
89	Why is it worse some days than others for no apparent reason?		Why is it worse some days than others for no apparent reason?	56
90	Do you recommend a slow jog if there is no pain while jogging or post jogging?		Do you recommend a slow jog if there is no pain while jogging or post jogging?	57
91	What will make my knee osteoarthritis worse?		What will make my knee osteoarthritis worse?	58
92	Is it going to worsen despite my efforts?		Is it going to worsen despite my efforts?	66
93	Does diet help?	107 - What impact can my diet have on my knee osteoarthritis?	Does diet help?	59
94	Is pain the only indication of worsening arthritis?		Is pain the only indication of worsening arthritis?	60
95	Will having a knee replacement be beneficial?		Will having a knee replacement be beneficial?	67
96	Can I find exercises online?		Can I find exercises online?	68
98	Is glucosamine helpful with lessening stiffness?		Is glucosamine helpful with lessening stiffness?	69
99	Is glucosamine helpful with lessening pain?		Is glucosamine helpful with lessening pain?	70
100	Is chondroitin helpful with lessening stiffness?		Is chondroitin helpful with lessening stiffness?	71
101	Is chondroitin helpful with lessening pain?		Is chondroitin helpful with lessening pain?	72
103	Do most people's symptoms improve when completing an education and exercise program		Do most people's symptoms improve when completing an education and exercise program	73
104	Does strengthening muscles around my knee help with osteoarthritis?		Does strengthening muscles around my knee help with osteoarthritis?	74
105	If I complete an education and exercise program, am I likely to be free of commitment to knee related exercise in the future?		If I complete an education and exercise program, am I likely to be free of commitment to knee related exercise in the future?	75

106	Are there medications that will help with the pain in the longer-term without side effects?		Are there medications that will help with the pain in the longer-term without side effects?	76
109	Are there inexpensive over the counter knee braces that help?		Are there inexpensive over the counter knee braces that help?	61
110	Why does it become stiff and painful when I don't move (e.g., driving a long distance)?		Why does it become stiff and painful when I don't move (e.g., driving a long distance)?	62

5B.iii Final priorities of people with knee osteoarthritis

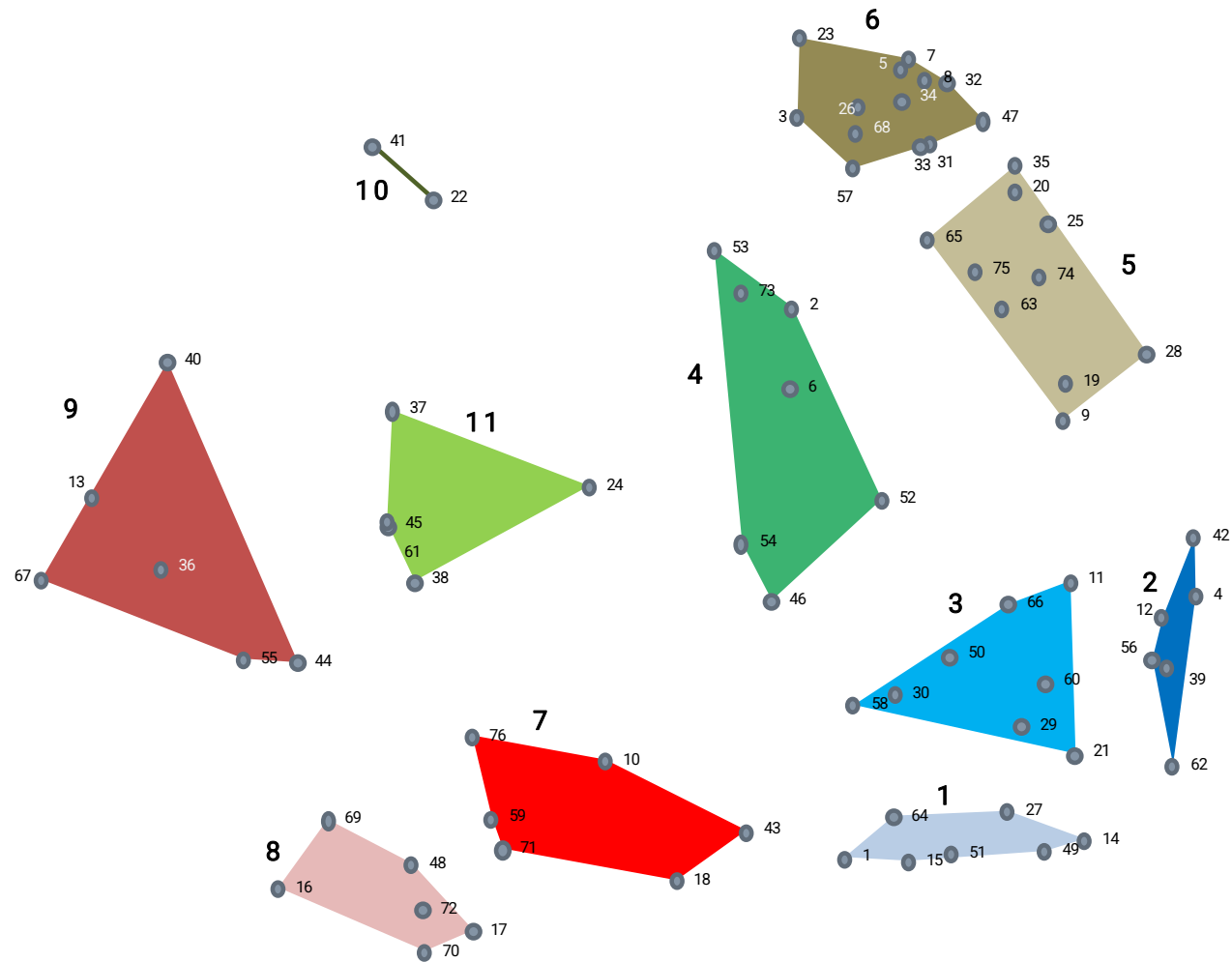
Statement ID after R2	Final Priorities
1	Can I regrow my cartilage?
2	Why are education and exercise programs the best option for knee OA?
3	Is exercise good for my knee even when its painful or swollen?
4	What are the best ways to minimise pain?
5	What are the best exercises to increase strengthen the muscles around the knee?
6	How far to bend my knee to avoid locking?
7	What are the best exercises to do?
8	What are the exercises to avoid?
9	Will exercise provide pain relief?
10	Are injections likely to assist with knee osteoarthritis?
11	What are the best ways to sleep at night to relieve pain?
12	What are the best ways to manage pain?
13	Will I need surgery eventually?
14	What causes my knee pain?
15	What is the current research for improving pain?
16	What are the benefits of turmeric for osteoarthritis?
17	What is the latest research into glucosamine?
18	Will medication make a difference to my pain?
19	Am I better off continuing to exercise with pain rather than take medications?
20	Can continuing to exercise despite pain make the knee worse?
21	What is the success rate of pain reduction?
22	Is education and exercise useful post total knee replacements?
23	What exercise can I do beyond the GLAD program?
24	What are my options beyond exercise?
25	How long will it take to remove pain if I exercise?
26	Where can you join with others to keep exercising after treatment is over?

27	Can osteoarthritis be reversed?
28	Why did an education and exercise program increase my pain?
29	Why knees 'crunch'?
30	Why knees lock?
31	Is it possible to strengthen leg muscles to improve ability to move from sitting to standing?
32	Can I do more physical activity?
33	Is there a point at which I should stop exercising?
34	How much exercise should I do?
35	Will my knee improve with exercise?
36	How do I know when/if it is time to accept the need for knee surgery (replacement)?
37	Is there any point in strapping the knee?
38	How should I strap my knee?
39	How do I manage the pain without medication?
40	How to get rid of pain a long time after surgery?
41	Will I be able to avoid surgery by committing to an education and exercise program?
42	What is the best way to manage pain in one knee without creating excessive strain on the other one?
43	What are the latest methods used to treat debilitating knee osteoarthritis?
44	What are the latest methods used to delay surgery?
45	What is the best thing I can do to help my situation?
46	Will losing weight help?
47	Will walking more help?
48	Will taking supplements help?
49	Why did I get knee osteoarthritis?
50	What are the best methods to control and manage the condition?
51	What is the expected progression of knee arthritis?
52	What methods will assist mobility?
53	What methods will improve balance?
54	What methods will improve confidence that I will not fall?
55	Are there any food or drinks that I should be avoiding?
56	Why is it worse some days than others for no apparent reason?
57	Do you recommend a slow jog if there is no pain while jogging or post jogging?

58	What will make my knee osteoarthritis worse?
59	Does diet help?
60	Is pain the only indication of worsening arthritis?
61	Are there inexpensive over the counter knee braces that help?
62	Why does it become stiff and painful when I don't move (e.g., driving a long distance)?
63	How to strengthen the joint?
64	Will it ever be 100% - or perhaps 90%?
65	Is exercise as a panacea or cure all?
66	Is it going to worsen despite my efforts?
67	Will having a knee replacement be beneficial?
68	Can I find exercises online?
69	Is glucosamine helpful with lessening stiffness?
70	Is glucosamine helpful with lessening pain?
71	Is chondroitin helpful with lessening stiffness?
72	Is chondroitin helpful with lessening pain?
73	Do most people's symptoms improve when completing an education and exercise program?
74	Does strengthening muscles around my knee help with osteoarthritis?
75	If I complete an education and exercise program, am I likely to be free of commitment to knee related exercise in the future?
76	Are there medications that will help with the pain in the longer-term without side effects?

Appendix 5C – Cluster map of people with knee osteoarthritis original through to final version

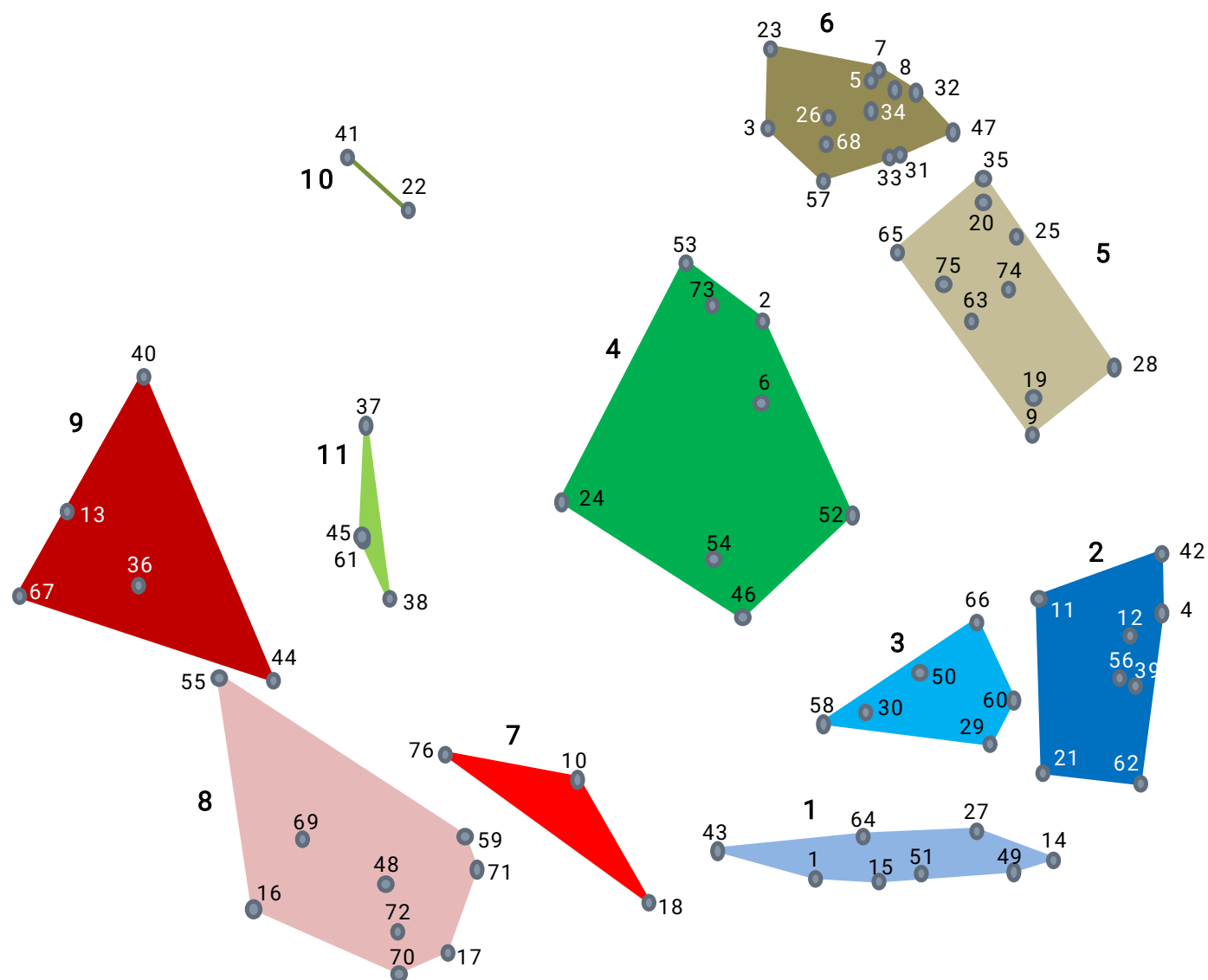
5C.i Eleven cluster map generated by hierarchical cluster analysis



5C.ii Priority re-assignment due to conceptual fit

Priority number	Original cluster number	Moved to which cluster?
11	3	2
21	3	2
24	11	4
43	7	1
55	9	8
59	7	8
71	9	8

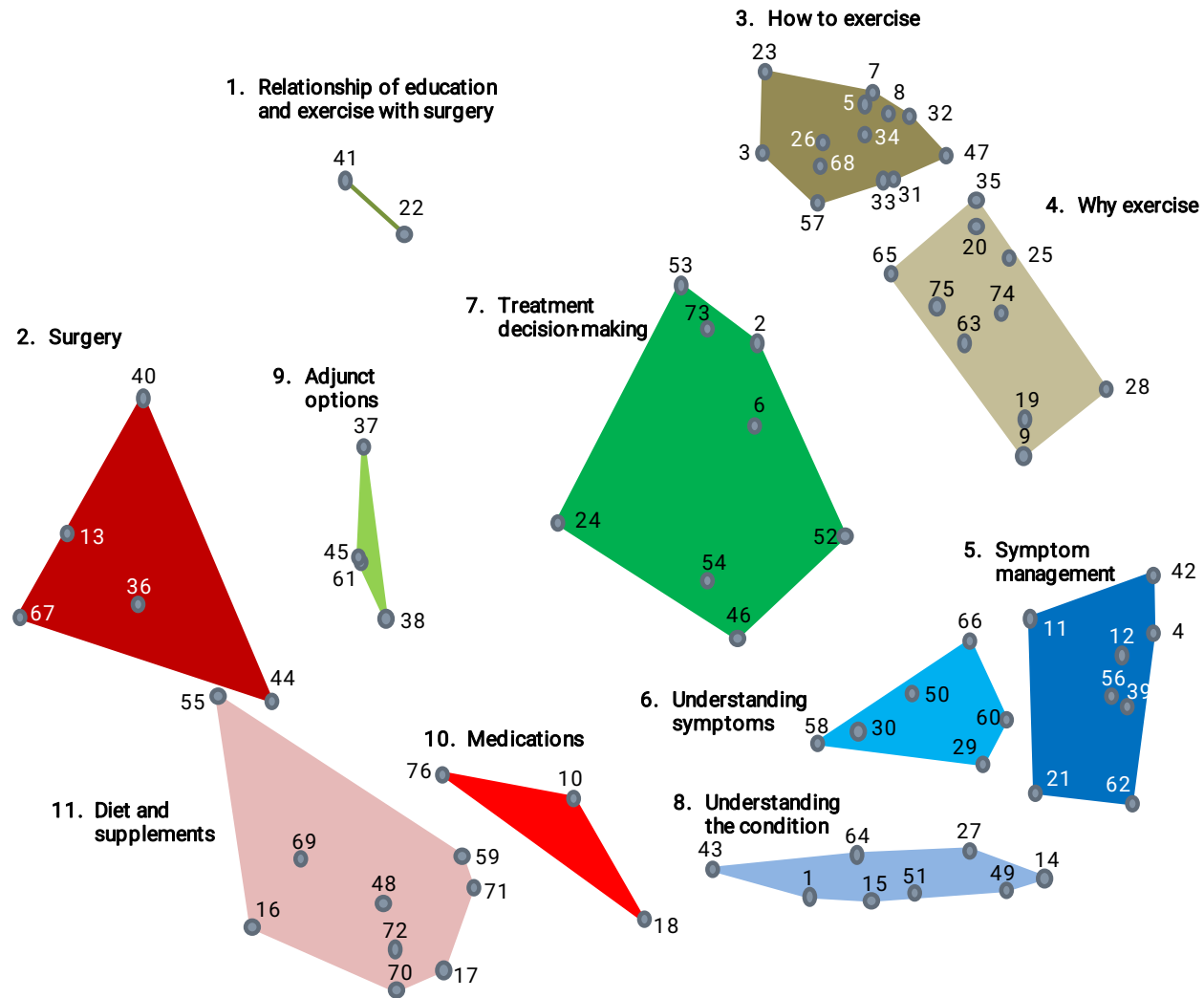
5C.iii Cluster map following re-assignment



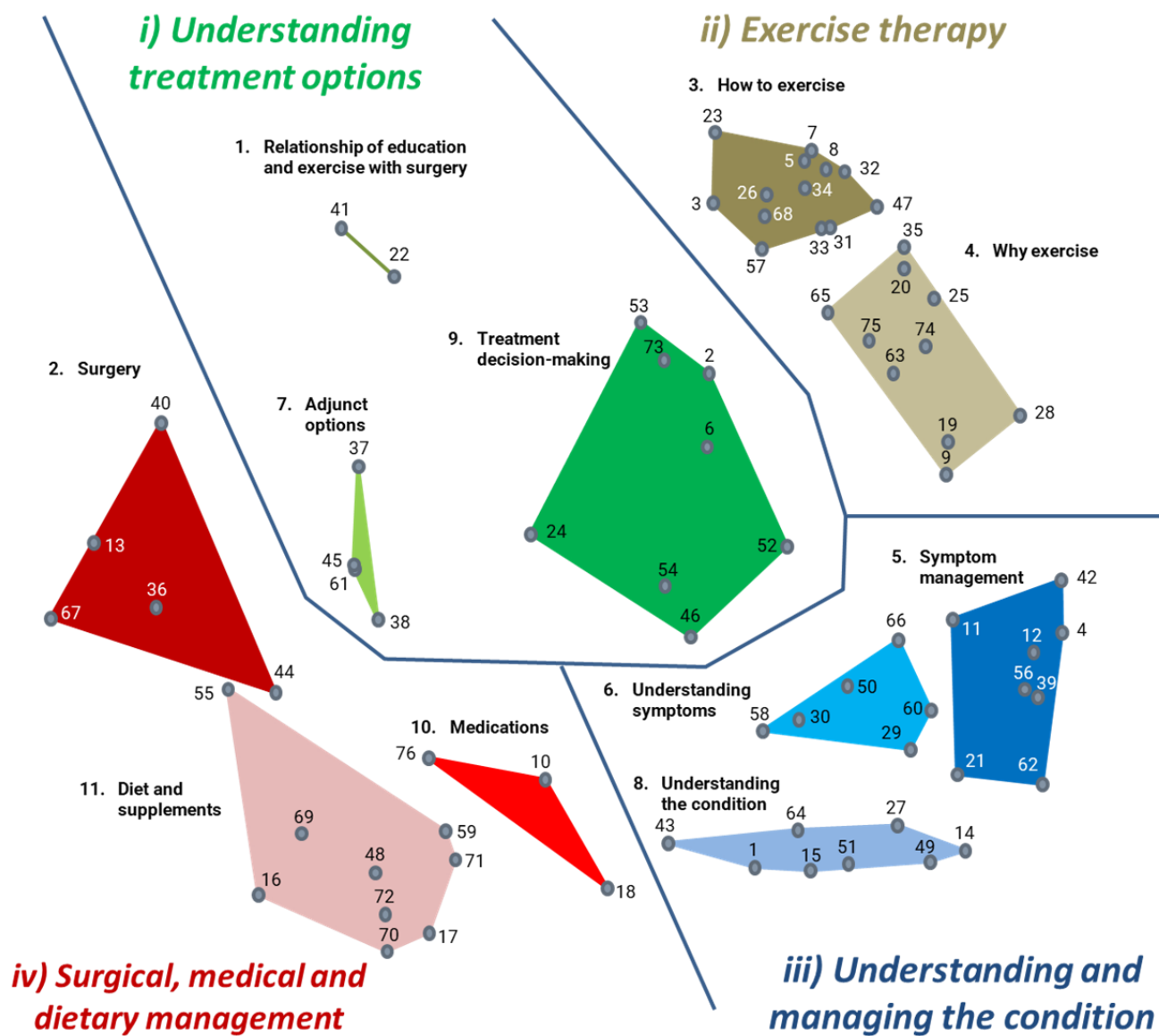
5C.iv Cluster re-numbering and naming

Original cluster number	Final cluster number (descending based on importance) – and name
1	8 – Understanding the condition
2	5 – Symptom management
3	6 – Understanding symptoms
4	7 – Treatment decision-making
5	4 – Why exercise
6	3 – How to exercise
7	10 – Medications
8	11 – Diet and supplements
9	2 – Surgery
10	1 - Relationship of education and exercise with surgery
11	9 – Adjunct options

5C.v Final cluster map of people with knee osteoarthritis without domains



5C.vi Final cluster map of people with knee osteoarthritis with domains



Appendix 5D – Educational priority and rating question 3 (frequency (%) of likely source of information)

Cluster number and title Priority	Likely source of information to meet the priority (%)				
	Health professional	Own research	Already know	Other source	Don't know
1. Relationship of education and exercise with surgery					
41 Will I be able to avoid surgery by committing to an education and exercise program?	59	5	23	0	14
22 Is education and exercise useful post total knee replacements?	55	5	36	0	5
2. Surgery					
44 What are the latest methods used to delay surgery?	82	5	5	0	9
36 How do I know when/if it is time to accept the need for knee surgery (replacement)?	86	5	0	0	9
40 How to get rid of pain a long time after surgery?	68	9	0	0	23
13 Will I need surgery eventually?	77	0	5	5	14
67 Will having a knee replacement be beneficial?	55	18	9	0	18
3. How to exercise					
7 What are the best exercises to do?	77	0	14	0	9
5 What are the best exercises to strengthen the muscles around the knee?	77	0	18	0	5
8 What are the exercises to avoid?	77	9	5	0	9
47 Will walking more help?	59	14	27	0	0
3 Is exercise good for my knee even when it's painful or swollen?	82	0	9	5	5
23 What exercise can I do beyond the GLAD program?	55	9	23	5	9
31 Is it possible to strengthen leg muscles to improve ability to move from sitting to standing?	36	5	55	0	5
32 Can I do more physical activity?	59	0	32	0	9
34 How much exercise should I do?	59	9	23	0	9
33 Is there a point at which I should stop exercising?	59	9	18	0	14
26 Where can you join with others to keep exercising after treatment is over?	27	27	23	0	23
68 Can I find exercises online?	27	27	27	0	18
57 Do you recommend a slow jog if there is no pain while jogging or post jogging?	55	9	23	0	14

Cluster number and title Priority	Likely source of information to meet the priority (%)				
	Health professional	Own research	Already know	Other source	Don't know
4. Why exercise?					
63 How to strengthen the joint?	55	5	36	0	5
74 Does strengthening muscles around my knee help with osteoarthritis?	55	5	36	5	0
20 Can continuing to exercise despite pain make the knee worse?	77	0	14	0	9
35 Will my knee improve with exercise?	64	0	32	0	5
9 Will exercise provide pain relief?	64	0	36	0	0
19 Am I better off continuing to exercise with pain rather than take medications?	50	9	27	0	14
25 How long will it take to remove pain if I exercise?	45	5	23	5	23
28 Why did an education and exercise program increase my pain?	59	5	23	5	9
65 Is exercise as a panacea or cure all?	27	23	23	0	27
75 If I complete an education and exercise program, am I likely to be free of commitment to knee related exercise in the future?	18	9	59	0	14
5. Symptom management					
4 What are the best ways to minimise pain?	73	9	14	0	5
12 What are the best ways to manage pain?	95	5	0	0	0
39 How do I manage the pain without medication?	64	14	9	0	14
42 What is the best way to manage pain in one knee without creating excessive strain on the other one?	82	0	0	5	14
56 Why is it worse some days than others for no apparent reason?	59	9	0	0	32
21 What is the success rate of pain reduction?	50	23	9	0	18
62 Why does it become stiff and painful when I don't move (e.g., driving a long distance)?	50	14	32	0	5
11 What are the best ways to sleep at night to relieve pain? [‡]	55	18	5	0	23
6. Understanding symptoms					
50 What are the best methods to control and manage the condition?	77	5	14	0	5
58 What will make my knee osteoarthritis worse?	68	14	0	0	18

Cluster number and title Priority	Likely source of information to meet the priority (%)				
	Health professional	Own research	Already know	Other source	Don't know
66 Is it going to worsen despite my efforts?	41	14	18	0	27
60 Is pain the only indication of worsening arthritis?	59	5	9	5	23
29 Why knees 'crunch'?	59	9	14	5	14
30 Why knees lock?	68	14	0	0	18
7. Treatment decision making					
24 What are my options beyond exercise?	59	18	0	0	23
2 Why are education and exercise programs the best option for knee osteoarthritis?	86	0	14	0	0
52 What methods will assist mobility?	64	9	23	0	5
73 Do most people's symptoms improve when completing an education and exercise program?	41	9	32	5	14
54 What methods will improve confidence that I will not fall?	59	14	18	0	9
46 Will losing weight help?	32	18	45	0	5
53 What methods will improve balance?	73	5	18	0	5
6 How far to bend my knee to avoid locking?	50	5	18	0	27
8. Understanding the condition					
15 What is the current research for improving pain?	73	9	0	0	18
51 What is the expected progression of knee arthritis?	68	14	0	0	18
43 What are the latest methods used to treat debilitating knee osteoarthritis?	73	9	5	0	14
1 Can I regrow my cartilage?	50	14	23	0	14
14 What causes my knee pain?	55	14	32	0	0
64 Will it ever be 100% - or perhaps 90%?	32	0	45	0	23
27 Can osteoarthritis be reversed?	32	5	50	5	9
49 Why did I get knee osteoarthritis?	45	18	18	0	18
9. Adjunct options					
45 What is the best thing I can do to help my situation?	64	18	9	0	9
37 Is there any point in strapping the knee?	68	0	9	0	23

Cluster number and title Priority	Likely source of information to meet the priority (%)				
	Health professional	Own research	Already know	Other source	Don't know
61 Are there inexpensive over the counter knee braces that help?	41	27	9	0	23
38 How should I strap my knee?	68	9	0	0	23
10. Medications					
76 Are there medications that will help with the pain in the longer-term without side effects?	73	9	0	0	18
18 Will medication make a difference to my pain?	50	14	32	0	5
10 Are injections likely to assist with knee osteoarthritis?	55	9	23	0	14
11. Diet and supplements					
55 Are there any food or drinks that I should be avoiding?	32	36	18	0	9
59 Does diet help?	41	27	23	0	9
48 Will taking supplements help?	32	32	14	0	23
16 What are the benefits of turmeric for osteoarthritis?	18	27	18	0	36
69 Is glucosamine helpful with lessening stiffness?	36	23	9	5	27
71 Is chondroitin helpful with lessening stiffness?	32	23	5	5	36
72 Is chondroitin helpful with lessening pain?	27	23	9	0	41
70 Is glucosamine helpful with lessening pain?	32	23	14	5	27
17 What is the latest research into glucosamine?	36	23	5	0	36

Appendix 6

[Appendix 6A](#) – Education specific content recommendations from guidelines and expert opinion

[Appendix 6B](#) – Physiotherapists’ – original brainstorming responses, edits, additions from guidelines and expert opinion and final priorities

[Appendix 6C](#) – Cluster map of physiotherapists original through to final version

Appendix 6A – Education specific content recommendations from guidelines and expert opinion

6A.i – education specific recommendations from guidelines used to add to brainstorming and match against collated list used for sorting and rating

Recommendation ID from guideline when possible	Recommendation	Recommendation ID for matching
<i>ACR¹¹⁸</i>		
n/a	Education about the condition	1.1
n/a	Education about medication effects	1.2
n/a	Education about medication side effects	1.3
n/a	Education about joint protection measures	1.4
n/a	Education about fitness and exercise goals and approaches	1.5
<i>EULAR¹¹⁶</i>		
3	All people with knee/hip OA should receive an individualised management plan (a package of care) that includes the core non-pharmacological approaches, specifically: a information and education regarding OA b addressing maintenance and pacing of activity c addressing a regular individualised exercise regimen d addressing weight loss if overweight or obese e reduction of adverse mechanical factors (e.g., appropriate footwear) f consideration of walking aids and assistive technology	2.1
4	When lifestyle changes are recommended, people with hip or knee OA should receive an individually tailored program, including long-term and short-term goals, intervention or action plans, and regular evaluation and follow-up with possibilities for adjustment of the program	2.2

- 5 To be effective, information and education for the person with hip or knee OA should:
a be individualised according to the person's illness perceptions and educational capability
b be included in every aspect of management
c specifically address the nature of OA (a repair process triggered by a range of insults), its causes (especially those pertaining to the individual), its consequences and prognosis
d be reinforced and developed at subsequent clinical encounters;
e be supported by written and/or other types of information (eg, DVD, website, group meeting) selected by the individual 2.3
- 6 f include partners or carers of the individual, if appropriate
The mode of delivery of exercise education (e.g., individual 1 : 1 sessions, group classes, etc.) and use of pools or other facilities should be selected according both to the preference of the person with hip or knee OA and local availability
Important principles of all exercise include:
a 'small amounts often' (pacing, as with other activities)
b linking exercise regimens to other daily activities (e.g., just before morning shower or meals) so they become part of lifestyle rather than additional events
c starting with levels of exercise that are within the individual's capability, but building up the 'dose' sensibly over several months 2.4
- 7 People with hip and/or knee OA should be taught a regular individualised (daily) exercise regimen that includes:
a strengthening (sustained isometric) exercise for both legs, including the quadriceps and proximal hip girdle muscles (irrespective of site or number of large joints affected)
b aerobic activity and exercise
c adjunctive range of movement/stretching exercises
Although initial instruction is required, the aim is for people with hip or knee OA to learn to undertake these regularly on their own in their own environment 2.5
- 8 Education on weight loss should incorporate individualised strategies that are recognised to effect successful weight loss and maintenance*—for example:
a regular self-monitoring, recording monthly weight
b regular support meetings to review/discuss progress
c increase physical activity
d follow a structured meal plan that starts with breakfast 2.6

- e reduce fat (especially saturated) intake; reduce sugar; limit salt; increase intake of fruit and vegetables (at least ‘5 portions’ a day)
- f limit portion size;
- g addressing eating behaviours and triggers to eating (e.g., stress)
- h nutrition education
- i relapse prediction and management (e.g., with alternative coping strategies)

11	*People with hip or knee OA at risk of work disability or who want to start/return to work should have rapid access to vocational rehabilitation, including counselling about modifiable work-related factors such as altering work behaviour, changing work tasks or altering work hours, use of assistive technology, workplace modification, commuting to/from work and support from management, colleagues and family towards employment	2.7
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NICE⁴¹

1.2.4	Discuss the risks and benefits of treatment options with the person, taking into account comorbidities. Ensure that the information provided can be understood.	3.1
1.2.5	Offer advice on the following core treatments to all people with clinical OA: access to appropriate information, activity and exercise, and interventions to achieve weight loss if the person is overweight or obese.	3.2
1.3.1	Offer accurate verbal and written information to all people with OA to enhance understanding of the condition and its management, and to counter misconceptions, such as that it inevitably progresses and cannot be treated. Ensure that information sharing is an ongoing, integral part of the management plan rather than a single event at time of presentation.	3.3
1.3.2	Agree on individualized self-management strategies with the person with OA. Ensure that positive behavioural changes, such as exercise, weight loss, and use of suitable footwear and pacing, are appropriately targeted.	3.4
1.3.3	Ensure that self-management programs for people with OA, either individually or in groups, emphasize the recommended core treatments, especially exercise.	3.5
1.4.1	Advise people with OA to exercise as a core treatment, irrespective of age, comorbidity, pain severity, or disability. Exercise should include local muscle strengthening and general aerobic fitness.	3.6

1.4.7	*Offer advice on appropriate footwear (including shock-absorbing properties) as part of core treatments for people with lower-limb OA.	3.7
1.6.6	When discussing the possibility of joint surgery, check that the person has been offered at least the core treatments for OA, and give him or her information about the benefits and risks of surgery and the potential consequences of not having surgery, recovery and rehabilitation after surgery, how having a prosthesis might affect him or her, and how care pathways are organized in his or her local area.	3.8

*OARSI*¹²⁵

n/a	Information about disease progression	4.1
n/a	Education about self-care techniques	4.2
n/a	Promote hope, optimism, and a positive expectation of benefit from treatment	4.3

6A.ii – education specific recommendations from expert opinion used to add to brainstorming only

French et al.³²⁰

Disease Knowledge

1. *Osteoarthritis is not just a disease of the cartilage but affects your whole joint including muscles and ligaments
2. Joint damage on an x-ray does not indicate how much your osteoarthritis will affect you
3. *The symptoms of osteoarthritis can vary greatly from person to person
4. Osteoarthritis is not an inevitable part of getting older

Drugs

5. *You should avoid the use of non-steroidal anti-inflammatory drugs for your osteoarthritis over the long term
6. *You may get some pain relief from your osteoarthritis by using acetaminophen (paracetamol) medications

Principles of Management

7. *Non-drug treatments have similar benefits for your osteoarthritis symptoms to pain-relieving drugs, but with very few adverse side effects
8. Actively taking part in self-management programs could benefit your osteoarthritis
9. Treatment interventions and lifestyle changes for your osteoarthritis should be individualised and include long- and short-term goals. These should be reviewed regularly with your health professionals
10. Methods for you to self-manage your osteoarthritis should be discussed and agreed on by you and your health professionals

Surgery

11. Your osteoarthritis symptoms can often be eased significantly without requiring an operation
12. If you cannot achieve pain relief from your osteoarthritis, have undertaken a sustained period of recommended conservative management, and it is very difficult to perform activities of daily living, joint replacement surgery is an option
13. *Keyhole surgery (arthroscopy) that involves washout of the joint and joint scraping should not be used to treat your pain unless there is mechanical blocking of your joint

Exercise, Physical Activity and Weight Loss

14. **Regular physical activity and individualised exercise programs (including muscle strengthening, cardiovascular activity and flexibility exercises) can reduce your pain, prevent worsening of your osteoarthritis, and improve your daily function

-
15. If you are overweight and have osteoarthritis, it will be beneficial to lose weight and maintain a healthy weight through an individualised plan involving dietary changes and increased physical activity
 16. *Living a sedentary life could worsen your osteoarthritis and also increases your risk of other lifestyle-related diseases, such as diabetes and cardiovascular disease
 17. *Individualised exercise is an integral component of treatment for everyone with osteoarthritis
 18. Maintaining sufficient muscle strength around the joints is important in reducing pain and maintaining function, and if you require an operation, will benefit both pre- and post-operative periods of your treatment
 19. Linking your individualised exercises to your other daily activities is a useful way to become more active
 20. Individualised exercises only work for your osteoarthritis if you do them regularly
 21. Small amounts of individualised exercise undertaken frequently can be beneficial for your osteoarthritis
-

*Teo et al.*³²¹

1. Discuss and offer a personalised exercise and physical activity program to people with hip and/or knee osteoarthritis according to their needs, preferences, self-motivation and ability to perform the exercises. An appropriate exercise program may include muscle strengthening, aerobic activity, land- or water-based exercise, and a supervised or unsupervised exercise program. The type and dosage of the exercise program should be individually tailored
2. *Provide information on opportunities for people to exercise locally at a minimal financial cost
3. Offer accurate verbal and written information to enhance understanding of the pain experience, including the neurobiological basis of pain

* = Added to participant brainstorming responses, ** = priority split into two

Appendix 6B – Physiotherapists – original brainstorming responses, edits, additions from guidelines and expert opinion and final priorities

6B.i Round 1 - Original brainstorming responses of physiotherapists with splitting to represent single ideas only

Response number from download	Original priority response	Revised priority	Priority ID after R1
1	The evidence around widely used treatments for osteoarthritis.	The evidence around widely used treatments for osteoarthritis.	1
2	The disparity between symptoms and imaging findings, and why imaging is discouraged.	The disparity between symptoms and imaging finding	2a
		why imaging is discouraged	2b
3	Understanding when to progress and regress exercise.	Understanding when to progress and regress exercise	3
4	Strategies in making exercise a routine and working it into your life.	Strategies in making exercise a routine and working it into your life	4
5	Pain does not equal harm. How to monitor pain during exercise and activity and when to consider adapting these tasks.	Pain does not equal harm or damage	5a
		How to monitor pain during exercise and activity	5b
		When to consider adapting exercise and activity in response to pain	5c
6	Load is not bad. Our body's tissues adapt to imposed demands. Osteoarthritic joints are no different.	Load is not bad	6a
		Osteoarthritic joints adapt to imposed demands	6b
7	Many factors that influence pain and disability with emphasis on the non-mechanical and how exercise and education can work as a mediator.	There are many factors that influence pain and disability	7a
		how exercise can work as a mediator for pain and disability	7b
		how education can work as a mediator for pain and disability	7c
		Non mechanical factors relating to pain should be emphasised	7d
8	The osteoarthritis process - onset and drivers of disease progression. Emphasis on chronic inflammatory role, factors that influence this, and importance of exercise as a mediator.	The osteoarthritis process - onset and drivers of disease progression	8a
		How chronic inflammation influences osteoarthritis	8b

9	If you need to lose weight, try NOT to focus on the total amount you would like to lose, aim for a small chunk initially and celebrate your achievement, then increase from there as every kilo helps improve your joints	importance of small achievable goals in weight loss	9
10	Try to keep some of your goals short term so that they are more achievable, then you can work towards your long term goals feeling that you are achieving something in the meantime	the importance of setting short and long term goals	10
11	That no matter how painful your joint is, there is always some type of exercise you can do to benefit your joint	That no matter how painful your joint is, there is always some type of exercise you can do to benefit your joint	11
12	Despite a 'bone on bone' exercise, education and weight loss can be very effective due to multifactorial pain nature, and joint loading. Many people have 'bone on bone' changes and are asymptomatic	exercise can be very effective	12a
		education can be very effective	12b
		weight loss can be very effective	12c
		Many people have 'bone on bone' changes and are asymptomatic	12d
13	It is never lost/wasted time. Even if you need to proceed to joint replacement after GLA:D, you'll still enter stronger which will help recovery. Hopefully it allows you to avoid or delay joint replacement due to symptoms control & improved function	It is never lost/wasted time. Even if you need to proceed to joint replacement after receiving education and exercise, you'll still enter stronger which will help recovery	13a
		exercise and education can delay joint replacement due to symptoms control & improved function	13b
14	Even if you are already very physically active or playing sport eg. tennis, GLA:D still has potential for benefit because it targets specific muscle strength, and improved limb alignment/control	Even if you are already very physically active exercise still has potential for benefit because it targets specific muscle strength, and improved limb alignment/control	14
15	you will not make the knee worse or damage it with the exercises from GLA:D	Therapeutic exercise will not make the knee worse in the long-term	15
16	Basic information about the principles of strengthening - and progressive load to increase muscle strength/function. Explanation on how strengthening can improve shock absorbing capacity in the lower limb.	basic information about the principles of strengthening and progressive load	16a
		strengthening can improve shock absorbing capacity in the lower limb	16b
17	There are more effective treatment options than joint replacement surgery	There are more effective treatment options than joint replacement surgery	17

18	Pacing of activities helps manage pain	Pacing of activities helps manage pain	18
19	You can make improvements with exercise	You can make improvements with exercise	19
20	Degenerative changes on Xray are a normal part of ageing	Degenerative changes on Xray are a normal part of ageing	20
21	practical and useable information on 'how to' lose weight - this may include referral to a dietician or similar with a biopsychosocial approach	Information on 'how to' lose weight	21
22	Bioplasticity - that we can improve pain with movement and with less fear around movement, despite changes on radiology.	we can improve pain with movement and with less fear around movement	22a
		you can improve despite changes on radiology	22b
23	That central nervous system changes are part of the picture - not just 'tissue damage'	That central nervous system changes are part of the picture - not just 'tissue damage'	23
24	Pacing can help	Pacing can help	24
25	Pain does not mean damage	Pain does not mean damage	25
26	Role of exercise and weight loss in OA (regardless of severity), identifying and overcoming barriers (eg. pain, ongoing motivation, lack of resources, comorbidities) that may prevent them to engage in these.	Role of exercise in OA	26a
		Role of weight loss in OA	26b
		identifying and overcoming barriers to exercise	26c
		identifying and overcoming barriers to weight loss	26d
27	Daily exercising , limiting activities according to pain threshold limits , keeping weight under control , etc	daily exercising	27a
		limiting activities according to pain thresholds	27b
		keeping weight under control	27c
28	Osteoarthritis requires active input from client - weight loss/commitment to exercise. Clients have the control to make the change - physiotherapists there to guide the process	Osteoarthritis management requires active input from client. Physiotherapist is there to guide the process	28a
		weight loss	28b
		the importance of being committed to exercise	28c
29	Education to be delivered in different languages and using culturally relevant examples or metaphors	Tailor education to be appropriate to various languages and cultures	29
30	How pain system works and that it can be affected by other factors including mood, sleep, diet etc.	How we get pain	30a
		Pain can be affected by non-mechanical factors including mood, sleep, diet etc.	30b
31	How to pace , and how to "pace-up" and improve function in a graded fashion	How to pace, and how to "pace-up" and improve function in a graded fashion	31
32	Importance of pacing and reducing boom-bust	Importance of pacing and reducing boom-bust	32
33		education about exercise	33a

	education about exercise and pain. Xrays showing severe OA don't necessarily equate to pain. Surgery is not the only option to help reduce pain	education about pain	33b
		X-Rays showing severe OA don't necessarily equate to pain	33c
		Surgery is not the only option to help reduce pain	33d
34	Improving self-efficacy relating to knee and hip pain is important	Improving self-efficacy relating to knee and hip pain is important	34
35	There is a high prevalence of hip/knee degenerative changes in asymptomatic individuals.	There is a high prevalence of hip/knee degenerative changes in asymptomatic individuals.	35
36	Hip or knee arthroscopy for OA is ineffective. Joint replacement is a last resort, it is useful for a relatively small group of patients but most patients can be managed well with GLA:D and weight loss.	knee arthroscopy for OA is ineffective	36a
		Joint replacement is a last resort, it is useful for a relatively small group of patients	36b
		most patients can be managed well with GLA:D and weight loss	36c
37	Improving general health is important in the management of hip and knee osteoarthritis	Improving general health is important in the management of knee osteoarthritis	37
38	Joint load management - what is it and how you do it	Joint load management - what is it and how you do it	38
39	Osteoarthritis is multi-factorial, radiology may be relevant but it is part of a bigger picture and it's relevance is often over-stated	Osteoarthritis is multi-factorial	39a
		radiology may be relevant but it is part of a bigger picture and it's relevance is often over-stated	39b
40	Painful does not mean damaging	Painful does not mean damaging	40
41	There are things which can help-not just surgery!	There are things which can help-not just surgery!	41
42	Effect of OA on other symptoms not just pain-e.g. mood, fatigue	Effect of OA on other symptoms not just pain-e.g. mood, fatigue	42
43	If overweight, weight loss can make a significant difference to symptoms-acknowledging can be very difficult to do	acknowledging weight loss can be very difficult to do	43
44	Pain is complicated and influenced by a variety of factors	Pain is complicated and influenced by a variety of factors	44
45	Most people do well after arthroplasty but not everyone does	Most people do well after arthroplasty but not everyone does	45
46	Bone on bone' doesn't equate to severity of symptoms (i.e. changes on x-ray don't necessarily correlate with symptom severity)	Bone on bone' doesn't equate to severity of symptoms (i.e. changes on x-ray don't necessarily correlate with symptom severity)	46
47	Not everyone with OA gets worse or requires surgery	Not everyone with osteoarthritis gets worse	47a
		not everyone with osteoarthritis requires surgery	47b
48		Exercise is safe for osteoarthritic joints	48a

	Exercise is safe for osteoarthritic joints, can make a big difference to pain and function, and may be helpful to cartilage	Exercise can make a big difference to pain and function	48b
		Exercise may be helpful to cartilage	48c
49	Is NOT wear and tear or normal part of ageing	Osteoarthritis is not "wear and tear"	49a
		Osteoarthritis is not a normal part of ageing	49b
50	Effectiveness of various treatment options	Effectiveness of various treatment options	50
51	A consistent, progressively overloaded strength program helps to improve function	A consistent, progressively overloaded strength program helps to improve function	51
52	A knee replacement is not always the ultimate outcome for someone with OA	A knee replacement is not always the ultimate outcome for someone with OA	52
53	A progressive strengthening based program can be highly beneficial in settling painful symptoms and improving function.	A progressive strengthening based program can be highly beneficial in settling painful symptoms and improving function.	53
54	Any possible "wear and tear" caused by increase in exercise is generally outweighed by benefits of increased strength/tissue load tolerance.	Any possible "wear and tear" caused by increase in exercise is generally outweighed by benefits of increased strength/tissue load tolerance.	54
55	Appropriate loading and load management is a crucial element to OA management	Appropriate loading and load management is a crucial element to OA management	55
	Arthritis is normal part of aging. We can't change this however we can improve pain/symptoms by improving strength and movement patterns through exercise	structural changes are a normal part of aging	56a
56		we can improve pain/symptoms by improving strength and movement patterns through exercise	56b
57	Benefits of strengthening programs and conservative management.	Benefits of strengthening programs and conservative management.	57
58	Christian Barton can fix your knee	Christian Barton can fix your knee	58
	Education about pacing and reassurance that appropriate activity/exercise is not only safe but necessary for improving symptoms and maintaining function	Education about pacing	59a
59		reassurance that appropriate activity/exercise is not only safe but necessary for improving symptoms and maintaining function	59b
60	EVB of regular exercise and strength	Evidence base of regular exercise and strength	60
61	Even if joint surgery is required, keeping or getting fitter/stronger beforehand will assist with the recovery process	Even if joint surgery is required, keeping or getting fitter/stronger beforehand will assist with the recovery process	61
62	Gradual improvements of strength and tolerance significantly improves function	Gradual improvements of strength and tolerance significantly improves function	62

63	Imaging findings do not predict function / quality of life	Imaging findings do not predict function / quality of life	63
64	Joint surgery is not mandatory just because it is recommended by a specialist but a choice the individual makes with appropriate levels of information.	Joint surgery is not mandatory just because it is recommended by a specialist but a choice the individual makes with appropriate levels of information.	64
65	Lifestyle changes	Lifestyle changes	65
66	Lifestyle changes can play a big role- weight loss, diet, physical activity and other daily stresses can impact on pain experience	Lifestyle changes can play a big role in the management of knee osteoarthritis	66a
		weight loss, diet, physical activity and other daily stresses can impact on pain experience	66b
67	Like with any other joint condition, in the management of osteoarthritis, we want to settle the joint down and then build up strength around the area, reflective of the patient's goals.	Like with any other joint condition, in the management of osteoarthritis, we want to settle the joint down and then build up strength around the area, reflective of the patient's goals.	
68	Most patients have functional goals. End stage rehabilitation for knee osteoarthritis should therefore include squats, lunges, deadlifts and step ups with or without weight.	Most patients have functional goals. End stage rehabilitation for knee osteoarthritis should therefore include squats, lunges, deadlifts and step ups with or without weight.	
69	MRI findings do not predict function / quality of life	MRI findings do not predict function / quality of life	69
70	OA does not necessarily worsen with ageing	OA does not necessarily worsen with ageing	70
71	Osteoarthritis is not a "wear and tear" disease	Osteoarthritis is not a "wear and tear" disease	71
72	Osteoarthritis is one way that the body adapts to the loads across the life. This can be a positive thing.	Osteoarthritis is one way that the body adapts to the loads across the life. This can be a positive thing.	72
73	Pain does not equal damage	Pain does not equal damage	73
74	Pain does not equal damage	Pain does not equal damage	74
75	People can remain healthy and active with osteoarthritis	People can remain healthy and active with osteoarthritis	75
76	People with OA will greatly benefit from losing weight	People with OA will greatly benefit from losing weight	76
		Reassurance that radiological findings have a poor correlation with pain	77a
77		Radiological findings cannot accurately predict prognosis	77a

	Reassurance that radiological findings have a poor correlation with pain and cannot accurately predict prognosis - education that active management with lifestyle and exercise choices can significantly reduce symptoms and potentially avoid surgery	education that active management with lifestyle and exercise choices can significantly reduce symptoms and potentially avoid surgery	77b
78	Relationship of pain and OA and pain does not necessarily mean damage	Relationship of pain and OA and pain does not necessarily mean damage	78
79	Strength and neuromuscular control exercises can help improve your knees capacity to tolerate load	Strength and neuromuscular control exercises can help improve your knees capacity to tolerate load	79
80	That exercise is a critical component of managing OA	That exercise is a critical component of managing OA	80
81	The importance and role of exercise , weight management and self-management strategies .	The importance and role of exercise	81a
		The importance and role of weight management	81b
		The importance and role of self-management strategies	81c
82	The prevalence of osteoarthritic "degenerative" findings in asymptomatic knees in the general population - highlights disconnect between findings and symptoms.	The prevalence of osteoarthritic "degenerative" findings in asymptomatic knees in the general population	82a
		The disconnect between findings and symptoms.	82b
83	The role of exercise - both specific (ie tailored program of specific exercises) and general (ie walking, bike)	The role of exercise - both specific (ie tailored program of specific exercises) and general (ie walking, bike)	83
84	Understanding anatomy vs function vs pain management	Understanding anatomy vs function vs pain management	84
85	We want to get you stronger without significantly flaring your pain. It is about matching your loads to your current muscle capacity.	We want to get you stronger without significantly flaring your pain. It is about matching your loads to your current muscle capacity.	85
86	Weight loss	Weight loss	86
87	When you have your joint surgery, you will not instantly be able to do the things you did 20 years ago!!	When you have your joint surgery, you will not instantly be able to do the things you did 20 years ago!!	87
88	With appropriate intervention and adherence to exercise program can function very well with OA	With appropriate intervention and adherence to exercise program can function very well with OA	8
89	Cartilage health and importance of acceptable loading - Acceptable and safe things to feel (pain) during exercise.	Cartilage health and importance of acceptable loading	89a
		Acceptable and safe to feel pain during exercise.	89b
		Why and how strengthening exercises (loading/using affected joint) helps knee OA	89c

	<ul style="list-style-type: none"> - Why and how strengthening exercises (loading/using affected joint) helps knee OA - Difference between joint pain and DOMS when exercising 	Difference between joint pain and Delayed onset of muscle soreness (DOMS) when exercising	89d
90	During the GLA:D program, most people notice their function improves even if the pain remains	with education and exercise, most people notice their function improves even if the pain remains	90
91	Exercise is good for knee cartilage health	Exercise is good for knee cartilage health	91
92	Goal should be to focus on trying to improve physical function and less of doing further damage to your knee.	Goal should be to focus on trying to improve physical function and less of doing further damage to your knee.	92
93	Information about joint surgery: facts and misconceptions.	Information about joint surgery: facts and misconceptions.	93
94	Reframe "bone on bone"- explain not a helpful way to think about OA as it goes against exercise as a helpful strategy	Reframe "bone on bone"- explain not a helpful way to think about OA as it goes against exercise as a helpful strategy	94
95	That it is ok to continue some light exercise when we experience a pain flare. We do not need to avoid future attempts to exercise the knee.	That it is ok to continue some light exercise when we experience a pain flare.	95a
		If you experience pain during exercise we do not need to avoid future attempts to exercise the knee	95b
96	The importance / benefits of weight loss	The importance / benefits of weight loss	96
97	The importance of knowing about your condition and the positive steps you can do to help, including appropriate exercise and weight management.	The importance of knowing about your condition	97a
		you can help your condition through weight loss	97b
		you can help your condition through exercise	97c
98	Understanding pain and knee OA	understanding pain	98a
		understanding OA	98b

6B.ii Round 2 – Condensing revised priorities of physiotherapists when priorities represent the same idea

Priority ID after R1	Revised priority from R1	Other R1 priorities that are same/similar	Final priority after R2	Priority ID after R2
2a	The disparity between symptoms and quality of life with imaging findings	<p>22b - you can improve despite changes on radiology</p> <p>33c – X-rays showing severe OA don't necessarily equate to pain</p> <p>39b - radiology may be relevant but it is part of a bigger picture and it's relevance is often over-stated</p> <p>46 - Bone on bone' doesn't equate to severity of symptoms (i.e. changes on x-ray don't necessarily correlate with symptom severity)</p> <p>63 - Imaging findings do not predict function / quality of life</p> <p>69 - MRI findings do not predict function / quality of life</p> <p>77a - Reassurance that radiological findings have a poor correlation with pain</p> <p>82b - The disconnect between findings and symptoms.</p>	The disparity between symptoms and quality of life with imaging findings	1
35	There is a high prevalence of knee degenerative changes in asymptomatic individuals.	<p>12d - Many people have 'bone on bone' changes and are asymptomatic</p> <p>82a - The prevalence of osteoarthritic "degenerative" findings in asymptomatic knees in the general population</p>	There is a high prevalence of knee degenerative changes in asymptomatic individuals.	2

2b	Why imaging is discouraged		Why imaging is discouraged	3
3	Understanding when to progress and regress exercise		Understanding when to progress and regress exercise	4
4	Strategies in making exercise a routine and working it into your life		Strategies in making exercise a routine and working it into your life	5
5a	Pain does not equal harm or damage	25 - Pain does not mean damage 40 - Painful does not mean damaging 73 - Pain does not equal damage 74 - Pain does not equal damage 78 - Relationship of pain and OA and pain does not necessarily mean damage	Pain does not equal harm or damage	6
5b	How to monitor pain during exercise and activity		How to monitor pain during exercise and activity	7
5c	When to consider adapting exercise and activity in response to pain	95a That it is ok to continue some light exercise when we experience a pain flare.	When to consider adapting exercise and activity in response to pain	8
6a	load is not bad	55 - Appropriate loading and load management is a crucial element to OA management 89a Cartilage health and importance of acceptable loading 91 - Exercise is good for knee cartilage health 72 - Osteoarthritis is one way that the body	Appropriate load and exercise is good for knee cartilage and health	9

		adapts to the loads across the life. This can be a positive thing.		
6b	Osteoarthritic joints adapt to imposed demands	<p>48c - Exercise may be helpful to cartilage</p> <p>89a Cartilage health and importance of acceptable loading</p> <p>91 - Exercise is good for knee cartilage health</p>	Osteoarthritic joints adapt to imposed demands	10
7a	There are many factors that influence pain and disability	44 - Pain is complicated and influenced by a variety of factors	There are many factors that influence pain and disability	11
7b	How exercise can work as a mediator for pain and disability	<p>8b - importance of exercise as a mediator</p> <p>26a - Role of exercise in OA</p> <p>48b - Exercise can make a big difference to pain and function</p> <p>56b - we can improve pain/symptoms by improving strength and movement patterns through exercise</p> <p>59b - reassurance that appropriate activity/exercise is not only safe but necessary for improving symptoms and maintaining function</p> <p>89c Why and how strengthening exercises (loading/using affected joint) helps knee OA</p>	How exercise can work as a mediator for pain and disability	12
7c	How education can work as a mediator for pain and disability		How education can work as a mediator for pain and disability	13

8a	The osteoarthritis process - onset and drivers of disease progression	39a - Osteoarthritis is multi-factorial 78 - Relationship of pain and OA and pain does not necessarily mean damage 97a The importance of knowing about your condition 98b understanding OA	The osteoarthritis process - onset and drivers of disease progression	14
8b	How chronic inflammation influences osteoarthritis		How chronic inflammation influences osteoarthritis	15
9	Importance of small achievable goals in weight loss		Importance of small achievable goals in weight loss	16
10	The importance of setting short and long term goals	92 - Goal should be to focus on trying to improve physical function and less of doing further damage to your knee.	The importance of setting short and long term goals	17
11	That no matter how painful your joint is, there is always some type of exercise you can do to benefit your joint		That no matter how painful your joint is, there is always some type of exercise you can do to benefit your joint	18
12a	Exercise can be very effective	19 - You can make improvements with exercise 48b - Exercise can make a big difference to pain and function 54 - Any possible "wear and tear" caused by increase in exercise is generally outweighed by benefits of increased strength/tissue load tolerance. 60 - Evidence base of regular exercise and strength 77b - education that active management	Exercise can be very effective	19

		<p>with lifestyle and exercise choices can significantly reduce symptoms and potentially avoid surgery</p> <p>80 - That exercise is a critical component of managing OA</p> <p>81a - The importance and role of exercise</p> <p>81b - The importance and role of weight management</p> <p>83 - The role of exercise - both specific (ie tailored program of specific exercises) and general (ie walking, bike)</p> <p>88 - With appropriate intervention and adherence to exercise program can function very well with OA</p> <p>97c you can help your condition through exercise</p>		
12b	Education can be very effective		Education can be very effective	20
12c	Weight loss can be very effective	<p>26b - Role of weight loss in OA</p> <p>27c - keeping weight under control</p> <p>28b - weight loss</p> <p>76 - People with OA will greatly benefit from losing weight</p> <p>86 - Weight loss</p> <p>96 - The importance / benefits of weight</p>	<p>Weight loss can be very effective</p>	21

		loss 97b you can help your condition through weight loss		
13a	It is never lost/wasted time. Even if you need to proceed to joint replacement after receiving education and exercise, you'll still enter stronger which will help recovery	61 - Even if joint surgery is required, keeping or getting fitter/stronger beforehand will assist with the recovery process	It is never lost/wasted time. Even if you need to proceed to joint replacement after receiving education and exercise, you'll still enter stronger which will help recovery	22
13b	Exercise and education can delay joint replacement due to symptoms control & improved function	77b - education that active management with lifestyle and exercise choices can significantly reduce symptoms and potentially avoid surgery	Exercise and education can delay joint replacement due to symptoms control & improved function	23
14a	Even if you are already very physically active exercise still has potential for benefit because it targets specific muscle strength, and improved limb alignment/control		Even if you are already very physically active exercise still has potential for benefit because it targets specific muscle strength, and improved limb alignment/control	24
15	Therapeutic exercise will not make the knee worse in the long-term	48a - Exercise is safe for osteoarthritic joints 54 - Any possible "wear and tear" caused by increase in exercise is generally outweighed by benefits of increased strength/tissue load tolerance. 59b - reassurance that appropriate activity/exercise is not only safe but necessary for improving symptoms and maintaining function 95b If you experience pain during exercise	Therapeutic exercise will not make the knee worse in the long-term	25

		we do not need to avoid future attempts to exercise the knee		
16a	Basic information about the principles of strengthening and progressive load	38 - Joint load management - what is it and how you do it 55 - Appropriate loading and load management is a crucial element to OA management	Basic information about the principles of strengthening and progressive load	26
16b	Strengthening can improve shock absorbing capacity in the lower limb	79 - Strength and neuromuscular control exercises can help improve your knees capacity to tolerate load	Strengthening can improve shock absorbing capacity in the lower limb	27
18	Pacing of activities helps manage pain	24 - Pacing can help 27b - limiting activities according to pain thresholds 31 - How to pace , and how to "pace-up" and improve function in a graded fashion 32 - Importance of pacing and reducing boom-bust 59a - Education about pacing	Pacing of activities helps manage pain	28
20	Degenerative changes on Xray are a normal part of ageing	56a - structural changes are a normal part of aging	Degenerative changes on Xray are a normal part of ageing	29
21	Information on 'how to' lose weight		Information on 'how to' lose weight	30
22a	We can improve pain with movement and with less fear around movement		We can improve pain with movement and with less fear around movement	31
23	That central nervous system changes are part of the picture - not just 'tissue damage'		That central nervous system changes are part of the picture - not just 'tissue damage'	32

26c	Identifying and overcoming barriers to exercise		Identifying and overcoming barriers to exercise	33
26d	Identifying and overcoming barriers to weight loss	43 - acknowledging weight loss can be very difficult to do	Identifying and overcoming barriers to weight loss	34
28a	Osteoarthritis management requires active input from client. Physiotherapist is there to guide the process		Osteoarthritis management requires active input from client. Physiotherapist is there to guide the process	35
28c	The importance of being committed to exercise	88 - With appropriate intervention and adherence to exercise program can function very well with OA	The importance of being committed to exercise	36
30a	How we get pain	84 - Understanding anatomy vs function vs pain management 98a understanding pain	How we get pain	37
30b	Pain can be affected by non-mechanical factors including mood, sleep, diet etc.	7d Non mechanical factors relating to pain should be emphasised 66b - weight loss, diet, physical activity and other daily stresses can impact on pain experience	Pain can be affected by non-mechanical factors including mood, sleep, diet etc.	38
33d	Surgery is not the only option to help reduce pain	41 - There are things which can help-not just surgery! 17 - There are more effective treatment options than joint replacement surgery	Surgery is not the only option to help reduce pain	39
34	Improving self-efficacy relating to knee pain is important		Improving self-efficacy relating to knee pain is important	40
36a	Knee arthroscopy for osteoarthritis is ineffective		Knee arthroscopy for osteoarthritis is ineffective	41
36b	Joint replacement is a last resort, it is useful for a relatively small group of patients	17 - There are more effective treatment options than joint replacement surgery 47b - not everyone with osteoarthritis requires surgery	Joint replacement is a last resort, it is useful for a relatively small group of patients	42

		52 A knee replacement is not always the ultimate outcome for someone with OA		
42	Effect of osteoarthritis on other symptoms not just pain-e.g. mood, fatigue		Effect of osteoarthritis on other symptoms not just pain-e.g. mood, fatigue	43
45	Most people do well after arthroplasty but not everyone does	87 - When you have your joint surgery, you will not instantly be able to do the things you did 20 years ago!!	Most people do well after arthroplasty but not everyone does	44
47a	Not everyone with osteoarthritis gets worse		Not everyone with osteoarthritis gets worse	45
51	A consistent, progressively overloaded strength program helps to improve function	<p>53 - A progressive strengthening based program can be highly beneficial in settling painful symptoms and improving function.</p> <p>55 - Appropriate loading and load management is a crucial element to OA management</p> <p>57 - Benefits of strengthening programs and conservative management.</p> <p>62 - Gradual improvements of strength and tolerance significantly improves function</p> <p>85 - We want to get you stronger without significantly flaring your pain. It is about matching your loads to your current muscle capacity.</p>	A consistent, progressively overloaded strength program helps to improve function	46
64	Joint surgery is not mandatory just because it is recommended by a specialist but a choice the individual makes with appropriate levels of information.		Joint surgery is not mandatory just because it is recommended by a specialist but a choice the individual makes with appropriate levels of information.	47

66a	Lifestyle changes can play a big role in the management of knee osteoarthritis	65 - Lifestyle changes	Lifestyle changes can play a big role in the management of knee osteoarthritis	48
75	People can remain healthy and active with osteoarthritis		People can remain healthy and active with osteoarthritis	49
77b	Radiological findings cannot accurately predict prognosis		Radiological findings cannot accurately predict prognosis	50
89b	Acceptable and safe to feel pain during exercise.		Acceptable and safe to feel pain during exercise.	51
89d	Difference between joint pain and Delayed onset of muscle soreness (DOMS) when exercising		Difference between joint pain and Delayed onset of muscle soreness (DOMS) when exercising	52
90	with education and exercise, most people notice their function improves even if the pain remains		with education and exercise, most people notice their function improves even if the pain remains	53
71	Osteoarthritis is not a "wear and tear" disease	49a - osteoarthritis is not wear and tear disease 70 - OA does not necessarily worsen with ageing	Osteoarthritis is not a "wear and tear" disease	54
49b	Osteoarthritis is not a normal part of ageing		Osteoarthritis is not a normal part of ageing	55
37	Improving general health is important in the management of knee osteoarthritis		Improving general health is important in the management of knee osteoarthritis	56

6B.iii Final list of priorities for use in sorting and rating

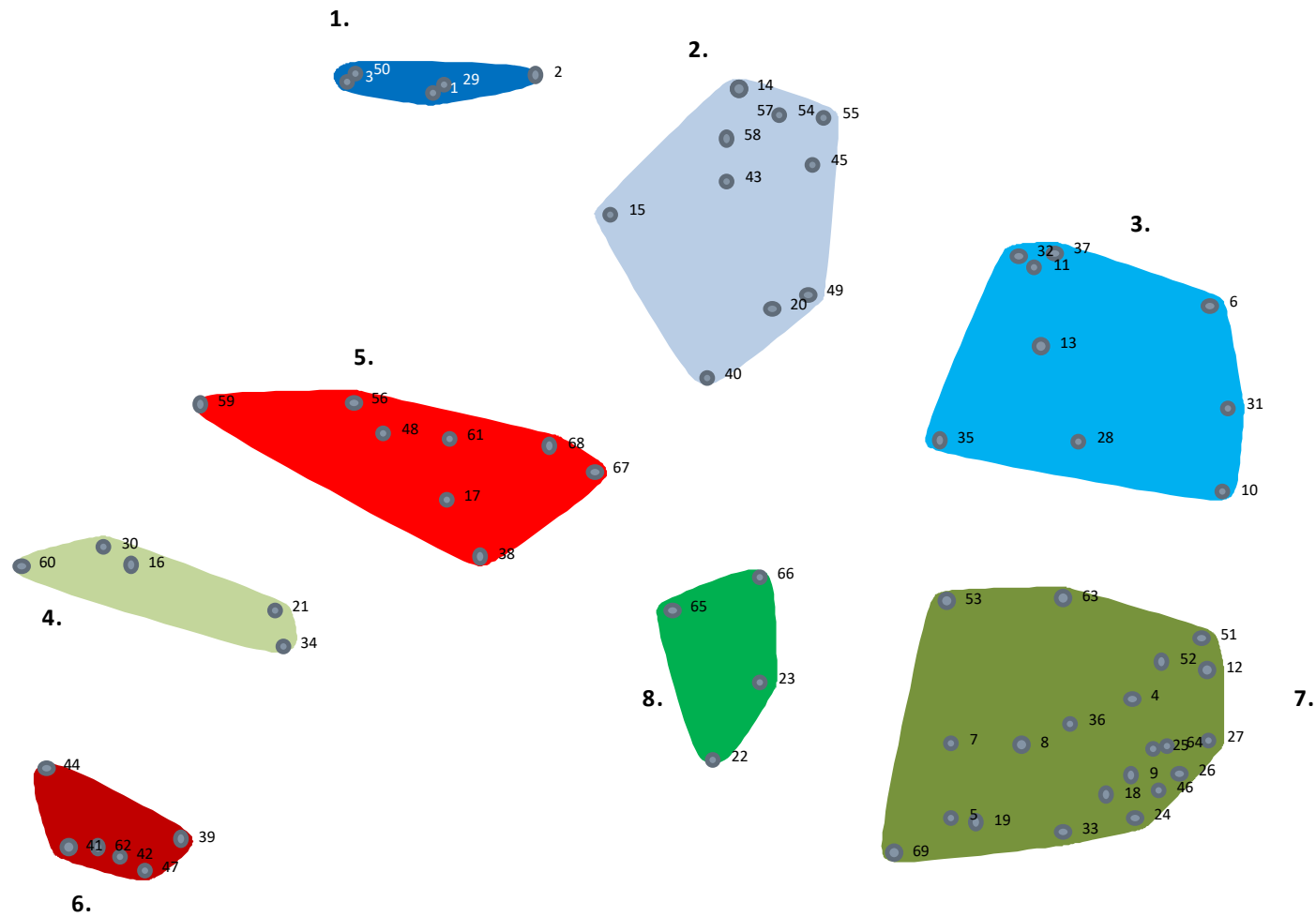
Priority ID after R2	Priority	Source
1	The disparity between symptoms and quality of life with imaging findings	Brainstorming
2	There is a high prevalence of knee degenerative changes in asymptomatic individuals.	
3	Why imaging is discouraged	
4	Understanding when to progress and regress exercise	
5	Strategies in making exercise a routine and working it into your life	
6	Pain does not equal harm or damage	
7	How to monitor pain during exercise and activity	
8	When to consider adapting exercise and activity in response to pain	
9	Appropriate load and exercise is good for knee cartilage and health	
10	Osteoarthritic joints adapt to imposed demands	
11	There are many factors that influence pain and disability	
12	How exercise can work as a mediator for pain and disability	
13	How education can work as a mediator for pain and disability	
14	The osteoarthritis process - onset and drivers of disease progression	
15	How chronic inflammation influences osteoarthritis	
16	Importance of small achievable goals in weight loss	
17	The importance of setting short and long term goals	
18	That no matter how painful your joint is, there is always some type of exercise you can do to benefit your joint	
19	Exercise can be very effective	
20	Education can be very effective	
21	Weight loss can be very effective	
22	It is never lost/wasted time. Even if you need to proceed to joint replacement after receiving education and exercise, you'll still enter stronger which will help recovery	
23	Exercise and education can delay joint replacement due to symptoms control & improved function	
24	Even if you are already very physically active exercise still has potential for benefit because it targets specific muscle strength, and improved limb alignment/control	
25	Therapeutic exercise will not make the knee worse in the long-term	
26	Basic information about the principles of strengthening and progressive load	

27	Strengthening can improve shock absorbing capacity in the lower limb	
28	Pacing of activities helps manage pain	
29	Degenerative changes on Xray are a normal part of ageing	
30	Information on 'how to' lose weight	
31	We can improve pain with movement and with less fear around movement	
32	That central nervous system changes are part of the picture - not just 'tissue damage'	
33	Identifying and overcoming barriers to exercise	
34	Identifying and overcoming barriers to weight loss	
35	Osteoarthritis management requires active input from client. Physiotherapist is there to guide the process	
36	The importance of being committed to exercise	
37	How we get pain	
38	Pain can be affected by non-mechanical factors including mood, sleep, diet etc.	
39	Surgery is not the only option to help reduce pain	
40	Improving self-efficacy relating to knee pain is important	
41	Knee arthroscopy for osteoarthritis is ineffective	
42	Joint replacement is a last resort, it is useful for a relatively small group of patients	
43	Effect of osteoarthritis on other symptoms not just pain-e.g. mood, fatigue	
44	Most people do well after arthroplasty but not everyone does	
45	Not everyone with osteoarthritis gets worse	
46	A consistent, progressively overloaded strength program helps to improve function	
47	Joint surgery is not mandatory just because it is recommended by a specialist but a choice the individual makes with appropriate levels of information.	
48	Lifestyle changes can play a big role in the management of knee osteoarthritis	
49	People can remain healthy and active with osteoarthritis	
50	Radiological findings cannot accurately predict prognosis	
51	Acceptable and safe to feel pain during exercise.	
52	Difference between joint pain and Delayed onset of muscle soreness (DOMS) when exercising	
53	with education and exercise, most people notice their function improves even if the pain remains	
54	Osteoarthritis is not a "wear and tear" disease	
55	Osteoarthritis is not a normal part of ageing	
56	Improving general health is important in the management of knee osteoarthritis	

57	Osteoarthritis is not just a disease of the cartilage but affects your whole joint including muscles and ligaments	Added from French et al
58	The symptoms of osteoarthritis can vary greatly from person to person	
59	You should avoid the use of nonsteroidal anti inflammatory drugs for your osteoarthritis over the long term	
60	You may get some pain relief from your osteoarthritis by using acetaminophen (paracetamol) medications	
61	Non-drug treatments have similar benefits for your osteoarthritis symptoms to pain relieving drugs, but with very few adverse side effects	
62	keyhole surgery may be considered if there is mechanical blocking of your joint	
63	Regular physical activity can reduce your pain, prevent worsening of your osteoarthritis, and improve your daily function	
64	Individualised exercise programs (including strength, cardiovascular and flexibility) can reduce your pain, prevent worsening of your osteoarthritis, and improve your daily function	
65	Living a sedentary life could increase your risk of other lifestyle-related diseases, such as diabetes and cardiovascular disease	
66	Living a sedentary life could worsen your osteoarthritis	
67	Use of suitable footwear is important for managing your osteoarthritis (e.g. supportive, shock-absorbing properties)	Added from clinical practice guidelines ¹¹⁶
68	Counseling about modifiable work-related factors e.g. behaviours, tasks, hours, assistive technology, workplace modification	
69	Provide information on opportunities for people to exercise locally at minimal financial cost.	From Teo et al ³²¹ Delphi

Appendix 6C – Cluster map of physiotherapists original through to final version

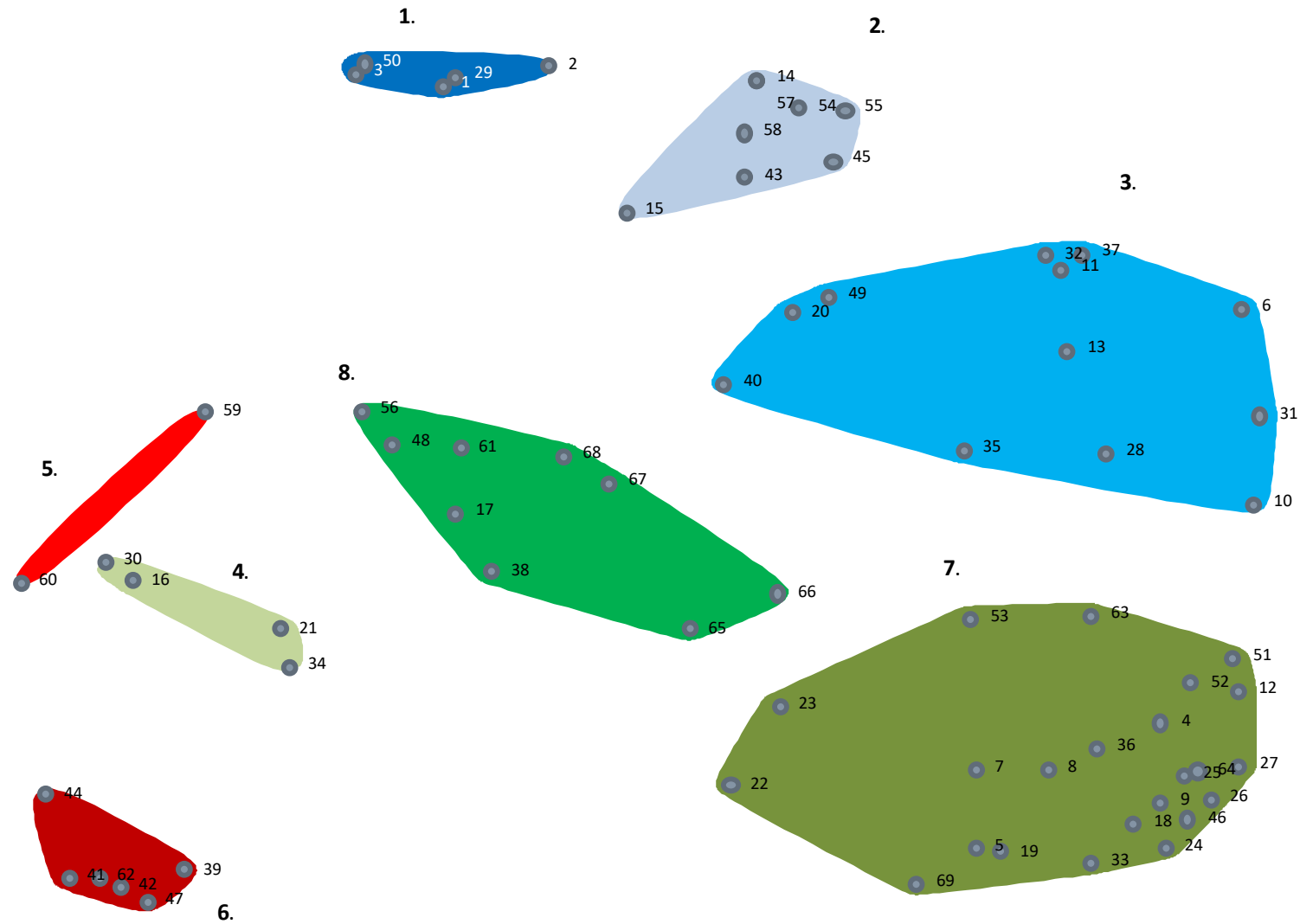
6C.i Eight cluster map generated by hierarchical cluster analysis (before priority re-assignment)



6C.ii Priority re-assignment based on conceptual fit

Priority number	Original cluster number	Moved to which cluster?
20	2	3
40	2	3
49	2	3
23	8	7
22	8	7
56	5	8
48	5	8
61	5	8
17	5	8
38	5	8
68	5	8
67	5	8
60	4	5

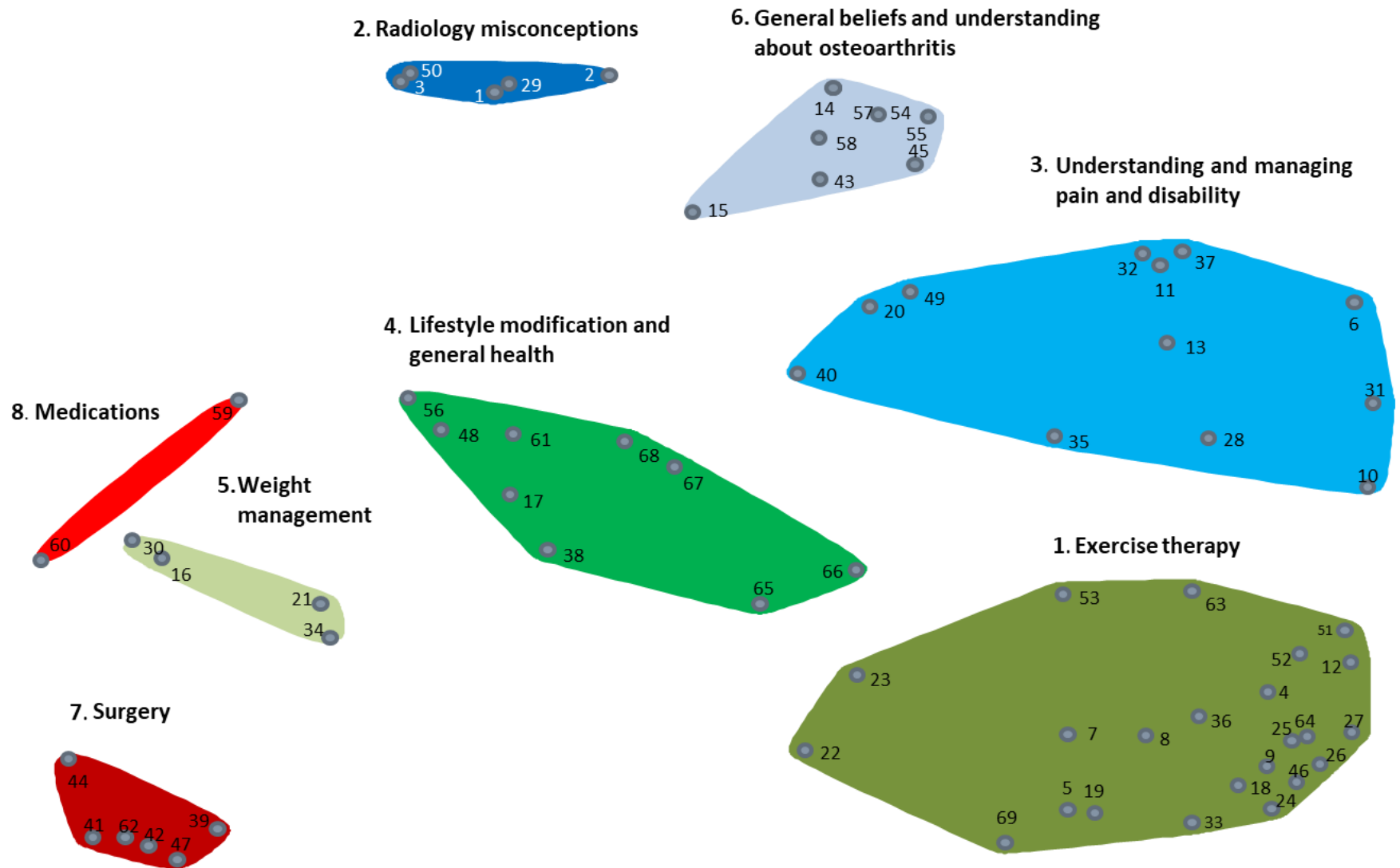
6C.iii Cluster map following priority re-assignment



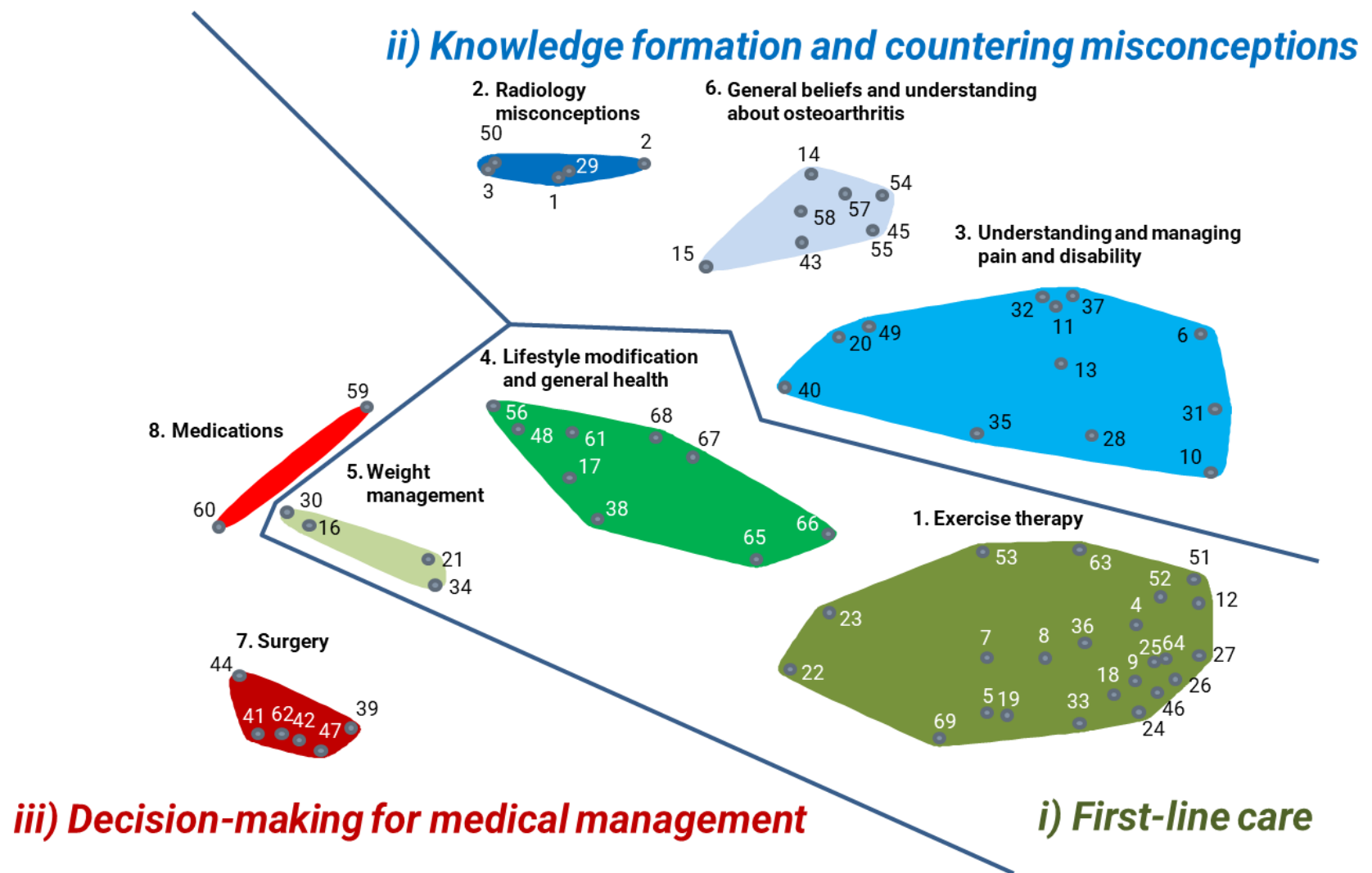
6C.iv Cluster re-numbering and naming

Original cluster number	Final cluster number (ascending based on importance) – and name
1	2 – Radiology misconceptions
2	6 – General beliefs and understanding about osteoarthritis
3	3 – Understanding and managing pain and disability
4	5 – Weight management
5	8 – Medications
6	7 – Surgery
7	1 – Exercise therapy
8	4 – Lifestyle modification and general health

6C.v Final cluster map without domains



6C.vi Final cluster map with domains



Appendix 7

[Appendix 7A](#) – CONSORT-EHEALTH checklist

[Appendix 7B](#) – Facilitation plans for workshops

[Appendix 7C](#) – Feedback options for expert review

[Appendix 7D](#) – Screenshot examples of the prototype toolkit

[Appendix 7E](#) – Screenshot examples of revisions to the toolkit following workshop 1

[Appendix 7F](#) – Screenshot examples of revisions to the toolkit following workshop 2

[Appendix 7G](#) – Screenshot examples of revisions to the toolkit following workshop 3

[Appendix 7H](#) – Screenshot examples of revisions to the toolkit following expert opinion review

Appendix 7A – CONSORT-EHEALTH checklist

Number	Subitem	Notes
i	Names, credential, affiliations of the developers, sponsors, and owners	Goff, A.J., MSc ^{1,2} De Oliveira Silva, D., PhD ¹ Ezzat, A.M., PhD ¹ Crossley, K. PhD ¹ Pazzinatto, M.F., PhD ¹ Barton, C.J., PHD ¹ 1 – La Trobe University Melbourne 2 – Singapore Institute of Technology All authors are part of Translating Research Evidence and Knowledge (TREK).
ii	Describe the history/development process	See Section 7.4 for full co-design process
iii	Revisions and updating	This manuscript outlines the development process for Version 1. Please refer to Appendix 8A for dissemination and continual improvement plan.
iv	Quality assurance methods	See Section 7.4 for full co-design process.
v	Ensure replicability by publishing the source code (preferably as open source), and/or providing screenshots/screen-capture video, and/or providing flowcharts of the algorithms used.	Toolkit available at: www.myknee.trekeeducation.org Please refer to Appendix 7D-7H for screenshots
vi	Digital preservation	Toolkit available at: www.myknee.trekeeducation.org
vii	Access	Participants were provided with the URL to access the toolkit prior to workshops or expert opinion review
viii	Describe mode of delivery, features/functionalities/components of the intervention and comparator, and the theoretical framework	Web-based resource available open access at: www.myknee.trekeeducation.org No Comparator used – note this is a development paper rather than trial
ix	Describe use parameters	Created to be used as a self-directed or therapist-facilitated resource. Research to determine ‘how’ best to use the resource is yet to be completed.
x	Clarify the level of human involvement	For human involvement of co-design process, please see Section 7.4.
xi	Report any prompts/reminders used	Not yet a feature of the ‘My Knee’ toolkit.
xii	Describe any co-interventions (including training/support)	Please see Appendix 8A for future training plan

Appendix 7B - Facilitation plans for workshops

7B.i Workshop 1 - Thursday 17th June 2021 1000-1200 AEST

Time	Item	Leads
5 mins	Welcome to event Re: confirm recording Set expectations	AG
10 mins	Overview of work to date and rationale	AG
5 mins	Introduction to tasks	AG
15 mins	Break out room activity 1 (feedback)	Facilitators AE and CB, DOS to join different group each time, AG to float between the two
15 mins	Feedback from breakout rooms 1	AG to facilitate and ask what was discussed in each room
15 mins	BREAK	
5 mins	Set scene for activity 2	AG
15 mins	Breakout room activity 2 (engaging content focus)	Facilitators AE and CB, DOS to join different group each time, AG to float between the two
15-25 mins	Feedback/big group discussion	AG to facilitate
5 mins	Close/summary/next stages	AG

Breakout activity 1 - Overall toolkit likes and dislikes with a focus of content and display of material within the toolkit.

- What aspects of the content did you find useful/not useful and why?
- Useful prompts. For example:
 - o Features, usability, accessibility, navigation?
 - o What aspects of the website layout did you find useful/not useful and why?
 - o What further recommendations would you make regarding the web-based toolkit?
 - o What does the toolkit achieve/not achieve?
- Was there anything missing?
- At the end – try and get to ‘what would be ideal on here’ and ‘how would an ideal toolkit look?’

Breakout activity 2 – targeted feedback

- Focused on the guide and engagement tools – e.g., quizzes and decision-making tools.
- Are they useful?
- Do they serve a purpose?
- How can we improve them?

7B.ii Workshop 2 Friday 22nd October 2021 1400-1600 AEST

Time	Item	Leads
5 mins	Welcome to event, introduce facilitators Re: confirm recording, Set expectations: all information is confidential and dealt with in a respectful manner. Should participants feel uncomfortable at any point during the workshop they are free to private message the facilitator and withdraw.	AG
10 mins	Introduction of participants	AG
2-5 mins	Introduction to tasks	AG
20 mins	Breakout room activity 1	AE and CB facilitators DOS and AG to join a group each
15 mins	Large group discussion from breakout room activity 1	AG
5-10 mins	BREAK	
20 mins	Breakout room activity 2	AE and CB facilitators DOS and AG to join a group each
15 mins	Large group discussion from breakout room activity 2	AG
10 mins	Breakout room activity 3	2-3 facilitators
5-10 mins	Feedback/summary/next stages Close	AG

Breakout activity 1: Discuss content from a patient perspective

- Do you think that patients will use the resource and find it useful?
 - o If yes why?
 - o If not why not?
- What do you like/not like about the toolkit?
 - o E.g. anything inaccurate or confusing
 - o Presentation
- Is any content missing?

Breakout activity 2: Discuss usability from a clinicians perspective

- Do you think you would use this with patients?
 - o If yes why?
 - o If not why not?
- What would make it easier (or you more likely to use it)?

Breakout activity 3: Suggestions for improvements

- Open ended – any other comments/suggestions/thoughts/critique

7B.iii Workshop 3 Thursday 29th November 2021 1330-1530pm AEST

Time	Item	Leads
5 mins	Welcome to event, introduce facilitators Re: confirm recording Set expectations: all information is confidential and dealt with in a respectful manner. Should participants feel uncomfortable at any point during the workshop they are free to private message the facilitator and withdraw.	AG
10 mins	Introduction of participants	AG
2-5 mins	Introduction to tasks	AG
20 mins	Breakout room activity 1 – general like and dislikes about the toolkit:	AE and CB facilitators DOS and AG to join a group each
15 mins	Large group discussion from breakout room activity 1	AG
5-10 mins	BREAK	
20 mins	Breakout room activity 2 -	AE and CB facilitators DOS and AG to join a group each
15 mins	Large group discussion from breakout room activity 2	AG
10 mins	Breakout room activity 3 – Wishlist/our perceived priorities (see list below – Anthony will introduce this)	2-3 facilitators
5-10 mins	Feedback/summary/next stages Close	AG

Breakout activity 1: General

- Is toolkit a relatable term – should it be website, learning resource?
- Is the toolkit well laid out or easy to use? If so suggestions for improvements
- Are the expert videos engaging and clear and what you want to know about?
- Are the lived experience videos engaging clear and what you want to know about?
- Are the FAQ's laid out well, easy to understand and relatable?

Breakout activity 2: Targeted on interactive features

What was your experiences with (see below), Did you use them?, Did you like them? Why didn't you use them/what would make you more likely to use them? Did you view the guide? Would you use it?





- Quiz ([the condition](#) and [treatments](#))
- [Personalised guide maker](#) (including whether we call it guide, workbook etc)
- [Exercise checker](#)
- [Exercise selector](#)

Breakout activity 3: Dreaming/ideal world/suggestions for improvements

The perceived list of priorities to get this live are the following (AG to present before the discussion):

- Add the local facilities to the 'where can I find local groups' – also ask for recommendations from participants
- Downloadable sheet about accessing funding
- Australian voice over on the introduction and tour video
- Add a voice over to the workalong video to coach through the exercises
- Get the personalized guide maker up and running with all the individualized guides
- Add references
- Cross check that all infographics and links are in the resources page

Appendix 7C – Screenshots of Qualtrics survey for expert opinion feedback

<div>LA TROBE UNIVERSITY</div> <div>Sport and Exercise Medicine Research Centre</div> <p>Expert opinion feedback.</p> <p>Many thanks for showing interest in our knee osteoarthritis self-management toolkit.</p> <p>This form is designed to provide you with access to our participant information sheet, plus to capture your consent and feedback.</p> <p>For further details about this project, please click on and read the below participant information sheet.</p> <p>Picf expert opinion 220321</p> <div>→</div>	<div>12:29</div> <div>LA TROBE UNIVERSITY</div> <div>Sport and Exercise Medicine Research Centre</div> <p>Expert opinion feedback.</p> <p>Many thanks for showing interest in our knee osteoarthritis self-management toolkit.</p> <p>This form is designed to provide you with access to our participant information sheet, plus to capture your consent and feedback.</p> <p>For further details about this project, please click on and read the below participant information sheet.</p>
<div>LA TROBE UNIVERSITY</div> <div>Sport and Exercise Medicine Research Centre</div> <p>Co-development of an online self-management toolkit for people with knee osteoarthritis</p> <p>Name:</p> <div></div> <p>I have been provided the opportunity to access and read the participant information sheet attached to this form.</p> <div><input type="radio"/> Yes</div> <div><input type="radio"/> No</div>	<div>12:29</div> <div>LA TROBE UNIVERSITY</div> <div>Sport and Exercise Medicine Research Centre</div> <p>Co-development of an online self-management toolkit for people with knee osteoarthritis</p> <p>Name:</p> <div></div> <p>I have been provided the opportunity to access and read the participant information sheet attached to this form.</p>

I agree to provide my feedback and acknowledge that de-identified quotes may be used in a future scientific publication.

☐ Yes
 ☐ No

Please provide the best email address that we can use to contact you should we need to clarify any of your comments.

→

☐ No

I agree to provide my feedback and acknowledge that de-identified quotes may be used in a future scientific publication.

☐ Yes
 ☐ No

Please provide the best email address that we can use to contact you should we need to

Please provide overall comments (positive or constructive criticism) about how **accurate** the information in this toolkit is for people with knee osteoarthritis

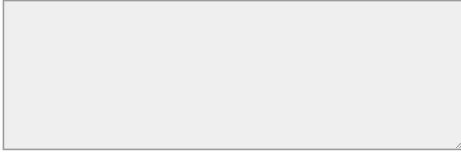
Please provide overall comments (positive or constructive criticism) about how **comprehensive** the information is in this toolkit for people with knee osteoarthritis. Please feel free to add in any suggestions for content that you feel should be included in our toolkit.

12:29

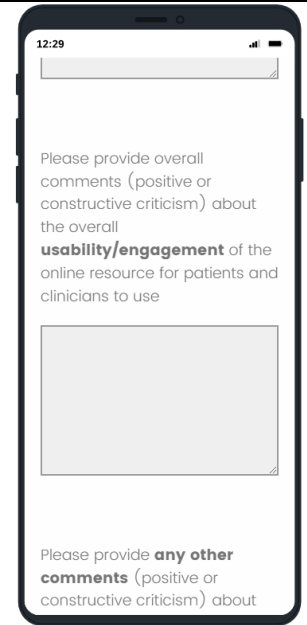
Please provide overall comments (positive or constructive criticism) about how **accurate** the information in this toolkit is for people with knee osteoarthritis

Please provide overall comments (positive or constructive criticism) about how **comprehensive** the information is in this toolkit for people with knee osteoarthritis. Please feel free to add in any suggestions for content that

Please provide overall comments (positive or constructive criticism) about the overall **usability/engagement** of the online resource for patients and clinicians to use



Please provide **any other comments** (positive or constructive criticism) about your experience interacting with the online self-management toolkit



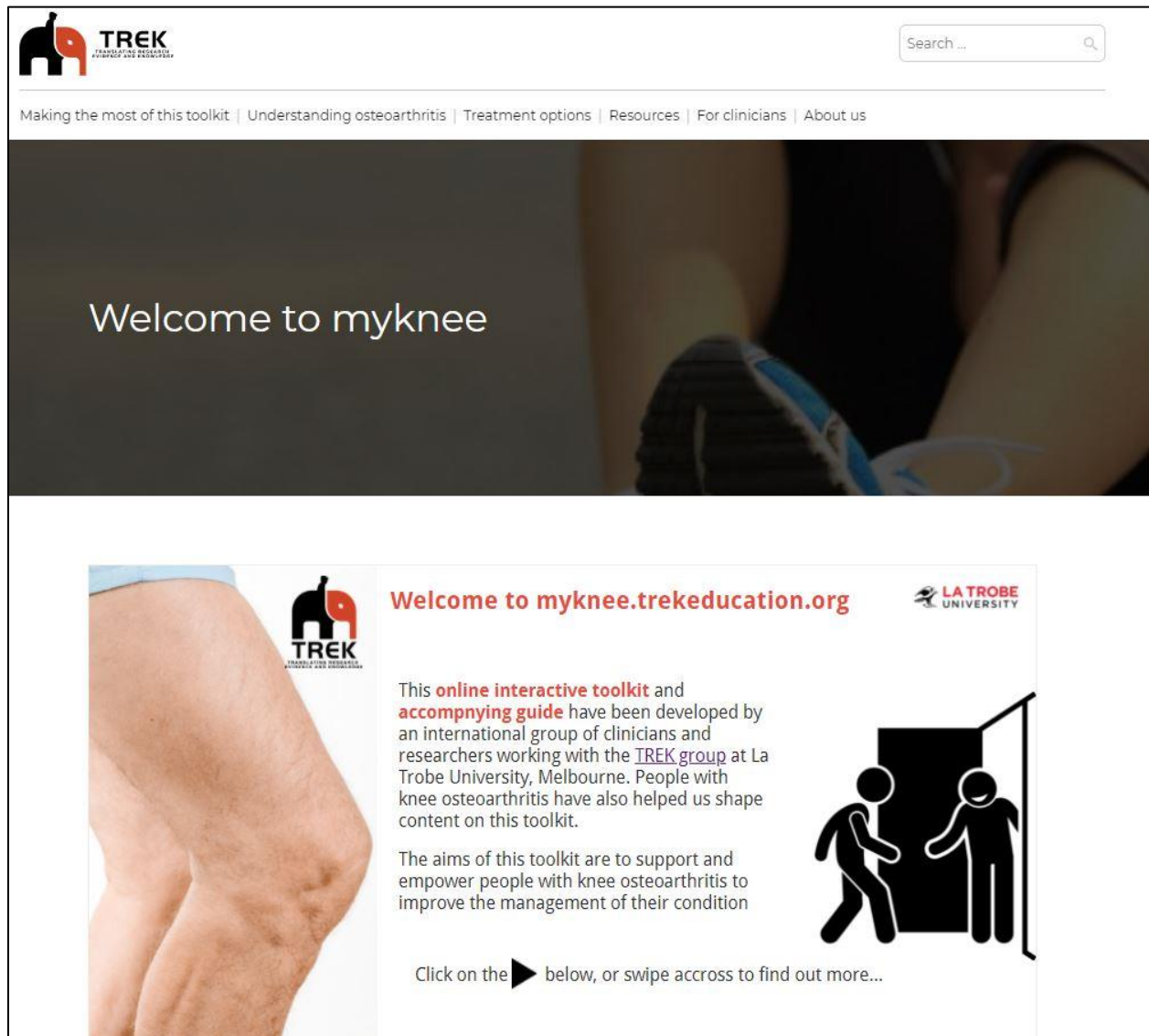
12:29

Please provide overall comments (positive or constructive criticism) about the overall **usability/engagement** of the online resource for patients and clinicians to use


Please provide **any other comments** (positive or constructive criticism) about

Appendix 7D – Screenshot examples of the prototype toolkit

7D.i Initial home page with main section headings and introduction slides



7D.ii Sample slideshow with infographic

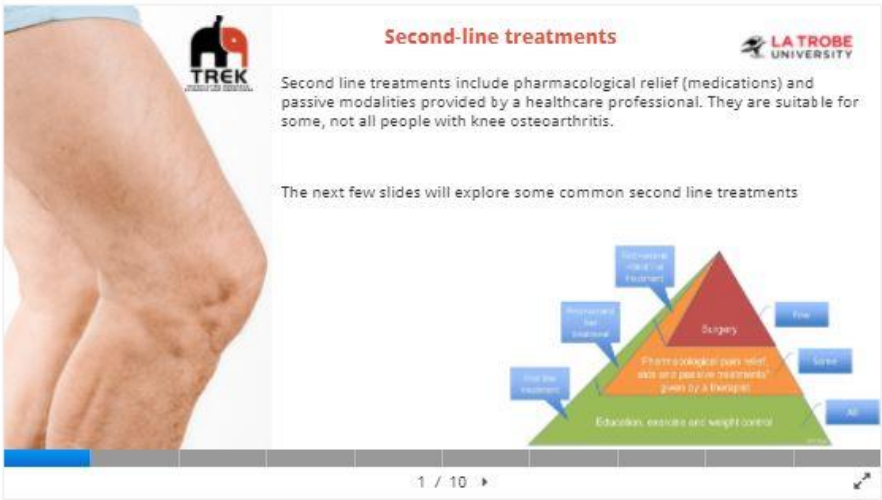
Search

Making the most of this toolkit | Understanding osteoarthritis | Treatment options | Resources | For clinicians | About us

Second line and complimentary treatments

Despite education, exercise and weight loss (if needed) being first line/core treatment options. Some patients may require a little extra assistance to control symptoms.

This section demonstrates and explains some examples of second line treatment choices:

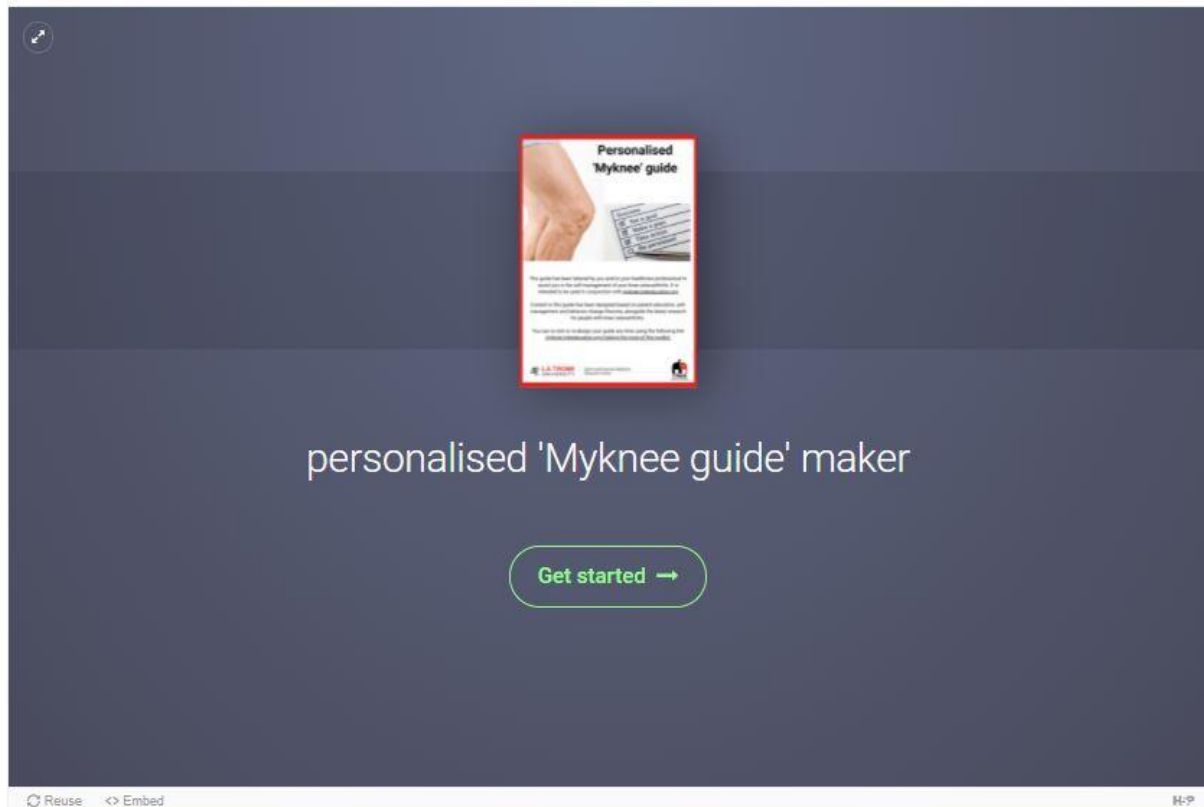


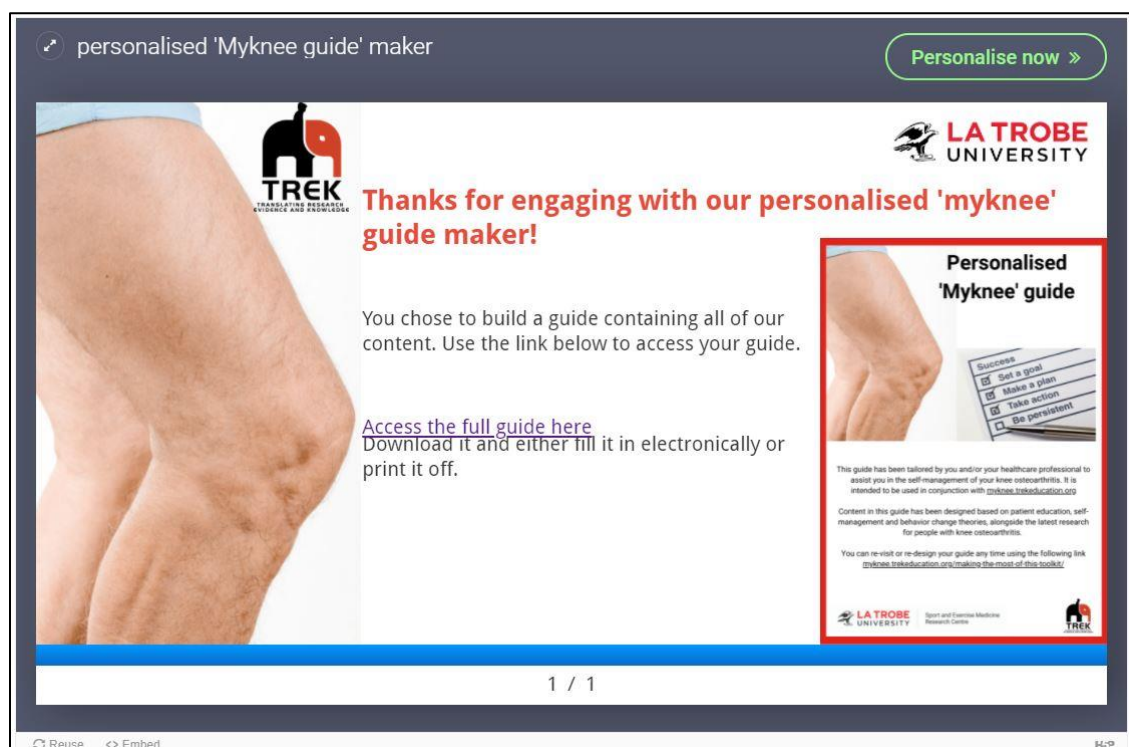
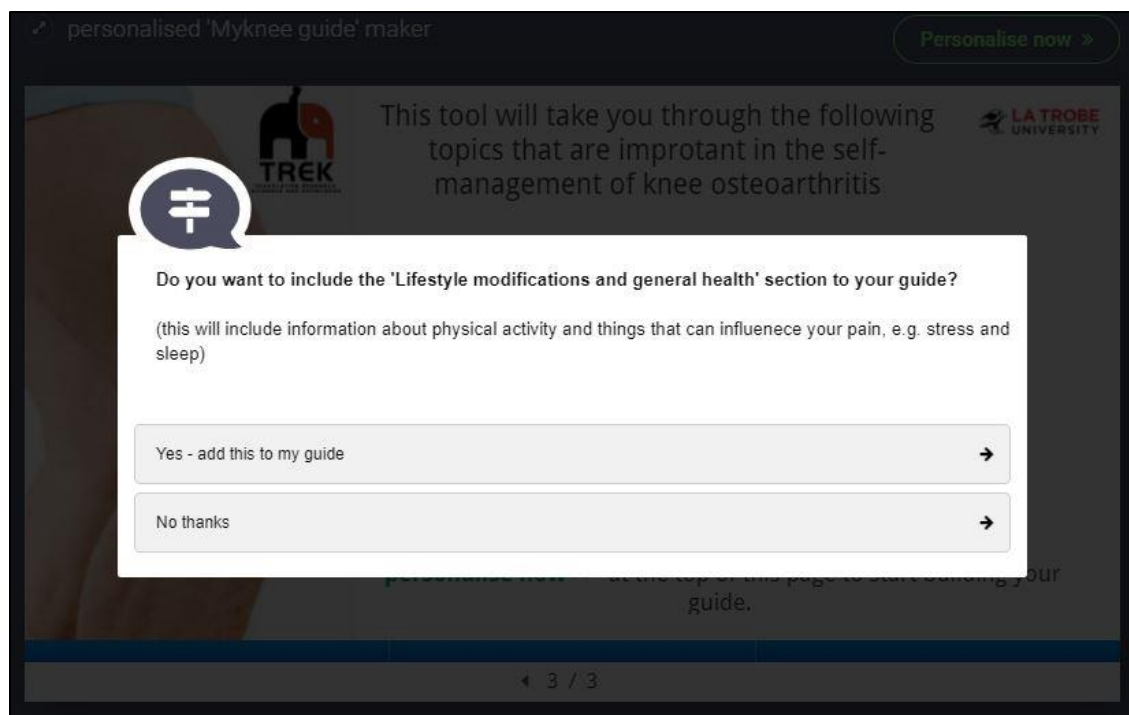
7D.iii Personalised guide maker tool

Use the below tool to start **creating your own personalised guide**.


The tool will take you through a series of steps and questions to help tailor content to the things you want to know about.

It's up to you how you want to use it. The guide has been designed to allow you to fill it in and save it electronically. You can also print it off and use it as a physical copy if you prefer





7D.iv Exercise therapy decision making tool




Search

Making the most of this toolkit | [Understanding osteoarthritis](#) | [Treatment options](#) | [Resources](#) | [For clinicians](#) | [About us](#)

Exercise behaviour and program checker

Use the below tool to find out whether there is anything you could be doing to help you and your exercise-therapy behaviour or programme





Exercise-therapy decision making

Get started →


[Home](#) [Embed](#)

Exercise-therapy decision making
Proceed »





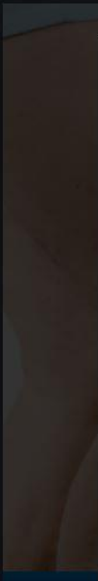
Weelcome to the section of our toolkit that helps you assess whether your're on the right track with your exercise-therapy programme, or if you may benefot from some of our resources in this toolkit.
Click '**proceed >>**' at the top, right hand side of this presentation to answer your first question




1 / 1

Reuse Embed


Exercise-therapy decision making
Proceed »





On a scale of 1-10 (10 being very improtant) - how improtant do you feel it is for you to engage in an exercise-therapy programme specifically targeted towards improving your function or condition?



1 - Not at all improtant	→
2	→
3	→
4	→
5 - somewhat improtant	→
6	→
7 - Quite important	→
8	→
9	→
10 - Very important	→




Reuse Embed

Exercise-therapy decision making

Proceed >



Wecome to the section of our toolkit that helps you assess whether your're on the right track with your exercise-therapy programme, or if you may benefot from some of our resources in this toolkit.



Actually - exercise-therapy is considered a key treatment for people with knee osteoarthritis, regardless of age, severity or other conditions they may have.

Want to find out more information about the benefits of exercise for knee osteoarthritis?


Yes - show me what resources can help me →

No thanks - not this time →

1 / 1

Reuse Embed H-P

7D.v Quiz tool







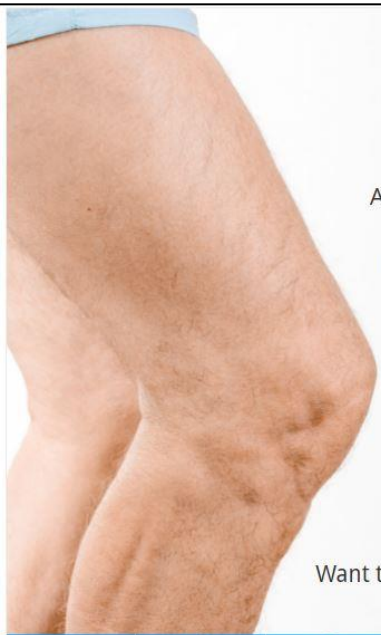
The next few slides are an opportunity for you to test your knowledge of some key points contained within the 'understanding osteoarthritis' section

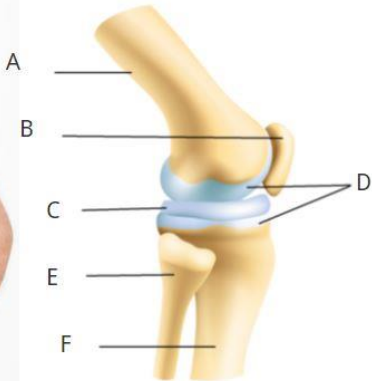
It may help you consolidate your knowledge, or identify gaps in your knowledge for future reading

1 / 10

Reuse <> Embed

H-P





Which structure does osteoarthritis affect the most?

- A - Femur
- B - Patella (knee cap)
- C - Meniscus
- ✓ D - Articular cartilage
- E - Fibula (bone)
- F - Tibia (shin bone)

Well done!

Want to recap your knowledge? click [here](#) (opens in a new window)

3 / 10

Reuse <> Embed


H-P


Appendix 7E – Screenshot examples of revisions to the toolkit following workshop 1

7E.i New home page with introductory video and lived experience video embedded



7E.ii Accordion function and re-arranging to FAQ style



Watch on  YouTube

Frequently Asked Questions (FAQs)

+ What is osteoarthritis?

+ How common is osteoarthritis?

+ How do I know if I have knee osteoarthritis?

+ Do I need a scan?

+ Why do I have knee osteoarthritis?

+ Can you show me the anatomy of the knee joint?

Resources and additional information

+ Recommended resources

+ Sources of information

Next – Understanding symptoms

7E.iii Example of a lived experience video embedded into page

First-line treatment: should be offered to anyone with osteoarthritis right away to help them self-manage their symptoms.

Second-line treatments: should be offered to those who have not improved with first line treatments. However first-line care should still be maintained

Third-line treatments: should only be offered when no other treatment has worked. However should also be provided alongside first-and second line care



For some motivation, below you will find a video full of tips from various people with knee osteoarthritis:



We asked people with knee osteoarthritis:


What advice would you give to others with knee osteoarthritis?

These are their responses

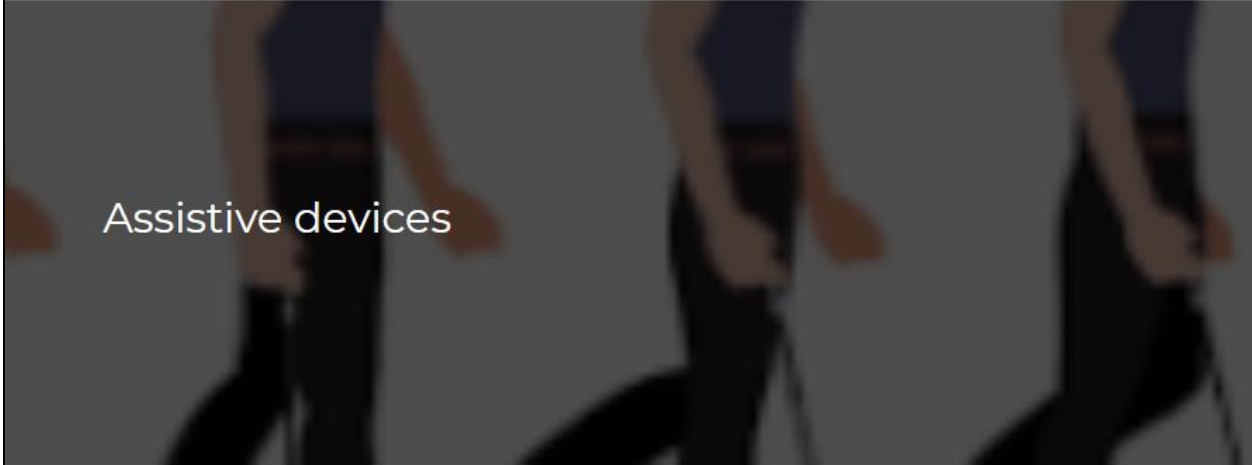


The rest of the 'understanding treatments' section provides you with more information about first, second and third-line care options. Use the menu at the top of this page to find the information you want. Also, see our list of FAQ's about treatments in general below.

7E.iv Example of an expert video embedded into page




[Home](#) | [Understanding osteoarthritis](#) | [Understanding treatments](#) | [Guide and resources](#) | [For clinicians](#) | [About us](#)




Assistive devices

Many people with knee osteoarthritis use assistive devices as part of their overall self-management. Some people will use devices all the time (e.g. using a walking stick regularly), and some people will only occasionally rely on devices (e.g. using Nordic walking poles for bush walking or using a knee brace during exercise).

Below is a video recorded with a specialist musculoskeletal physiotherapist taking you through some basic information about each:







Learning from experts

Assistive devices

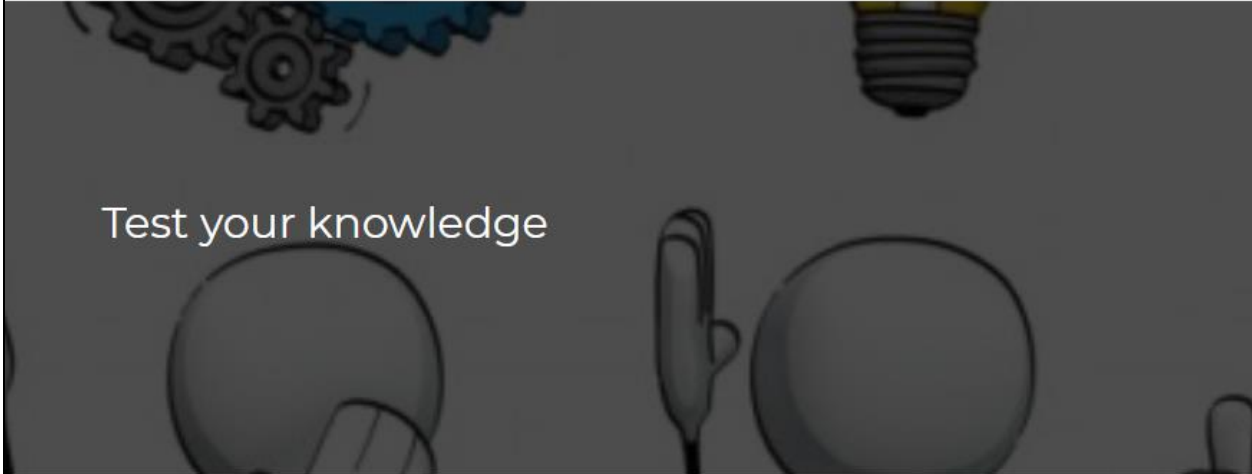
With Ali Gibbs
Physiotherapist and PhD candidate
La Trobe University

7E.v Homepage and sample question in the understanding osteoarthritis quiz




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TRANSLATING RESEARCH
STRATEGY AND COMPLEXITY

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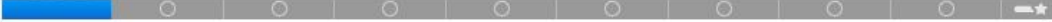



Test your knowledge





The next few slides are an opportunity for your to test your knowledge of some key points contained within the 'understanding osteoarthritis' section

It may help you consolodate your knowledge, or identify gaps in your knoweldge for future reading

1 / 10 ▶

Test your knowledge




True or False:

Only someone above 45 years of age can have osteoarthritis?

☐ True


☐ False

✓ Check



< 6 / 10 >

7E.vi Homepage and sample question for the treatments quiz





TREK


TRANSFORMING RESEARCH
KNOWLEDGE INTO PRACTICE

[Home](#) |
 [Understanding osteoarthritis](#) |
 [Understanding treatments](#) |
 [Guide and resources](#) |
 [For clinicians](#) |
 [About us](#)

Test your knowledge - Treatments







The next few slides are an opportunity for you to test your knowledge of some key points contained within the 'understanding treatments' section


It may help you consolidate your knowledge, or identify gaps in your knowledge for future reading

1 / 12 ▶
⌂ ⭐ ↗

Test your knowledge - Treatments

LA TROBE UNIVERSITY **TREK**

Drag the treatment options into a category then check your answers



First-line treatments

Surgery

Education

Exercise

Massage

Medications

Weight management

Injections


Second-line treatments

Third-line treatments

☒ Check

◀ 2 / 12 ▶

7E.vii Screenshot of the 'workalong' exercise video



Search ...

[Home](#) | [Understanding osteoarthritis](#) | [Understanding treatments](#) | [Guide and resources](#) | [For clinicians](#) | [About us](#)


Beginner's exercise program


The below video has been created to motivate and guide people with knee osteoarthritis to engage in exercise. This video is based upon the NEMEX program that has been extensively researched in people with knee osteoarthritis and is what is currently used in GLA:D Australia programs.

We encourage everyone to seek advice from a healthcare professional before engaging in these exercises for the first time. All the exercises can also be found in the '[personalised guide](#)' if you include the 'exercise' section.

If the video is too fast then pause it to go at your own pace.


Note that the video has no sound. Why not put on your favorite music whilst working out?







Sit-ups – Set 3

Repetition number: 5



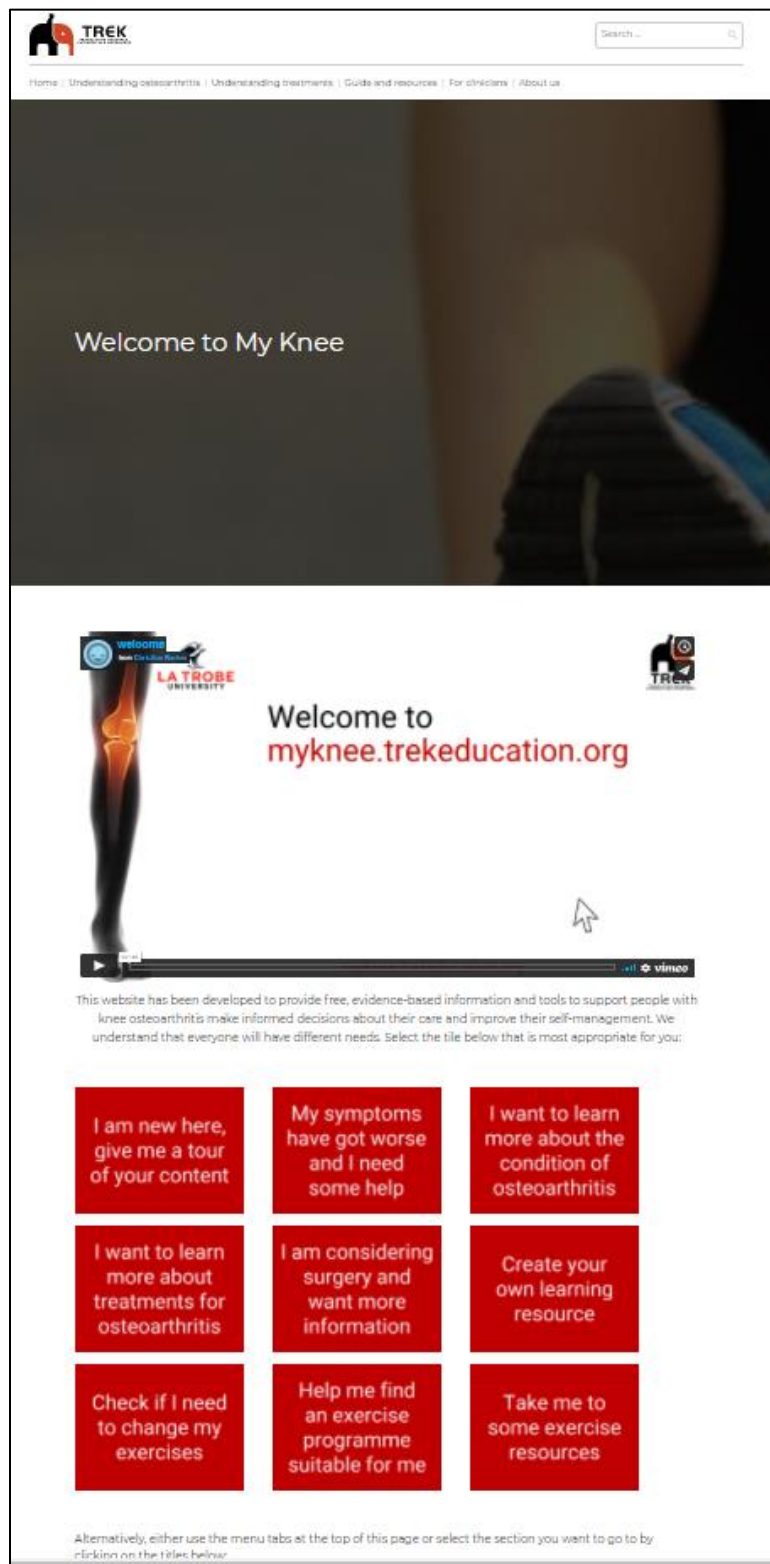
myknee.trekeducation.org





Appendix 7F – Screenshot examples of revisions to the toolkit following workshop 2

7F.i Revised homepage with updated intro video and quick access buttons



7F.ii Example of downloadable factsheet

Knee Osteoarthritis

FACT & FICTION

 <p>ACTIVITY RELATED KNEE PAIN</p> <p>Usually in people 45 years or older with either no morning stiffness or stiffness that lasts no longer than 30 minutes.</p>	<p>EVERYONE GETS WORSE</p> <p>It is not an inevitable part of ageing and not everyone gets worse. In fact many people can improve their pain and function</p> 
 <p>PAIN CAN CHANGE</p> <p>Across a day, one day to the next and week to week. This is normal and rarely a sign that anything serious has happened to your knee.</p>	<p>X-RAY'S TELL US LOTS</p> <p>Actually, medical imaging can't predict someone's pain or function and they are no longer needed to diagnose or manage knee osteoarthritis.</p> 
 <p>MANY FACTORS INFLUENCE SYMPTOMS</p> <p>Including: anxiety, stress, fatigue, quality of sleep, fears and past experiences.</p>	<p>"BONE ON BONE" OR "WEAR AND TEAR"</p> <p>Are common phrases that are incorrectly used to explain the condition and its symptoms. The condition is far more complex than we once thought</p> 
 <p>KNEES LIKE AND NEED MOVEMENT</p> <p>Regular exercise keeps your joint healthy and can decrease pain and stiffness. Plus exercise has a whole lot of other benefits to improve your overall physical and psychological health</p>	<p>AVOID EXERCISE</p> <p>Exercise is suitable for all people with knee osteoarthritis regardless of age, severity of condition or comorbidities</p> 
 <p>SELF-MANAGEMENT IS FIRST-LINE CARE</p> <p>Educating yourself about how to best self-manage the condition along with exercise and weight loss (if appropriate) is the best thing everyone can do to help their condition</p>	<p>SURGERY WILL FIX IT</p> <p>Surgery is not a magic cure. Keyhole surgery is no more effective than fake surgery and up to 1 in 5 people who have a knee replacement are unsatisfied with outcomes.</p> 

For more information about knee osteoarthritis and references to this factsheet visit www.myknee.trekeducation.org



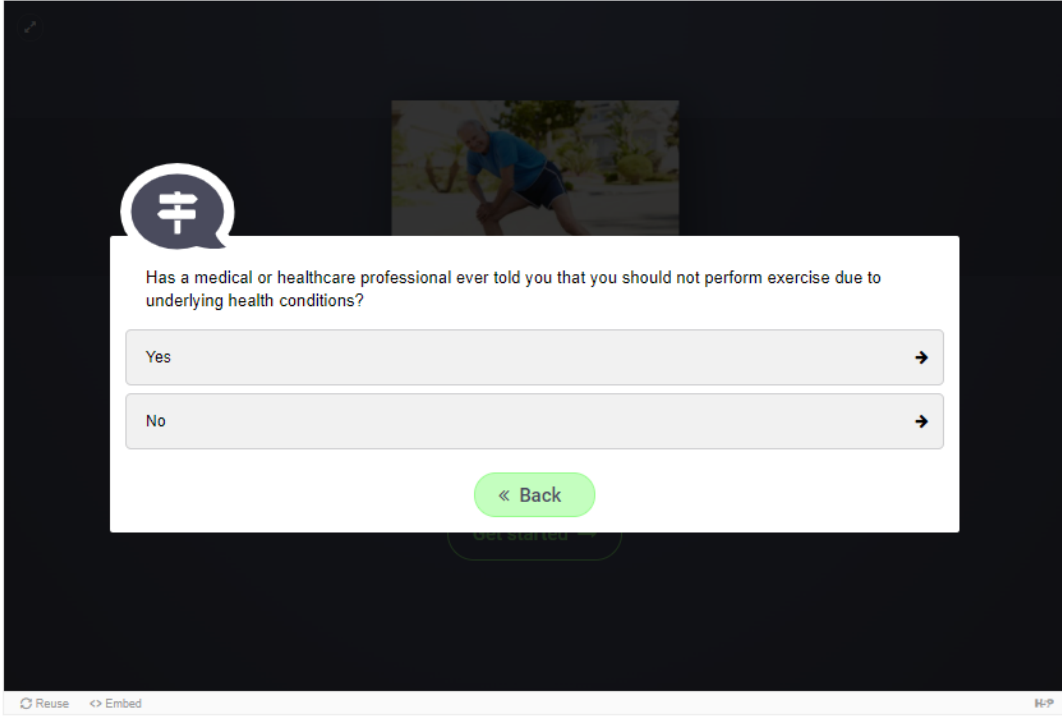
Sport and Exercise Medicine Research Centre



7F.iii Examples of additional questions and end points on exercise tool

Home | Understanding osteoarthritis | Understanding treatments | Guide and resources | For clinicians | About us

Use the below tool to find out what exercises may be suitable for you



The screenshot shows a dark-themed interface for an exercise selector. A white question box is centered, featuring a speech bubble icon with a red cross. The question is: "Has a medical or healthcare professional ever told you that you should not perform exercise due to underlying health conditions?". Below the question are two buttons: "Yes" and "No", each with a right-pointing arrow. A green "« Back" button is positioned below the "No" button. In the background, a person is shown performing a physical activity. At the bottom of the interface, there are links for "Reuse" and "Embed", and a small "H-P" logo.

Has a medical or healthcare professional ever told you that you should not perform exercise due to underlying health conditions?

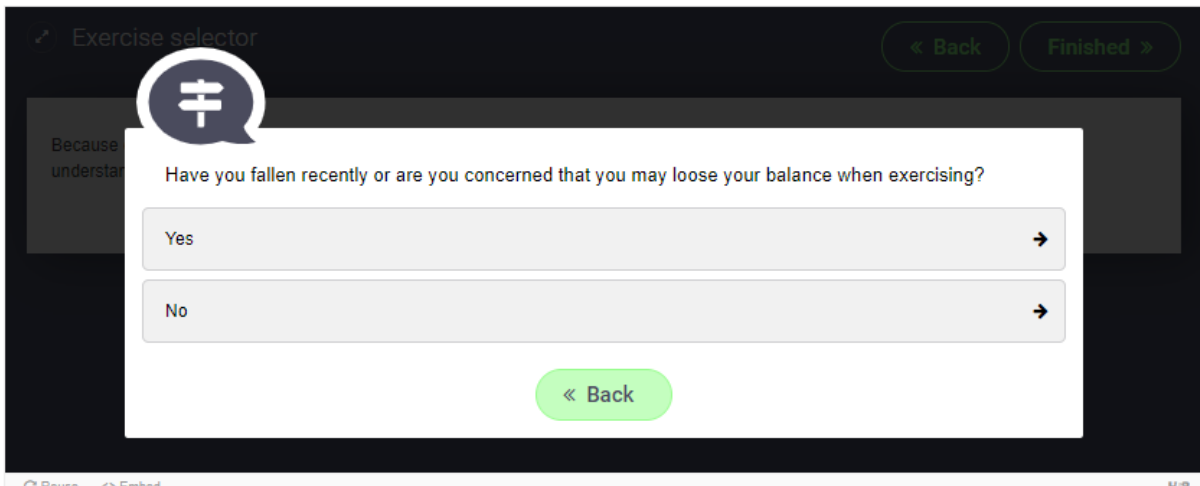
Yes →

No →

« Back

Reuse Embed H-P

Use the below tool to find out what exercises may be suitable for you



This screenshot shows the same exercise selector interface as the first one, but with a different question. The question is: "Have you fallen recently or are you concerned that you may lose your balance when exercising?". The "Yes" and "No" buttons are present with right-pointing arrows. A green "« Back" button is located below the "No" button. The background image shows a person performing a physical activity. The top of the interface includes the title "Exercise selector" and two buttons: "« Back" and "Finished >". At the bottom, there are links for "Reuse" and "Embed", and a small "H-P" logo.

Exercise selector « Back Finished >

Have you fallen recently or are you concerned that you may lose your balance when exercising?

Yes →


No →

« Back

Reuse Embed H-P

Exercise selector

Use the below tool to find out what exercises may be suitable for you


 Exercise selector

[<< Back](#) [Finished >>](#)

We recommend that you seek professional advice from your medical or healthcare practitioner.

In the meantime, the following gentle exercises may be suitable for you to improve your balance or strength in a controlled manner. Right click and open each link in a new page or tab.

- [1. Balance exercises](#)
2. Seated exercises

[Reuse](#) [Embed](#) 

7F.iv Additional balance question within the personalized guide maker with sample screenshot of guide


[Home](#) | [Understanding osteoarthritis](#) | [Understanding treatments](#) | [Guide and resources](#) | [For clinicians](#) | [About us](#)

Personalised guide maker

Use the below tool to start **creating your own personalised guide**.

The tool will take you through a series of steps and questions to help tailor content to the things you want to know about.

It's up to you how you want to use it. The guide has been designed to allow you to fill it in and save it electronically. You can also print it off and use it as a physical copy if you prefer.




You are going to be asked a series of questions about what you want to include in your guide.

The options will be the following:

1. Lifestyle and general health
2. Exercise
3. Weight management
4. Medical management
5. Surgical management
6. Balance and falls

We will give you a little more information about the contents of each section when you decide whether to include it in your guide or not.

Got it 

Balance and falls

Being a little unsteady on your feet is relatively common for people with knee osteoarthritis. Use the below to see if you need to seek further help.

Do you want to stay active and strong?



- Slips, trips and falls can happen to anyone
- It is more common if you have osteoarthritis
- It is **NOT** because you are 'old and frail'



Try this simple checklist to see if you are at risk ...

Yes? ☒

Have you slipped, tripped, stumbled or fallen in the last year? ☐

Having a fall in the past increases your risk of falling again

Have you felt your knee 'giving way'? ☐

Do you feel that you sometimes 'lose your balance'? ☐

Many falls are related to a lack of muscle strength and/or balance

Are you taking four or more medications? ☐

Some tablets or combinations of tablets can increase your risk of falling

Do you have any other health conditions e.g. Parkinson's disease, stroke or diabetes? ☐

Many health conditions can put you at greater risk of slipping, tripping, stumbling or falling

If you answered 'Yes' to one or more of these questions – you can reduce your risk of slips, trips and falls. Speak to your GP, physiotherapist and pharmacist about how to reduce your risk.



MONASH
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Australia Project Grant

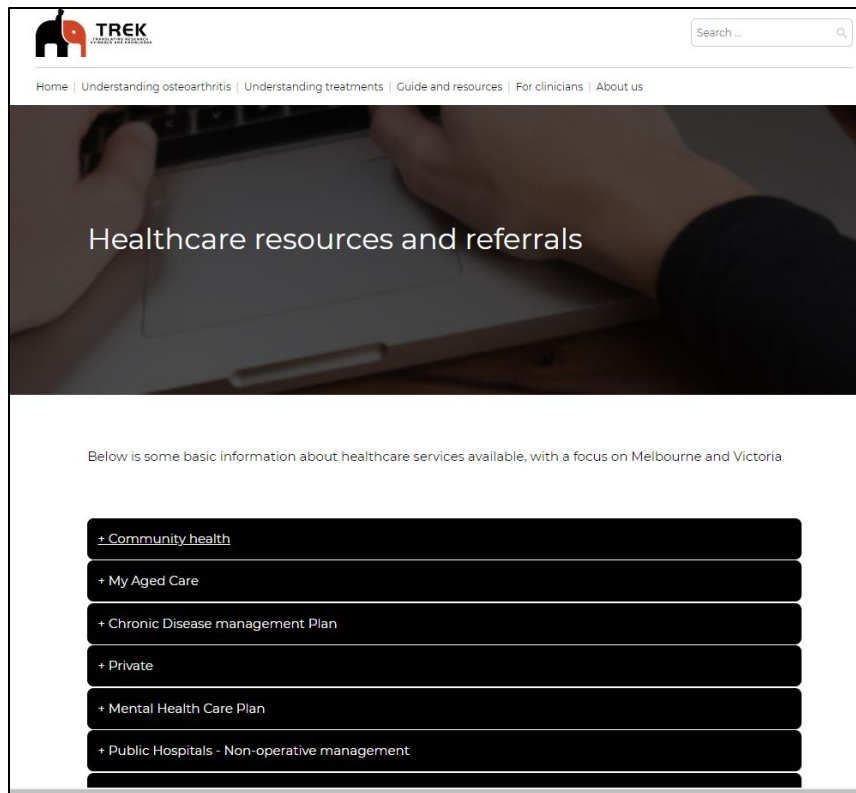


LA TROBE
UNIVERSITY

Sport and Exercise Medicine
Research Centre



7F.v Healthcare resources information section home page plus example



- My Aged Care

Anyone referred to community health aged 65 or over needs to be referred via the Commonwealth government agency My Aged Care (<https://www.myagedcare.gov.au/>) unable to refer directly to community health centre.

Patient will be contacted by My Aged Care, and have an assessment from a RAS (*Rapid Assessment Service*); referral then forwarded to community health service.

If patient has more complex needs, an ACAS (Aged Care Assessment Service) will be done however these may have longer waiting times.

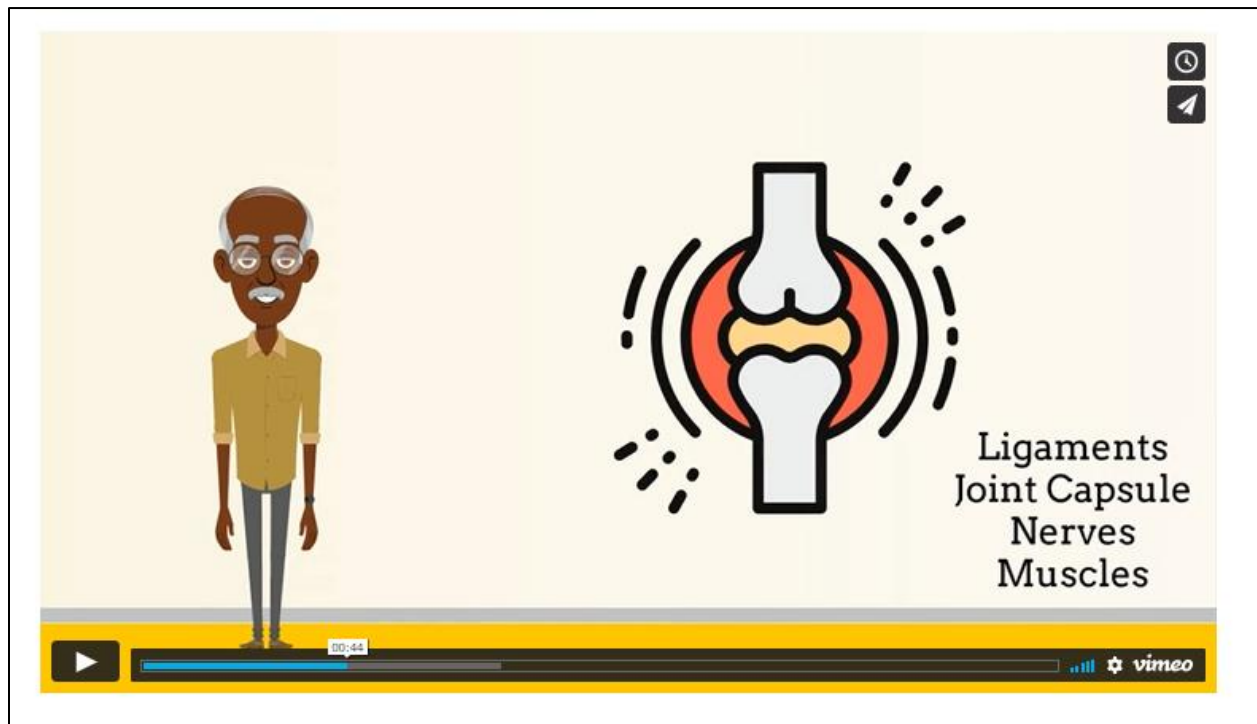
- Chronic Disease management Plan

Provides a medicare rebate for up to 5 sessions of allied health per calendar year. Depending on the practitioner, this may fully cover the cost of the appointment, or the patient may have to pay a 'gap' fee.

This is 5 in total, not 5 per discipline (e.g. 3 physiotherapy sessions and 2 dietetics sessions).

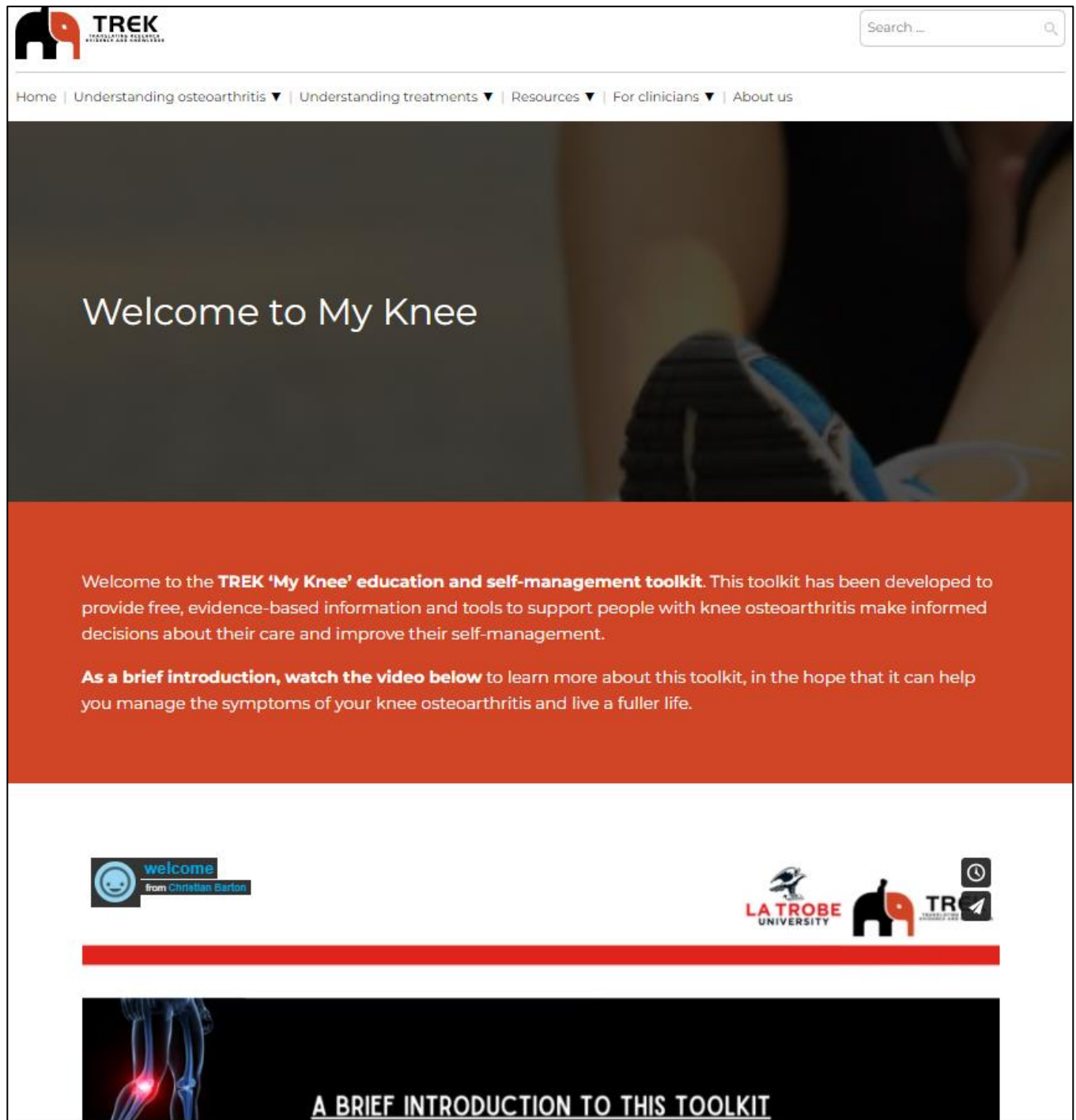
If not referred through the end of the process, please refer the following web page: [https://www.medicare.gov.au/medicare/health-care/medicare-rebate/medicare-rebate-for-allied-health-services](#)

7F.vi Screenshot of new animated video about ‘understanding osteoarthritis’

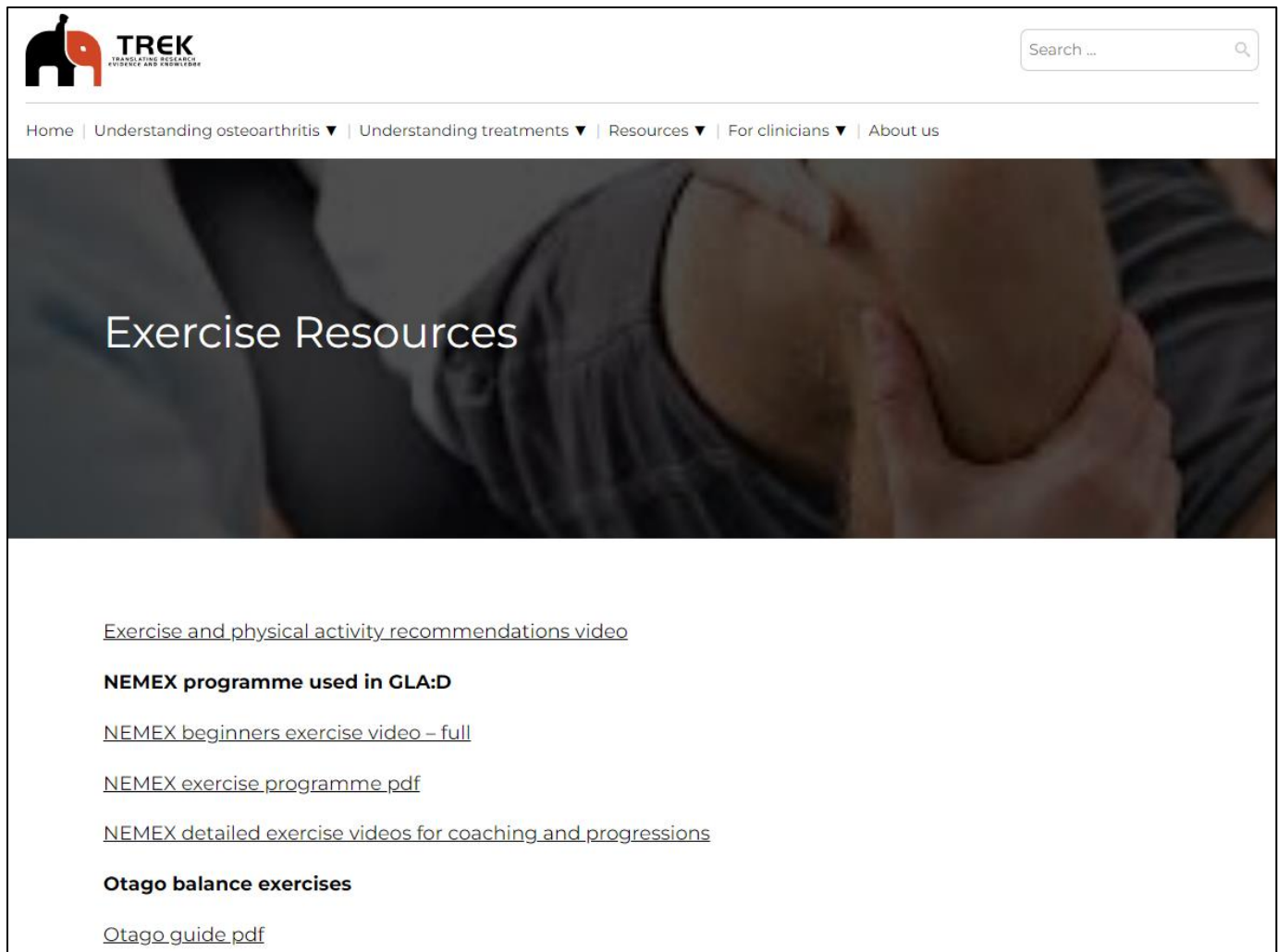


Appendix 7G – Screenshot examples of revisions to the toolkit following workshop 3

7G.i Revised home page demonstrating (i) the agreed name of the TREK '[My Knee](#)' education and self-management toolkit, (ii) drop down icons on the menu, and (iii) demonstrating a new thumbnail to the welcome video that differs from other videos



7G.2 Screenshot of the exercise resource page – found in the resources tab



TREK
TRANSLATING RESEARCH
EVIDENCE AND KNOWLEDGE

Search ...

Home | Understanding osteoarthritis ▼ | Understanding treatments ▼ | Resources ▼ | For clinicians ▼ | About us

Exercise Resources

[Exercise and physical activity recommendations video](#)

NEMEX programme used in GLA:D

[NEMEX beginners exercise video – full](#)

[NEMEX exercise programme pdf](#)

[NEMEX detailed exercise videos for coaching and progressions](#)

Otago balance exercises

[Otago guide pdf](#)

7G.iii Revised home page icons to improve site navigation

We understand that different people will have different needs. So to start your journey to better living with knee osteoarthritis, select the tile below that is most appropriate for you.

 I am new here, give me a tour of your content	 My symptoms have gotten worse and I need some help
 I want to learn more about osteoarthritis	 I want to learn more about treatments for osteoarthritis
 I am considering surgery and want more information	 I want to create my own learning resource
 I want to check if I need to change my exercises	 I need help finding an exercise program that is suitable for me
 Take me to some exercise resources	 I want to know what services are available for my knee osteoarthritis

Alternatively, either use the menu tabs at the top of this page or select the section you want to go to by clicking on the titles below:

 UNDERSTANDING OSTEOARTHRITIS	 UNDERSTANDING TREATMENTS	 MAKING THE MOST OUT OF THIS TOOLKIT	 FOR CLINICIANS
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Appendix 7H – Screenshot examples of revisions to the toolkit following expert opinion review

7H.i Revised wording about NICE criteria

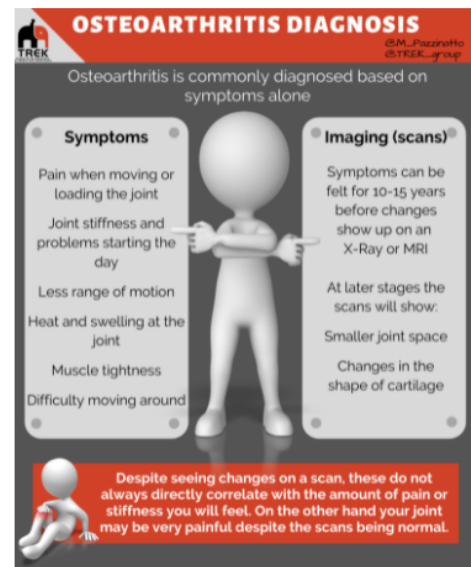
- How do I know if I have knee osteoarthritis?

Knee osteoarthritis can be diagnosed by your Doctor or another health professionals (i.e. a physiotherapists) clinically without the need for further scans (e.g. x-Ray).

x-Ray's used to be a common way to diagnose osteoarthritis, but now that we understand more about the condition, we realise that they are not needed (and can sometimes even be misleading!).

A clinical diagnosis is now what is recommended in all guidelines for Doctors and health professionals.

This means that a Doctor or other health professional can diagnose your knee osteoarthritis just by you reporting what symptoms you are experiencing.



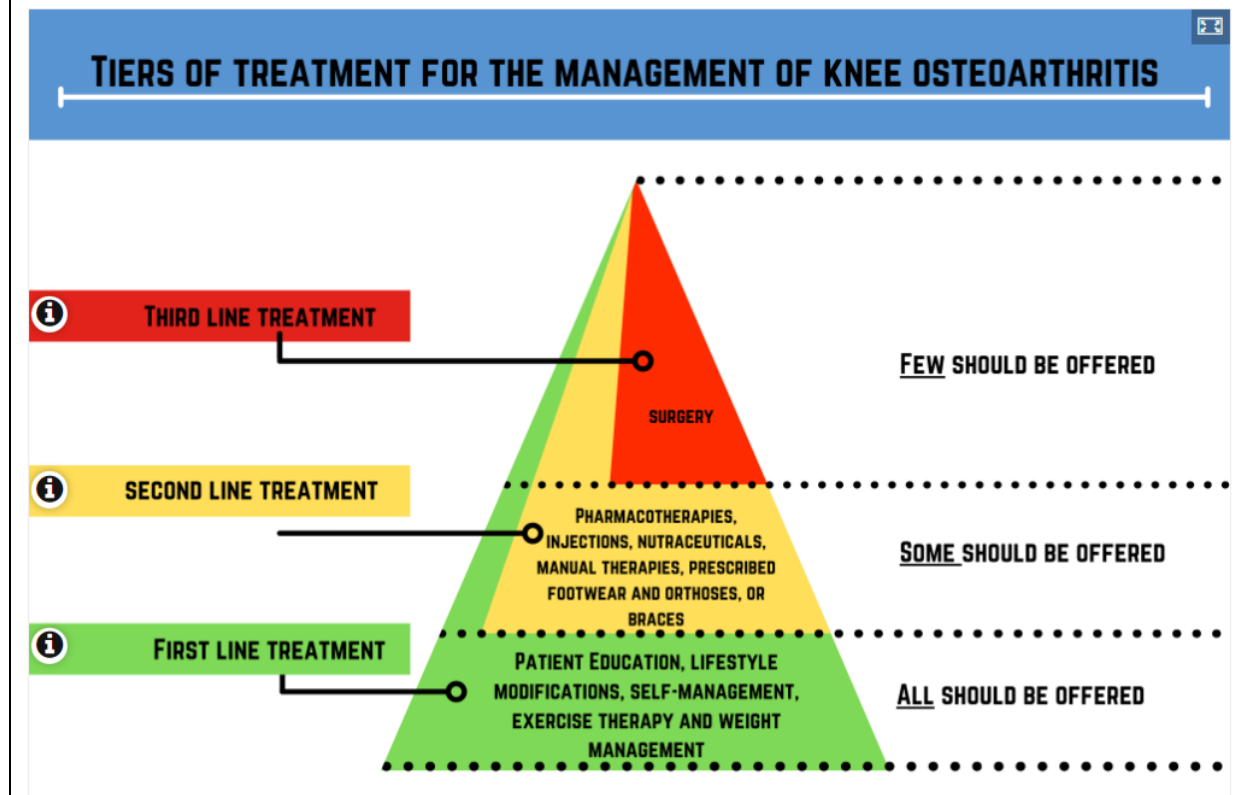
The criteria that was developed by the [National Institute for Health and Care Excellence \(NICE\)](#) in the U.K. is most commonly used. It states that someone has knee osteoarthritis if they:

- Are aged 45 years or older
- Have activity related joint pain
- Have either no morning stiffness or stiffness that lasts no longer than 30 minutes

There are other criteria available. For example, there are specific criteria for people with 'early-onset osteoarthritis'. Speak with your doctor or health professional to find out more.

7H.ii Injections shown as second-line treatment

Treatment for knee osteoarthritis is broken down into 3 tiers; simply, **first**, **second** and **third** line treatment. The below image summarises what each tier involves. Click on the 'i' in the image below or use the menu bar at the top of the page to learn more about each tier of care.



7H.iii Greater clarity about the use of paracetamol provided

- What are the medication options for knee osteoarthritis?

There are a few medications that can help with your knee osteoarthritis. But its important to note that **no medications fix or cure your osteoarthritis**. Instead they can help to **improve symptoms such as pain**. Below is some basic information about medication options.

Anti-inflammatories (for example ibuprofen, aspirin and naproxen)

- Probably show the most promise at controlling symptoms for people with knee osteoarthritis.
- There are two types – oral (medications you swallow) or topical (for example creams).
- Topical anti-inflammatories are generally advised before oral anti-inflammatories as they are generally safer.
- **HOWEVER** it is important to note that anti-inflammatories are not suitable everyone. For example, some people who also have other medical conditions like gastrointestinal or heart conditions are not recommended to use these medications.
- There are also many side effects associated with these medications (for example gastro-intestinal issues)

Paracetamol

- Used to be a common medication provided to people with knee osteoarthritis to help control symptoms.
- **HOWEVER** improvements in pain are very small and have not been found to be clinically effective in scientific trials. For example, they often do not work better than a placebo.
- There is also emerging evidence to suggest that paracetamol is also linked to a number of side effects (for example gastro-intestinal issues)

Opioids (for example tramadol)

- These are strong prescribed pain relievers.
- They are generally not recommended for people with knee osteoarthritis as the harms outweighs any benefit. For example, harms include increased frequency of dizziness, risks of falls and fractures compared to anti-inflammatories, plus can lead to addiction, overdose and dependency issues

- Are medications effective for the treatment of knee osteoarthritis?

Remember – medications **shouldn't be used as a standalone** treatment but instead should be used in conjunction with first-line treatments. They should also **not be considered a long-term solution**.

Of all available medications, anti-inflammatories show the most promise, however many people are not able to use them due to their side-effects.

Paracetamol is recommended in some guidelines but they may not be effective at reducing pain.

7H.iv Changes to weight management FAQs: (i) removed body mass index, (ii) encouraged to seek advice from a dietician, and (iii) additional information about processed foods added

- How do I know if I need to lose weight?

The most accurate way to determine if you are overweight is using some simple measurements at your hips and waist. These are generally encouraged over other measures like the Body Mass Index (BMI).

First, see the below information about a **waist circumference** measurement.

For men:

- Below 94cm is considered a healthy waist circumference.
- Between 94-102cm you are at increased risk of developing a chronic condition.
- Greater than 102cm you are at a greatly increased risk of developing a chronic condition



For women:

- Below 80cm is considered a healthy waist circumference.
- Between 80-88cm you are at increased risk of developing a chronic condition.
- Greater than 88cm you are at a greatly increased risk of developing a chronic condition

Another measurement is the **waist-to-hip** ratio (i.e. comparing the circumference around your waist hips to the circumference of your hips). Use this tool [here](#) to help you determine your measurements

If you fall into a higher risk category then be sure to add the 'lifestyle and general health', 'exercise' and 'weight management' sections to your [guide](#). This may help you lose weight over time.

If you need more specialist advice then please speak to your general practitioner to refer you to a dietician.

Alternatively click [here](#) to access the Dieticians Australia accredited list of Dieticians.

- Are there any food or drinks that I should be avoiding?

No

There are no specific food or drinks that you should be absolutely avoiding to help manage your osteoarthritis. The key is to have a balanced, healthy diet.

Within a balanced, healthy diet it is recommended that you control your intake of fatty or processed foods and alcohol. To find out more about what is recommended for a healthy diet, [click here](#).

7H.v Inclusion of a tibial osteotomy into surgical options

- What are the surgical options available?

There are a few surgical options to consider for someone with knee osteoarthritis:

1. A **total joint replacement** (also known as arthroplasty) is the most common surgery for people with knee osteoarthritis. In this surgery they replace the surfaces of the thigh bone (femur) and the shin bone (tibia).
2. A **partial knee replacements** is where just half of the knee joint is replaced.
3. A **tibial osteotomy** is a procedure to straighten a deformity of the knee. Usually this involves removing part of the shin bone (tibia), just underneath the joint surface

DID YOU KNOW?

Key hole surgery (arthroscopy) is not an effective treatment option for people with knee osteoarthritis. It is now only recommended if people have a mechanical blocking of the knee.

7H.vi Example of improved clarity of healthcare resources and referrals section






Chronic disease management plan

Chronic disease management plan (previously known as Enhanced Primary Care) is a service on the Medicare Benefits Scheme. It is one way that you can receive subsidised care that you may need for you knee osteoarthritis. This page was designed to inform you more about this option so that you may consider it if it is appropriate for you.

As described above, the Chronic Disease Management Plan (CDMP) is a government service provided under the Medicare Benefits Scheme. It allows individuals with a chronic health condition to receive up to 5 fully covered, or subsidized allied health service each calendar year (1st of January to the 31st of December) to treat that chronic health condition.

The service is co-ordinated by the individual's GP – who will determine the combination and number of services that is necessary, in conjunction with the individual's goals and wishes.

The list below are the allied health providers that are eligible to provide care under the CDMP.

ELIGIBLE ALLIED HEALTH PROVIDERS		
 ABORIGINAL AND TORRES STRAIT ISLANDER HEALTH WORKERS AND PRACTITIONERS	 DIETITIANS  EXERCISE PHYSIOLOGISTS	 PHYSIOTHERAPISTS  PODIATRISTS

- How does CDMP relate to my knee osteoarthritis?

Through CDMP, your GP may identify that you need the assistance of an allied health practitioner to help you manage your symptoms. These allied health practitioners may include:

- **Physiotherapists** who may be able to help and guide you in how to start increasing your physical activity. They can also help you find suitable exercises that fits into your life with the goal of reducing your arthritis symptoms and increasing your functional capacity. They can also help you learn more about knee osteoarthritis and provide advice when symptoms flare-up. To learn more about what exercise can do for your arthritic knee [click here](#).
- **Dietitians** who may be able to educate and assist you in weight loss and/or weight management. Just a 5% reduction in body weight can significantly improve your arthritis symptoms and general health. To learn more about what weight management can do for your knee [click here](#).
- **Podiatrists** who may be able to guide you to find the right orthoses or footwear that can help manage your knee osteoarthritis. For more information about shoes, footwear and knee osteoarthritis [click here](#).
- **Psychologists and mental health workers** who may be able to help you in navigating through some beliefs you may have about knee osteoarthritis. Unfortunately, psychological and lifestyle factors such as having high stress level, having anxiety or depression influence the level of pain an individual with knee osteoarthritis might experience. Psychologists and counsellors will be able to help you navigate through these factors.

+ What are the fees involved with the CDMP?

+ Am I eligible to start a CDMP?

+ How can I get started on CDMP, and what does the whole process look like?

Appendix 8

[Appendix 8A](#) – Dissemination and continual improvement plan for the ‘My Knee’ toolkit

Appendix 8A – Dissemination and continual improvement plan for the ‘[My Knee](#)’ toolkit

Dissemination will involve promotion via:

- Social media campaign to promote the toolkit⁴⁸⁴.
- Email to all stakeholders involved in the creation of toolkit contents (patients, health professionals, experts).
- Email to the research teams professional networks, including certified GLA:D[®] clinicians in Australia and internationally to educate them about the toolkit and encourage its use.
- Conference submission and presentation (e.g. OARSI, Canadian Arthritis Research Conference).
- Free webinar with the creators to demonstrate the toolkit.

Continual improvement involves:

- Review of the toolkit and resources by the research team every 12-months, which will facilitate the creation of a workflow for the following 12 months for improvements in accuracy, clarity, and/or usability.
- Ensure regular monitoring of the TREK email for feedback, which will be addressed through toolkit edits or additions where necessary
- Apply for funding and plan for mixed-methods research to test the feasibility and effectiveness of the toolkit, and complete further co-design workshops with different potential users (e.g. general practitioners or CALD communities), to inform future iterations

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