NICE National Institute for Health and Care Excellence

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HealthTech Programme

Medical Technologies Advisory Committee (MTAC)

HTE10057 Digital technologies for managing mild to moderate hip or knee osteoarthritis – 1st meeting

Thursday 18 September 2025

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Link to SCM and Expert register for topic:	specialist-committee-members.pdf

The following documents are made available to the Committee:

1. Cover sheet [noACIC]

2. Final Scope [noACIC]

3. Assessment Report Overview (ARO) [noACIC] - dated September 2025

4. Patient group, professional group and NHS organisation submissions:
   - 4a. Arthritis Action [no ACIC]
   - 4b. Versus Arthritis [no ACIC]
   - 4c. Musculoskeletal Association of Chartered Physiotherapists (MACP) [no ACIC]

5. Updated External assessment report (EAR) dated 19/08/2025 – prepared by Kleijnen Systematic Reviews Ltd (KSR). Note, this report is an updated version to the one issued to stakeholders on 20/06/2025. The updates are listed on page 3 of the report [noACIC]

6. Collated stakeholder comments on the External Assessment Report (EAR) and draft External Assessment Group (EAG) responses [noACIC]

7. Evidence Generation Feasibility Report June 2025 [noACIC]

NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE

HealthTech Programme

GID-HTE10057 Digital technologies for managing mild to moderate hip or knee osteoarthritis: early value assessment

Final scope

March 2025

1 Introduction

The topic has been identified by NICE for early value assessment (EVA). The objective of EVA is to identify promising technologies in health and social care where there is greatest need and where the evidence base is still emerging. It will provide an early indication to the system that they could be used while evidence is generated. The process will enable the technologies to be recommended for use only if further data is collected before NICE does a final evaluation.

2 Technologies

This section describes the properties of digital technologies for managing mild to moderate hip or knee osteoarthritis based on information provided to NICE by companies and experts, and information available in the public domain. NICE has not carried out an independent evaluation of these descriptions.

2.1 Purpose of the technology

In the UK, an estimated 10 million people have osteoarthritis, with more people anticipated to be living with undiagnosed osteoarthritis. The most commonly affected joints are knees and hips, with over 5 million people affected by knee osteoarthritis and over 3 million people by hip osteoarthritis. Self-management is encouraged for people with mild to moderate hip or knee osteoarthritis to give them the knowledge, skills and confidence to better understand and manage their condition. Self-management typically includes components for therapeutic exercise, education and coping strategies. Evidence-based face-to-face group self-management programmes, such as ESCAPE-pain (Enabling Self-management and Coping with Arthritic Pain through Exercise), have been found to reduce pain and improve physical function, wellbeing and quality of life.

The NHS Long Term Plan highlights that treatment capacity in the NHS has not grown fast enough to keep up with clinical need. This reduced ability to meet demand has resulted in longer waiting times for people with musculoskeletal (MSK) conditions. NHS England's framework to reduce community musculoskeletal waits states that actions for primary care services include making best use of patient resources and non-medicalised interventions to improve supported self-management. Actions for community MSK services to keep waiting times down suggests making best use of digital resources to support the management of long-term MSK conditions, where appropriate. A Getting It Right First Time (GIRFT) community MSK workstream has also been funded to enable integrated care systems to commission the delivery of high quality MSK services in the community, with a key aim to integrate digital health therapeutics.

Digital technologies for managing mild to moderate hip or knee osteoarthritis can be used to help people manage their condition remotely in the community, at a time that is convenient to their lifestyle. They can be accessed online or via a mobile app through a smart phone or tablet. They provide access to specialist information and advice related to managing osteoarthritis, as well as exercise programmes through videos or group sessions. Technologies have varying levels of support from healthcare professionals that can be contacted through online messenger, chat functions or video calls. They should also have ongoing risk monitoring to make sure users are signposted to the appropriate support in response to their progress when using the technologies.

These technologies can offer an alternative option to in-person appointments or can be used to in addition to a reduced number of in-person appointments. Using these technologies could reduce the number of GP or first contact practitioner (FCP) visits, as well as the need for onward referral to MSK providers. But, some people may need support in accessing and using digital technologies and some people may prefer not to use digital technologies.

2.2 Description of the technologies

This EVA focuses on digital technologies designed to help people with mild to moderate hip or knee osteoarthritis self-manage their condition. A broad range of digital technologies can be used to provide this treatment. The digital technologies included in the scope vary in terms of their mode of delivery (computer, app), intended populations, the frequency and level of support by healthcare professionals and the additional features offered by the technology (for example, the level of monitoring and feedback to users and healthcare providers). Digital self-management technologies should be

codesigned with people with lived experience of the condition and should be adaptable to the varying local requirements of primary and community care services across the NHS.

For this EVA, NICE will consider digital technologies that:

- are intended for use by people aged 16 and over to manage mild to moderate hip or knee osteoarthritis
- are designed to give people the knowledge, skills and confidence to manage their condition and should include the following components:
  - information, education and advice on managing hip or knee osteoarthritis (including weight-management when appropriate)
  - a personalised therapeutic exercise programme for hip or knee osteoarthritis
  - signposting to appropriate support services, including contacting healthcare professionals when appropriate
- have a CE or UKCA mark where required. Products may also be considered if they are actively working towards required CE or UKCA mark
- are available for use in the NHS.

NICE will not consider digital technologies, or components of technologies, for diagnosing or triaging people with suspected osteoarthritis or other MSK conditions.

In total, 11 digital technologies for managing mild to moderate hip or knee osteoarthritis are included in the scope.

ESCAPE-pain (Orthopaedic Research UK)

ESCAPE-pain is a digital self-management programme that includes exercise plans, educational modules and progress tracking. The technology has exercise videos that show how to safely perform exercises and educational videos that provide information about the condition and techniques to help manage pain. It also includes a progress chart to help users track their engagement over time. The technology can be accessed via an app on a smartphone or tablet.

getUBetter (getUBetter)

GetUBetter is a digital self-management programme that includes personalised exercise plans and educational information related to living with and managing hip and knee osteoarthritis. It can be accessed via self-referral

or after review from a healthcare professional via an app using a smartphone, or online via the web. GetUBetter provides daily advice which is tailored to a user's progress and how they are feeling. Progress can be monitored using a pain scale and diary function. The technology can also connect users to local treatment, healthcare providers or support services, and has ongoing symptom monitoring to flag when users need to be redirected to these services.

Good Boost (Good Boost Wellbeing Ltd)

Good Boost is a self-management programme that includes personalised exercise plans, information about osteoarthritis and peer support. It is delivered via the We Are Undefeatable app, which can be accessed via a smart phone or tablet after referral from a healthcare professional, or via self-referral. When accessed via self-referral, the technology uses artificial intelligence to triage the user and make sure the appropriate programme is selected. When using the technology, users are signposted to in-person classes in their local area or can join group exercise classes or group support classes virtually through the app. Users can also track their progress in the app, with an option to share this information with a healthcare professional. Healthcare professionals can view this information and communicate with users via a messaging function when appropriate.

Hinge Health Programme (Hinge Health)

Hinge Health is a digital self-management programme that includes exercise plans and educational modules for hip and knee osteoarthritis. It can be accessed via an app through a smartphone or tablet. Users are prescribed a personalised exercise programme and are prompted to log their pain at the start of the programme and after each session. Users also have access to educational resources, including articles and videos, related to managing pain. Users can communicate with healthcare professionals via phone, email or live web chat, and have access to 24/7 support. The app also uses smart camera technology to analyse a person's movement when performing exercises at home.

Joint Academy (Arthro Therapeutics Ltd)

Joint Academy is a digital self-management programme that includes personalised educational modules, exercise plans and progress tracking for hip or knee osteoarthritis. It can be accessed following a referral from a healthcare professional via an app through a smartphone or tablet. Users are matched with physiotherapists who prescribe personalised exercise programmes based on symptoms. Users are given short daily exercises which

include video instructions and educational information is delivered through interactive lessons. Users can contact physiotherapists through video and chat functions and have regular follow ups to monitor progress. Pain and function can be tracked using the built in progress tracker. Information on other services is given to users who are not suitable for the program or users that are not progressing.

Pathway Through Arthritis (Wellmind Health)

Pathway Through Arthritis is a web-based self-management programme designed to give users a better understanding of osteoarthritis, disability and pain through a combination of physical and psychological therapies. It includes a 4-week programme that that has pre-recorded videos, exercises and assignments for users to complete at their own pace. The programme includes educational content on osteoarthritis, guided exercises for joint mobility and strength, mindfulness techniques, pain management strategies, behavioural change approaches and lifestyle advice on weight management The programme is led by a multidisciplinary team of healthcare professionals including a rheumatologist, GP, physiotherapist and mindfulness specialist. Users report progress and outcomes during assessments throughout the programme which are reported to their healthcare professional through a secure web-based management portal. The technology includes ongoing engagement and risk monitoring to make sure users are signposted to the appropriate pathways when appropriate. The programme can only be accessed online via a computer, or via an app through a smartphone or tablet after referral from a healthcare professional.

Phio Engage (EQL Ltd)

Phio Engage is a digital self-management programme which includes personalised exercise plans, educational content on managing osteoarthritis and symptom tracking. It is a part of a suite of programmes which includes a separate technology to screen people with osteoarthritis (Phio Access) and a technology used to collect patient reported data (Phio Collect). Phio Engage can be accessed after referral from a healthcare professional or through self-referral after screening by Phio Access. The technology is available as an app and can be accessed through a smartphone or tablet. Users are given daily exercises to follow with video instructions, with exercise reminders to notify users to complete the task. Daily sleep, pain and function scores are measured to track progress, and users can contact healthcare professionals through the app chat function for further support if needed. The technology also includes a step count feature if enabled by the user.

Physio Wizard (Physio Medics)

Physio Wizard is a digital self-management programme that provides advice and information on how to manage a condition, as well as personalised exercises based on symptoms inputted via a screening questionnaire. The technology can be accessed via an app through a smartphone or tablet.

Re.Flex (Reflex.Help)

Re.flex is a digital self-management programme for knee osteoarthritis. Users are given a tailored exercise program to complete with video guidance using 3D animation. A wearable sensor is also provided to track users exercises and give feedback on the quantity and quality of movements. The technology can be accessed via an app through a smartphone or tablet.

Thrive (Sword Health)

Thrive is a digital self-management programme that includes a personalised physiotherapy programme and educational resources for hip and knee osteoarthritis. Users have regular contact with physiotherapists who prescribe exercises designed to improve a person's pain and function. Educational resources include modules about the condition, pain management and healthy-lifestyle choices. Each user receives a kit that includes a 'Thrive Pad' which is designed to provide real-time feedback to users as they perform exercises in both audio and video formats. User's progress is monitored, and people are signposted to the appropriate primary and secondary care services where necessary.

TrackActiveMe (Active Health Tech Ltd)

TrackActiveMe is a digital self-management programme that includes exercise modules, educational content and progress tracking for hip and knee pain. It can be accessed via an app through a smartphone or tablet, and users are assessed for eligibility using a self-assessment tool in the app. If eligible, users are given personalised exercise videos with text instructions depending on the severity of their condition. Educational content includes condition-specific information, optimising recovery, and general health, wellbeing, lifestyle information and support which can be accessed through PDFs or videos. The technology contains a symptom tracking feature, where users are asked to review their progress at every exercise session. If users are not progressing, the app flags this to the appropriate healthcare professional for follow up.

3 Relevant diseases and conditions

Osteoarthritis is defined as a long-term disorder of synovial or cartilaginous joints which occurs when damage triggers repair processes. This leads to structural changes within a joint, with features of localised loss of cartilage, remodelling of adjacent bone and the formation of osteophytes, and mild synovitis (inflammation of the synovial membrane that lines the joint capsule). People with mild to moderate hip or knee osteoarthritis may experience occasional joint pain, pain when walking and some limitations to daily activities.

4 Current management and care pathway

People with suspected hip or knee osteoarthritis typically present to healthcare professionals in primary or community care and may initially see a GP or first contact practitioner (FCP). But, some services will also have a self-referral pathways and some people may present to other community based services, such as local pharmacies. NHS England's framework to reduce community musculoskeletal waits recommends using FCPs to support shared decision making on diagnosis and management. It also recommends making best use of community MSK triage and therapy services where access to FCPs is limited. NICE's guideline for the diagnosis and management of osteoarthritis in over 16s describes the diagnosis of osteoarthritis.

Treatment for hip or knee osteoarthritis depends on the severity of symptoms. Current treatment options for mild to moderate hip or knee osteoarthritis include both pharmacological and non-pharmacological treatments. Non-pharmacological treatment options include therapeutic exercise and weight management (if appropriate), along with information and support. Manual therapy (such as manipulation, mobilisation or soft tissue techniques) and devices (such as walking aids) may also be offered alongside therapeutic exercise. Pharmacological treatment options include medicines and corticosteroid injections to relieve pain and inflammation. But, these treatments may become less effective as the severity of the condition increases. Access to treatments may vary depending on geographical location because some areas have waiting lists to see a physiotherapist. NICE's guideline for the diagnosis and management of osteoarthritis in over 16s recommends considering combining therapeutic exercise with an education programme or behaviour change approaches in a structured treatment package. A treatment package is defined as pharmacological or non-pharmacological treatments with one of the following:

- behaviour change approaches, including ways to reduce pain and straining when using joints, pain coping skills training (including

spouse-assisted coping skills training), goal setting; motivational coaching; weight management counselling and workplace risk counselling

- an education programme given by 1 or more healthcare professionals over multiple sessions, including those based on behavioural theory.

NICE's interventional procedures guidance on platelet-rich plasma injections for knee osteoarthritis states that this procedure should only be used with special arrangements for clinical governance, consent, and audit or research.

People with mild to moderate hip or knee osteoarthritis can often be managed in the community under the guidance of a healthcare professional, such as a GP or FCP. This can be done either in person or remotely. NHS England's framework to reduce community musculoskeletal waits recommends using evidence informed interventions such as peer support, self-management education and health coaching to support self-management. It also suggests making best use of digital resources and group interventions. The Getting It Right First Time elective hip or knee replacement pathway suggests attempting conservative treatment for at least 3 months prior to referral for surgical intervention (for example, using medicines, physiotherapy and support with lifestyle and weight loss for patients with a body mass index over 30). NICE's guideline for the diagnosis and management of osteoarthritis in over 16s recommends advising people with osteoarthritis to seek follow-up if planned management is not working within an agreed time period, or they are having difficulties with the agreed approaches.

Potential place of digital technologies for managing mild to moderate hip or knee osteoarthritis in the care pathway

Some digital technologies for managing mild to moderate hip or knee osteoarthritis allow people to self-refer to access the technology and other technologies can be considered when people first present with mild to moderate osteoarthritis in primary or community care (including community MSK services). Before accessing a digital technology, people must undergo eligibility screening to make sure that the technology is a suitable option for them. This screening can be done by the technology itself (using a built-in self-assessment questionnaire) or in-person by a healthcare professional (for example, a GP, FCP or physiotherapist), but will not be assessed as part of this evaluation. Digital technologies may be offered instead of non-pharmacological standard care (in-person therapeutic exercise, weight management [where appropriate] and information and support), or in addition to a reduced number of in person appointments. Use of digital technologies

should align with NICE guidelines and be appropriate for the severity of the condition and the step in the care pathway for which it is intended to be used.

5 Comparator

The comparator for this assessment is non-pharmacological standard care for people aged 16 and over with mild to moderate hip or knee osteoarthritis. Standard care varies across primary and community care, but should include therapeutic exercise, weight management (if appropriate) and information and support, delivered alongside pharmacological interventions. Manual therapy and devices (such as walking aids) may also be offered alongside therapeutic exercise, where appropriate.

6 Decision problem

Table 1 Decision problem for the assessment

Population	Adults aged 16 and over with mild to moderate hip or knee osteoarthritis that have been assessed as suitable for digital self-management
Interventions (proposed technologies)	Digital technologies for managing mild to moderate hip or knee osteoarthritis, including: • ESCAPE-Pain • getUBetter • Good Boost • Hinge Health • Joint Academy • Pathway Through Arthritis • Phio Engage • Physio Wizard • Re.Flex • Thrive • TrackActiveMe
Comparator	Non-pharmacological standard care for managing mild to moderate hip or knee osteoarthritis
Healthcare setting	Primary and community care
Outcomes	The outcome measures to consider include: **Primary outcomes** Patient reported outcomes • Health-related quality of life (for example, EQ-5D or SF-36) • Pain and stiffness

	• Physical function
	• Self-efficacy (for example, Musculoskeletal Health Questionnaire [MSK-HQ] or Arthritis self-efficacy scale [ASES])
	
	Clinical outcomes
	• Referrals for injections
	• Medicine use and appointments
	
	Secondary outcomes
	Patient reported outcomes
	• Psychological outcomes
	• User satisfaction and acceptability
	• Activity impairment
	
	Intermediate outcomes
	• Intervention adherence, rates of attrition and completion (including but not limited to the number of exercise/therapy sessions completed, interaction with health professionals, education contents reviewed)
	• Intervention related adverse events
	• Work productivity/return to full activity
	• Healthcare professional satisfaction
	
	Clinical outcomes
	• Secondary care referrals
	• Referrals for surgery
	
	Costs will be considered from an NHS and Personal Social Services perspective. Costs and resource use outcomes for consideration should include:
	• Costs of the technologies (including license fees and maintenance)
	• Cost related to supporting digital technologies (including but not limited to additional hardware or software, cost of staffing and training)
	• Cost of resource use
	  ○ Primary, community and secondary care appointments
	  ○ Medicine, manual therapy and device use
	  ○ Healthcare professional grade and time

Time horizon	The time horizon for estimating the clinical and economic value should be sufficiently long to reflect any differences in

	costs or outcomes between the technologies being compared.

7 Other issues for consideration

Considerations for patients

Digital technologies for managing mild to moderate hip or knee osteoarthritis can be accessed remotely in a person's home environment. For people struggling to access face-to-face services due to long waiting lists or inability to attend in person appointments (for example, due to travel or mobility restrictions, or other time commitments), digital technologies could improve access and engagement. Digital technologies for managing osteoarthritis may also appeal to regular users of digital technologies who may prefer to access healthcare remotely, or people who are housebound due to illness.

Some people who are eligible to use digital technologies may choose not to use them and may prefer in-person clinician led treatment if this is available. People may also have concerns about the use of digital technologies for example data security, potential costs or their ability to use the technology effectively. People should be supported by healthcare professionals to make informed decisions about their care, including the use of digital technologies.

8 Potential equality issues or considerations

NICE is committed to promoting equality of opportunity, eliminating unlawful discrimination and fostering good relations between people with particular protected characteristics and others.

Osteoarthritis is more common in women, people aged 45 and over, people with overweight and obesity and people living in the most deprived areas. NICE's clinical knowledge summary for osteoarthritis states that other risk factors include low bone density, joint injury or trauma and genetics.

Digital technologies for managing mild to moderate hip or knee osteoarthritis are accessed via a smartphone, tablet or computer. People will need regular access to a device with internet access to use the technologies and people living in the most deprived areas may have more difficulty accessing these resources. So, digital technologies may not be suitable for some people. People who are less comfortable or skilled at using digital technologies may prefer another treatment option. Additional support and resources may also be needed.

People with visual or hearing difficulties, cognitive impairment, problems with manual dexterity, a learning disability, people who are unable to read or understand health-related information (including people who cannot read English) or neurodivergent people may need additional support to use digital technologies. Some people would benefit from digital technologies being available in a language other than English.

People's ethnic, religious, and cultural background may affect their views of digital technologies for managing mild to moderate hip or knee osteoarthritis. People have the right to make informed decisions about their care, including the use of digital technologies. Healthcare professionals should discuss the language and cultural content of the technologies with patients.

Age, sex, disability and religion or belief are protected characteristics under the Equality Act 2010.

9 Potential implementation issues

Initial screening and ongoing monitoring

Digital technologies may be unsuitable for some people with mild to moderate hip or knee osteoarthritis. For example, people who are considered high risk with complex comorbidities may need increased levels of monitoring by healthcare professionals and in person appointments may be more suitable. A person’s suitability for using digital technologies should be screened before they are given access to digital programmes. Some digital technologies also have inbuilt processes to flag the need for further intervention. Initial screening and ongoing monitoring are important to make sure the right advice and support is given to all users. Initial screening and ongoing monitoring could be done by a healthcare professional in primary or community care or by the digital technology itself and may depend on how the technologies are implemented into the care pathway.

Integration with NHS systems, capacity and costs

It may be beneficial for healthcare professionals in primary, community and secondary care to be able to access data collected by the technologies so that they can monitor and manage a person’s progress and provide continuity of care between healthcare settings. The Digital Technology Assessment Criteria (DTAC) is designed to be used by healthcare organisations to assess digital technologies at the point of procurement to make sure that they meet NHS clinical safety, data protection, technical security, interoperability and usability and accessibility standards.

Implementation of digital technologies may initially increase staff workload to set up new or additional pathways and become familiar with new systems. Staff may need to spend time attending training or training users. It may also initially increase costs to set up new pathways, change service delivery and amend IT infrastructure if necessary. Smaller service areas may have higher costs per user due to not needing as many licences for the technology.

10 Stakeholders

10.1 Healthcare professional organisations

The following healthcare professional organisations have been identified as stakeholders for this evaluation:

- Advanced Practice Physiotherapy Professional Network
- AGILE: Chartered Physiotherapists working with Older People
- Association of District Nurse and Community Nurse Educators
- British Association of Prosthetists and Orthotists
- British Association of Sport Rehabilitators
- British Dietetic Association
- British Orthopaedic Association
- Chartered Society of Physiotherapy
- Institute of Osteopathy
- Musculoskeletal Association of Chartered Physiotherapists
- National Association of Primary Care
- Physiotherapy Pain Association
- Royal College of General Practitioners
- Royal College of Nursing
- Royal College of Occupational Therapists
- Royal College of Physicians
- Royal College of Physicians of London
- Royal College of Radiologists
- The Society of Sport Therapists

10.2 Patient and carer organisations

NICE's Public Involvement Programme contacted / have identified the following patient and carer organisations for advice:

- Action on Pain
- Anxiety UK
- Arthritis Action
- Arthritis and Musculoskeletal Alliance (ARMA)
- British Society of lifestyle medicine
- Lindsay Leg Club Foundation
- MIND
- National Academy for Social Prescribing
- Pain Concern
- Versus arthritis

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Appendix A Related Guidance

- **Related Medical Technologies Guidance:**
  - AposHealth for knee osteoarthritis (2023). NICE Medical technologies guidance 76.
- **Related Guidelines:**
  - Osteoarthritis in over 16s: diagnosis and management (2022). NICE guideline 226.
  - Joint replacement (primary): hip, knee and shoulder (2020. NICE guideline 157.
- **Related Interventional Procedures**:
  - Platelet-rich plasma injections for knee osteoarthritis (2019). NICE interventional procedures guidance 637.
- **Related Quality Standards:**
  - Osteoarthritis in over 16s (2015, updated 2022). NICE quality standard 87.
  - Joint replacement (primary): hip, knee and shoulder (2022). NICE quality standard 206.

Early use assessment

HTE10057 Digital technologies for managing mild-to-moderate hip or knee osteoarthritis

Assessment report overview

This overview summarises key information from the assessment and sets out points for discussion in the committee meeting. It should be read together with the final scope and the external assessment report (EAR). The list of abbreviations used in this overview is in appendix A.

1. The technologies

The assessment included 11 digital technologies for self-management of mild-to-moderate hip and/or knee osteoarthritis (OA). They are designed to help people manage their condition remotely in the community, at a time that is convenient to their lifestyle. They can offer an alternative to in-person appointments or be used in addition to a reduced number of in-person appointments.

All the technologies are indicated for hip and knee osteoarthritis except for re.flex which is indicated for knee joints only. All technologies include exercise and education components, but vary in terms of their delivery, access route, intended population, professional involvement, additional features, and costs. Table 1 provides a more detailed overview of the technology details.

For this overview, technologies are grouped according to the level of professional involvement, also accounting for available evidence. This includes four levels of grouping:

- Group 1 – Technologies offering healthcare professional communication or supervision

- Group 2 – Technologies with no direct healthcare professional communication
- Group 3 – Digital technologies associated with group classes
- Group 4 – Technologies with uncertain features for which no evidence was identified or received.

Table 1. Digital self-help OA technologies characteristics

Technology	Access	Referral route	Current NHS use	Regulatory status	HCP communication	Additional features	Program adjustments	AI element
Group 1 – Technologies with healthcare professional communication and/or supervision (with available evidence)								
Joint Academy	Mobile and web	Professional and self-referral	Currently used (5 providers)	Class 1 medical device	Two-way (messaging and video with company specialist)	No	Amount of exercises and difficulty personalised by company physiotherapist	Yes – personalise exercise programme and flags for HCP reviews
Phio Engage	Mobile only	Professional and self-referral	Currently used (10 providers)	Not a medical device	Two-way (messaging with company or NHS specialist, depending on configuration)	No	Exercises personalised by physiotherapist using feedback received from user after each session	No
Thrive	Mobile and web	Professional and self-referral	Not currently used	Class 1 medical device	Two-way (messaging and video with company specialist)	Yes – wearable sensor	Exercise programme created and adjusted by Sword physiotherapist	Yes – provides user feedback on movements
Track Active Me	Mobile and web	Self-referral only	Not currently used	Class 1 medical device	One way (user to professional)	No	Exercises selected for user based on feedback from preceding session	Yes – personalise exercise programme and flags for HCP reviews
Group 2 – Technologies with no direct healthcare professional communication (with available evidence)								
re.flex	Mobile only	Professional only	Not currently used	Class 1 medical device	No direct communication	Yes – wearable sensor	Automatic program adjustment by AI-driven feedback received from sensor-based tracking system	Yes – provides user feedback on movements

Hinge Health	Mobile (web use unclear)	[redacted]	Not currently used	Not a medical device (company stated)	No direct communication	Yes – motion tracking	Initial program selected based on enrolment screening questionnaire, with motion tracking technology [redacted]	Yes – provides personalised exercise programme
getUbetter	Mobile and web	Professional and self-referral	Currently used (17 integrated care systems)	Class 1 medical device	No direct communication	No	Targeted support modules enable the user to pick advice and exercises most relevant to their condition and situation. Users can move between easier and harder exercises as their recovery progresses.	No
Group 3 – Digital technologies associated with group classes (with available evidence)								
Good Boost	Mobile only	Professional and self-referral	Currently used (4 providers)	Class 1 medical device	One-way (professional to user)	Yes – optional in-person or virtual classes	AI (expert clinical algorithm) selects a tailored exercise programme for the participant to follow based on users' initial digital assessment results.	Yes – provides personalised exercise programme
ESCAPE pain	Mobile and web	Unclear	Unclear	Unclear	Unclear	No	Unclear	Unclear
Group 4 – Technologies with uncertain features (no evidence identified)								
Pathway Through Arthritis	Mobile and web	Professional only	Not currently used	Class 1 medical device	One-way (user to professional)	Unclear	Unclear	No
Physio Wizard	Mobile (web use unclear)	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
MHRA - Medicines and Healthcare products Regulatory Agency.								

2. The condition

OA is a long-term disorder of synovial or cartilaginous joints. It occurs when damage triggers repair processes. This leads to structural changes within a joint. These can include a loss of cartilage, remodelling of the adjacent bone, the formation of osteophytes (bony lumps on the bones), and mild synovitis (inflammation of the synovial membrane that lines the joint capsule). People with mild to moderate hip or knee OA may experience occasional joint pain, pain when walking and some limitations to daily activities.

Around 10 million people in the UK have a diagnosis of OA. The knees and hips are most affected. Over 5 million have knee OA and over 3 million have hip OA. The condition often gets worse over time. There is currently no cure, but symptoms can be managed.

3. Current practice

People with suspected hip or knee OA usually present to primary or community care. Most will initially see a GP or first contact practitioner. But some may present to other community services, such as pharmacies. Some services also have a self-referral pathway for physiotherapy services. NICE's guideline for the diagnosis and management of osteoarthritis in over 16s describes the diagnosis pathway in more detail.

Treatment depends on symptom severity. Pharmacological options include medicines and corticosteroid injections. Nonpharmacological options can include therapeutic exercise and weight management (if appropriate), along with information and support. Manual therapy such as manipulation, mobilisation or soft tissue techniques and devices such as walking aids may also be offered.

People with mild to moderate hip or knee OA are usually managed in the community. Self-management is encouraged. This usually includes therapeutic exercise, education and coping strategies. A treatment package combining these techniques is usually recommended. The Getting It Right First Time elective hip or knee replacement pathway suggest that people

attempt conservative treatments for at least 3 months before a referral for surgical intervention is considered. NICE's guideline for the diagnosis and management of osteoarthritis in over 16s recommends advising people with OA to seek follow-up if planned management is not working.

4. Unmet need

More people are developing musculoskeletal conditions. More referrals to specialist care mean that some services cannot meet demands. Access to OA treatment can vary depending on location as some areas have waiting lists to access specialist care and services. This means that some people may wait longer to start treatment. People may also live away from treatment centres and find it hard to reach services where they are available. These delays in starting treatment or issues accessing services can negatively impact a person's quality of life. There is an unmet need for a treatment option that could start when symptoms are first identified and notified, for example in primary care.

5. Innovative aspects

Digital self-help technologies may be offered instead of nonpharmacological standard care, or in addition to help reduce the number of in person appointments required. By reducing the demand on the number of in-person appointments (i.e., GP or physiotherapy appointments), digital technologies can help reduce wait lists. Using these technologies does not depend on healthcare professional capacity to provide support and could offer people with OA faster access to support. Also, since people can access digital technologies from anywhere anytime, this can help to remove access barriers.

As outlined in Table 1, some technologies have additional features, including wearable hardware and motion tracking technology, AI-elements, and group-based interactive elements. Wearable hardware and motion tracking can be used to track user performance and check whether exercises are performed correctly. User data can be applied to help update exercise programmes and ensure these are appropriate for users. This helps ensure that users are engaging with exercises safely and may help to minimise injury risk, without

additional professional capacity. AI-based elements can be used to help tailor programmes in response to user needs, without the need for healthcare professional involvement. Group-based interactive elements, such as virtual classes, can help to improve patient engagement.

Further details, including descriptions of the interventions, comparator, care pathway and outcomes, are in the final scope.

6. Clinical effectiveness

The EAG did targeted literature searches to identify relevant published clinical evidence. Also 9 companies provided information about the evidence for their technologies. The EAG literature search and selection methods are described in sections 6.1 and 6.2 of the external assessment report (EAR).

The EAG found 19 studies on 9 of the digital technologies. No evidence was found for 2 technologies listed in the scope (Pathway Through Arthritis, or Physio Wizard).

Studies were prioritised based on design and population. RCT evidence was prioritised over other design types, and studies on knee or hip populations were prioritised over broader MSK populations. The EAG sought to include at least one study per technology, with 10 studies included as key evidence (details provided below).

An overview of the deprioritised evidence is available in appendix B. In brief, this includes 9 observational studies (4 full-text publications and 5 abstract articles) covering 3 technologies (Joint Academy, Good Boost and Hinge Health). The evidence varies in terms of outcomes, populations, and follow-up. Most deprioritised evidence (7 of 9 studies) covers Joint Academy, for which a RCT was available and included within the key evidence.

6.1 Overview of key studies

Table 2 provides an overview of the 10 studies the EAG prioritised.

- 3 RCTs use standard care or treatment as usual as the comparator. Other evidence without a comparator includes a single-arm trial, observational studies, and unpublished company data.
- Most studies were done in the UK (6/10), with 2 from the US, 1 from Germany, and 1 with the location undisclosed.
- The EAG prioritised identifying evidence for each technology, rather than fulfilling all population criteria. Only 2 studies are directly applicable to population included in the scope. All other evidence is indirectly applicable because it includes people from different populations (that is different severities or single joints).
- The maximum follow-up time among the prioritised studies is 12 weeks, included in 6 studies. 2 studies have a follow-up of 6 weeks, and 2 do not report a follow-up duration.
- Outcomes include adherence, HRQoL, pain and stiffness, physical function, psychological effects, user satisfaction, and adverse events. Pain is the only outcome included across all studies. No studies include self-efficacy or clinical outcomes.

Further details are provided in section 6.2 and table 6 -1 of the EAR.

Table 2. Key evidence overview

Intervention	Design	Comparator	Country	Sample size	Joint	Severity	Follow-up (weeks)	Outcomes
Group 1 – Technologies with healthcare professional communication and/or supervision (with available evidence)								
Joint Academy	RCT	Usual care	UK	146	Knee	NR	6	• Adherence • HRQoL • Pain and stiffness • Physical function
Phio Engage	Single-arm observational	NA	UK	120	Hip and knee	Mild – moderate	12	• Pain and stiffness • Physical function
	Single-arm observational	NA	UK	272	Hip and knee	Mild – moderate	12	• HRQoL • Pain and stiffness • Physical function
Thrive	Single-arm observational	NA	USA	534	Hip	NR	12	• Adherence • HRQoL • Pain and stiffness • Physical function • Psychological • Satisfaction • Adverse events
Track Active Me	Company data (unpublished)	NA	NR	15	Hip and knee	NR	NR	• Pain and stiffness
Group 2 – Technologies with no direct healthcare professional communication (with available evidence)								
re.flex	RCT	Usual care	Germany	194	Knee OA (moderate – severe)	Moderate – severe	12	• Adherence • HRQoL • Pain and stiffness • Physical function • Psychological • Satisfaction • Adverse events

Hinge Health	RCT	TAU	USA	162	Knee	NR	12	• Adherence • Pain and stiffness • Physical function
getUbetter	Single-arm service evaluation (unpublished)	NA	UK	160	Knee	NR	NR	• Pain and stiffness • Physical function • Satisfaction
Group 3 – Digital technologies associated with group classes (with available evidence)								
Good Boost	Audit (unpublished)	NA	UK	4429	Hip and knee	NR	12	• Pain and stiffness • Physical function • Satisfaction
ESCAPE pain	Single-arm trial	NA	UK	136	Hip and knee	NR	6	• Adherence • HRQoL • Pain and stiffness • Physical function • Satisfaction
Group 4 – Technologies with uncertain features (no evidence identified)								
Pathway Through Arthritis	NA	NA	NA	NA	NA	NA	NA	NA
Physio Wizard	NA	NA	NA	NA	NA	NA	NA	NA
HRQoL – health related quality of life; NA – not applicable; NR – not reported; RCT – randomised controlled trial; TAU – treatment as usual; UK – united kingdom; USA – untied states of America.								

Study quality

Quality appraisal was completed for the 3 RCTs. None were rated as having a high risk of bias across any domain. All were classed as having “some concerns” overall. The EAG noted that the methodological quality is generally acceptable. But limitations are noted with incomplete data and the reporting of outcomes. Generalisability to clinical practice is also highlighted as a limitation. This is because of complexity across the interventions which could impact implementation. Relevance to the UK setting is also noted, as 2 of 3 RCTs were completed outside of the UK.

A formal quality assessment was not completed for the observational studies because the EAG considered them to be of lower quality.

Full details of the quality appraisal are available in section 6.3 and Appendix E of the EAR.

Patient reported outcomes – primary

Table 3 shows the primary patient reported outcomes of HRQoL, pain and stiffness and physician function. No evidence was found for self-efficacy.

The RCTs showed improvements compared with usual care or TAU across all primary outcomes. Some differences were small and non-significant. Statistically significant improvements were found for:

- HRQoL: re.flex (VR-12)
- Pain: re.flex (KOOS pain), Joint Academy (VAS and WOMAC), and Hinge Health (VAS and KOOS)
- Stiffness: Joint Academy (WOMAC) and Hinge Health (VAS)
- Physical function: Joint Academy (timed up and go test and WOMAC), and Hinge Health (KOOS physical function).

The observational studies had more limited evidence, but a general improvement was shown across all outcomes. Further details are available in section 6.2 of the EAR.

Table 3. Patient reported outcomes

Intervention	HRQoL	Pain and stiffness	Physical function
Group 1 – Technologies with healthcare professional communication and/or supervision (with available evidence)			
Joint Academy	• Greater improvement than usual care at 6 weeks. • Non-significant improvement in MSK-HQ of -0.3 (95% CI: -3.3,2.6).	• Greater improvement than usual care at 6 weeks. • Statistically significant reduction in WOMAC pain (mean -1.39; 95% CI: -2.2, -0.55) and stiffness (mean -1; 95% CI: -1.5, -0.5). • Changes in conditional and pressure pain modulation variable and inconsistent.	• Greater improvements than usual care at 6 weeks. • Statistically significant functional improvements in sit-to-stand repetitions (mean difference of 3.4; 95% CI: 2.2,4.5), timed up and go test (mean difference of -1.8: 95% CI -3, -0.5) and WOMAC physical function scores (mean difference -3.4; 95% CI: 6.2, 0.7).
Phio Engage	• Improvement in MSK-HQ. Mean change of 6.84 (SD 8.91) between baseline at 12 weeks.	• Improvement in NRS pain score with a mean change of -9.7 (SD 1.66) over 12 weeks.	• Improvement in Primary PAFM (patient actuated functional measures) of 7.76 (SD 2.39) and Secondary PAFM and 7.11 (SD 2.39) at 12-weeks.
Thrive	• Improvement in HOOS-QoL of 14.08 at 12 weeks.	• Improvement in HOOS pain score with a mean change of 13.32 at 12 weeks. Mean decrease in NRS pain score of 2.22 at 12 weeks.	• Improvement in HOOS function of 11.01 and HOOS sport of 13.55 at 12 weeks.
Track Active Me	NR	• Improvement in VAS pain score of -2.45 among hip users and -1 among knee users.	NR
Group 2 – Technologies with no direct healthcare professional communication (with available evidence)			
re.flex	• Greater improvement than usual care across measures at 13 weeks. • Statistically significant improvement in VR-12 PCS of 1.7 (mean difference of 2.4; 95% CI: 0.3 to 4.5).	• Greater improvement than usual care at 13 weeks • Statistically significant mean difference in reduction in KOOS pain score of 4.8 (95% CI: 0.7 to 8.9).	• Greater improvements than usual care at 13 weeks. • Improvements in KOOS Sport/Rec, KOOS Symptoms, and KOOS-activities of daily living (ADL) subscales • Statistically significant difference in ADL (mean difference of 3.9; 95% CI: 0 to 7.9)

	• Non-significant improvement in KOOS-QoL of 4.1 (mean difference of 2.4; 95% CI: -1.6 to 6.5) • Negligible changes in VR-12 MCS and PGA scores		• Non-significant improvement in 30-second sit-to-stand test of 1.7 (SD 1.9; mean difference of 0.3, 95% CI: -0.3 to 0.9)
Hinge Health	NR	• Greater improvement than TAU at 12 weeks. • Statistically significant reductions in KOOS pain (mean -7.7: 95% CI: -12.3,-3), VAS pain (mean -12.3; 95% CI: -19.1,-5.4), and VAS stiffness (mean -13.4; 95% CI: -21.1,-5.6)	• Greater improvement than TAU at 12 weeks. • Statistically significant improvement in KOOS physical function (mean difference of -7.2; 95% CI: -11.5,-3).
getUbetter	NR	• Improvement (reduction) in pain among 62% of participants but only 13.8% noted improvement as a 'great deal'.	NR
Group 3 – Digital technologies associated with group classes (with available evidence)			
Good Boost	NR	• Improvement in VAS (0-100) pain by a mean of 7.54 (SD 26.7) over 26 weeks.	• Improvement in patient specific complaint of a mean -11.6 (95% CI: -13.6, -9.6) at 6-weeks, and -9.1 (95% CI: -11.2, -6.9) at 12-weeks.
ESCAPE pain	• Improvement in KOOS-QoL from 31 (SD 23) at baseline to 39 (SD 21) at 6 weeks.	• Improvement in KOOS pain from 46 (SD 20) at baseline to 54 (SD 18) at 6 weeks.	• Improvement in KOOS-ADL from a mean of 48 (SD 22) at baseline to 56 (SD 20) at 6 weeks.
Group 4 – Technologies with uncertain features (no evidence identified)			
Pathway through Arthritis	NR	NR	NR
Physio Wizard	NR	NR	NR

ADL- activities of daily living; CI – confidence interval; NR – not reported; KOOS - Knee Injury and Osteoarthritis Outcome Score (KOOS); MSK-HQ - Musculoskeletal Health Questionnaire; QoL – quality of life; SD – standard deviation; TAU – treatment as usual; VR-12 - veterans rand 12-item health survey; VAS – visual analogue scale; WOMAC - Western Ontario and McMaster Universities Osteoarthritis Index

Patient reported outcomes – secondary

Secondary patient reported outcomes included treatment satisfaction, psychological outcomes and activity impairment. None of the prioritised studies included evidence on activity impairment.

Treatment satisfaction was reported in 2 studies. For re.flex, 63% of users reported that they were either ‘satisfied’ or ‘very satisfied’. For getUBetter, 73.6% of users reported that the intervention was acceptable to very good, with 16.4% rating their experience as ‘very good’.

Psychological outcomes were reported in 2 studies. For ESCAPE-pain, Hospital Anxiety and Depression Scale (HADS) scores decreased from 8.3 (SD 4.5) to 7.0 (SD 4.5) for anxiety, and from 7.5 (SD 4.1) to 6.2 (SD 4.3) for depression between baseline and 6-weeks follow-up. For Thrive, the Generalised Anxiety Disorder Assessment 7-Item scale (GAD-7) score decreased by 1.13, and the Patient Health Questionnaire-9 (PHQ-9) score decreased by 1.16 between baseline and 12-weeks follow-up.

Clinical outcomes

Clinical outcomes outlined in the scope included medication use, and referrals for injections, secondary care appointments and surgery. None of the prioritised studies reported on these outcomes.

Intermediate outcomes

Intermediate outcomes from the scope included intervention adherence (attrition and completion), intervention-related adverse events, workplace productivity, and healthcare professional satisfaction. None of the prioritised studies included professional satisfaction.

Workplace productivity was reported in 1 study. For Thrive, a decrease in the Work Productivity and Activity Impairment Questionnaire (WPAI) was shown (indicating increased productivity). This included a decrease in overall impairment of -6.77, work impairment of -5.86, and activity impairment of -11.39 between baseline and 12-weeks follow-up.

Adverse event data was reported in 3 studies. For Thrive and TrackActiveMe, no adverse events were reported. For re.flex, an unpublished study was submitted with reported AE. Within this 12.2% of users from the intervention arm reported AE, with 5.1% directly related to the technology, 5.1% likely related, and 2% possibly related. No information on AE rates among the comparator arm was available.

Adherence related outcomes (i.e., completion, attrition) were reported in 5 studies, covering re.flex, Joint Academy, Hinge Health, ESCAPE-pain, and Good Boost. Attrition or drop out ranged between 21.5% for Joint Academy, to 30.6% for Good Boost. Completion or adherence rates ranged between 73.5% for Good Boost, to 77% for re.flex. Further details are available in table 6-8 of the EAR.

6.2 Ongoing studies

The EAG noted 2 ongoing studies for Phio Engage relevant to the scope due to complete in December 2025. Further details are provided in **Error! Reference source not found.**, and section 9.1 of the EAR.

7. Health economic evidence

The EAG reviewed the evidence on the included technologies to identify any economic evaluations or information. An additional search was also completed to identify HRQoL data. Details of the methods are provided in section 4.1 and Appendix A of the EAR.

The clinical evidence review returned no economic evaluations for the included technologies. None of the identified studies included resource use estimates. One study Dieter (2025) reported HRQoL outcomes, measured by KOOS-QoL. This was used to supplement standard care improvements from baseline in the economic model. The HRQoL search returned one study with EQ-5D-3L data on Joint Academy. This evidence was included in the EAG model to inform baseline HRQoL and improvements in the technology arm.

Evidence request documents were completed by 8 companies and 4 of these were used to inform the economic model: 3 for cost and resource use, and 1 for utility inputs. Table 7-1 of the EAR provides details of the included evidence.

[redacted] Table 7-2 of the EAR provides more detail.

7.1 Health economic model

As no existing models were found in the evidence review, the EAG developed an early cost-utility model. This aimed to assess if the scoped digital technologies have potential to be cost-effective and if or where more evidence is needed. Due to the early nature of the model, this was more simplified and reliant on a range of assumptions where data is not yet available.

Model structure

The EAG produced an early economic model which was simplified because of the limited evidence and data availability. This model could be updated in the future to include additional health states, alternative pathways, or longer time horizons if new evidence becomes available.

The model compares digital technologies (plus standard care, or a reduction in standard care) with non-pharmacological standard care. Costs and benefits are modelled over a 1-year period, with outcomes captured each month. The state-transition cohort model includes a decision-tree element in the first model cycle.as shown in figure 1.

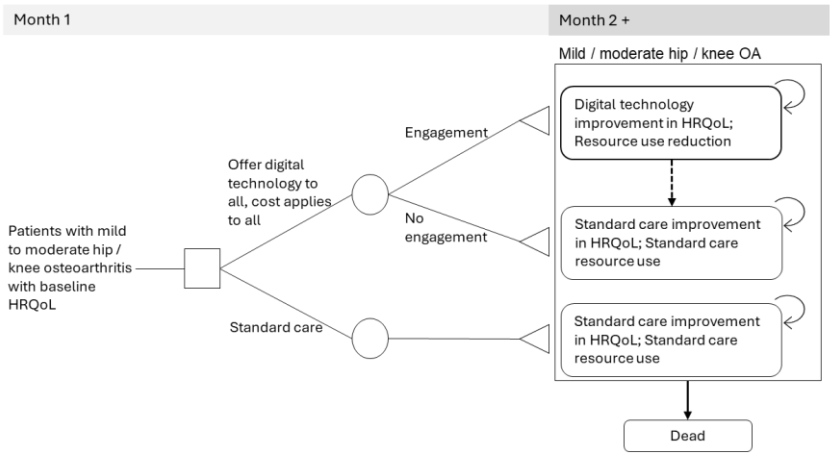

Figure 1. Patient flow in the model

People enter the model assigned to either digital technologies or usual care for the first month. Those assigned to digital technologies can either engage or not. After month 1 and at the end of each month, people's symptoms either remain the same, improve, or they can transition to 'death'.

Key model assumptions

Several key assumptions are used in the model, including:

- Model built with a 1-year time horizon.
- The impact of technologies on HRQoL and costs lasts 9 months, based on expert opinion, with positive effects starting in month 2.
- Users remain in the mild-to-moderate disease state for the model duration, unless they die of unrelated causes. Users have the same mortality risk as the general population.

Further details are described in section 7.2 of the EAR.

Population

The model estimates outcomes for people 16 years and over with mild-to-moderate hip or knee OA assessed as suitable for digital management. The model assumes an entry age of 62 years, with 68.3% being female. Full details are available in section 7.2 of the EAR.

Comparator

The comparator in the model was standard care.

Model inputs

Health-related quality of life

Changes in quality-adjusted life years (QALYs) are calculated over 1-year, starting from month 2.

Baseline utility is assumed to be the same for both the digital technology and standard care arms at 0.65 (SD 0.14). This is based on a single-arm study from the HRQoL search, which included one of the digital technologies (Joint Academy). An improvement to 0.69 (SD 0.15) is used for the digital technologies, taken from the same study. An improvement to 0.666 (SD 0.135) from 0.65 (SD 0.14) is used for the standard care arm. This is based on data from a RCT of one of the digital technologies (re.flex). This study showed similar improvements between the technology and standard care arms and was judged to have a low risk of bias. The utility value is calculated from the KOOS QoL score, as EQ-5D-3L data was not available. Details are provided in Table 7-13 of the EAR.

A utility cap was applied in the model to ensure that values could not be higher than general population utility. These were taken from the HSE 2014 dataset.

Engagement

Patient engagement was assumed at 50%. This was based on variable rates of engagement identified through expert opinion and within published literature. Four clinical experts estimated engagement to fall between 40 and 70%. Published literature showed an engagement rate of 61% for one of the included technologies. Further details are available in section 7.2 of the EAR.

Mortality

It is assumed that digital technologies do not influence survival. People remain in the mild-to-moderate OA state unless they die of unrelated causes.

Background mortality data to inform this was taken from the Office of National Statistics 2021-2023 data.

Digital technology costs

Table 4 includes the per person per year costs for each digital technology. A large variation between technologies, and across technology groupings was seen.

Table 4. Digital technology costs

Technology	Cost (per-person)	Programme duration	Additional features	Professional involvement	Programme adjustment
Group 1 – Technologies with healthcare professional communication and/or supervision (with available evidence)					
Joint Academy	£112.50 (12 weeks)	12 weeks	[redacted]	Two-way messaging and video calls with company specialist	By company physiotherapist
Phio Engage	£45.28 (annual)	Unclear	NA	Two-way messaging with company or NHS specialist	Surveillance by company physiotherapist or NHS (depending on configuration), with adjustment only where necessary
Thrive	£375 (annual)	Unclear	Wearable sensor for motion tracking and feedback	Two-way messaging and video calls with company specialist	By company physiotherapist
Track Active Me	[redacted] (annual)	Unclear	NA	One way (user to professional) – limited to where red flag mechanism is triggered	Automated adjustment
Group 2 – Technologies with no direct healthcare professional communication (with available evidence)					
re.flex	£229.50 (12-weeks)	12 weeks	Wearable sensor to provide user feedback	No direct communication	Automated adjustment
Hinge Health	£296.25 (annual)	Unclear	[redacted]	No direct communication	Automated adjustment
getUbetter	£18.86 (annual)	Unclear	NA	No direct communication	Automated adjustment
Group 3 – Digital technologies associated with group classes (with available evidence)					
Good Boost	£46.15 (annual)	Unclear	AI expert algorithm and option to attend in-person or virtual classes	One-way messaging (professional to user) with company specialist	Automated adjustment

ESCAPE pain	Unclear	Unclear	Unclear	Unclear	Unclear
Group 4 – Technologies with uncertain features (no evidence identified)					
Pathway Through Arthritis	Unclear	4 weeks	Unclear	One-way communication (user to professional)	Unclear
Physio Wizard	Unclear	Unclear	Unclear	Unclear	Unclear
NA – not applicable; NHS – National health service.					

A one-off yearly cost of £160.51, reflecting the mean cost of the 7 technologies that were not marked as commercial in confidence, is used in the base case. Individual technology costs were not used as there was significant variability in the cost structures provided by companies both in the level of detail and also what was included: extent of physiotherapist support, duration of software access and use of hardware accessories. Full details are available in Table 7-4 of the EAR.

Standard care costs

A monthly standard care cost of £31.66 is applied throughout the model. This is based on estimates for primary care appointments, community care appointments, and medication based on expert opinion. Tables 7-5 to 7-7 in the EAR provide more detail.

Secondary care costs are not included in the model as they were assumed not to apply to mild-to-moderate OA. Manual therapy and devices (i.e., walking aids) were excluded due to limited evidence. Some medications are excluded due to unavailable cost data, but the EAG consider the impact of this to be low.

Healthcare resource use and costs during treatment

Compared with standard care, engaging with digital technologies is assumed to reduce medication use by 10% and primary and community care resource use by 30%. The monthly cost of primary and community care and medication use was £23.54 for the technology arm, compared with £31.66 for the standard care arm. However total resource use costs are higher among the digital technology arm compared to standard care when including the monthly cost of the digital technologies (£36.92 versus £31.66). The total monthly

incremental costs for all resource for the digital technology arm compared to standard care was £5.26. Further details are provided in Tables 7-11 and 7-12.

7.2 Model results

Base case

The base-case results are exploratory only. They provide an indicative range only, rather than conclusive evidence on cost-effectiveness. This is because of limited evidence and data available for the individual technologies.

In the deterministic analysis the digital technologies cost £124 more and generated 0.0090 QALYs more than standard care. This results in an incremental cost effectiveness ratio (ICER) of £13,833 per QALY and suggests that digital technologies may be cost effective.

The probabilistic analysis highlights uncertainty in the results because of the uncertainty in the model outputs. The probability of cost-effectiveness is 51% at a willingness-to-pay threshold of £20,000 per QALY. The calculated ICER was £11,405 based on an incremental cost of £126 per person and an additional 0.0110 QALYs for using digital technologies compared with standard care.

Total costs and results are detailed in Table 7-17 (deterministic), 7-18 (probabilistic) and section 7.3 of the EAR.

Sensitivity analyses

One-way sensitivity analysis showed that utility values (baseline and improvements from standard care) and technology costs have the most impact on results. Two-way sensitivity analysis showed that digital technologies can remain cost-effective if utility improvement is sufficient. Further details of the sensitivity analyses are in section 7.3 of the EAR. Specifically, Tables 7-7 to 7-13.

Scenario analyses

The EAG analysed a range of scenarios alongside the base case. This is because of differences across the included technologies and uncertainty with the included data. These involved:

1. Only including digital technologies with additional features within the average cost used for the economic modelling (Good Boost, Hinge, Thrive, re.flex and Joint Academy)
2. Only including digital technologies with lower costs and limited additional features (getUBetter, Phio Engage)
3. Only including digital technologies intended to be used for a shorter duration (re.flex, Joint Academy)
4. Removing all standard care costs from the technology arm

Across the scenarios, incremental costs ranged between £10 to £179. QALY differences ranged from 0.004 to 0.011. The results ranged from £934 per QALY for scenario 2, to £38,760 per QALY in scenario 3. All results for scenarios 1,2 and 4 fall below the £20,000 per QALY threshold. This suggests an increased likelihood of cost-effectiveness under such scenarios.

The scenario analyses suggest that technologies with higher costs and potentially larger effects may have higher ICERs, while technologies with lower costs and potentially lower effects may have lower ICERs. Further details are available in section 7.3. Specifically, tables 7-19 (deterministic) and 7-20 (probabilistic).

8. Equality considerations

The final scope and the scoping equality impact assessment describe equality considerations for this assessment. In brief, as the technologies require smartphone and web access, digital literacy and economic status may impact access for some. People with visual or hearing difficulties, cognitive impairment, manual dexterity problems, learning disabilities, neurodivergent people, those unable to read, write, or understand health-related information

(including people who cannot read English) may need additional support to use digital technologies. Peoples ethnic, religious, or cultural background may affect their views of using digital technologies.

The EAG noted that most participants in the key studies were women and that most did not report subgroup data. The evidence either did not account for different types of MSK conditions at baseline, or only reported on one body part (i.e., hip or knee). These factors should be considered when considering the use of digital technologies based on the available evidence.

9. Evidence gaps

The EAG completed an evidence gap analysis for clinical and cost-effectiveness data. Table 5 provides an overview of the evidence gap analysis for the primary outcomes. Appendix C provides an overview of the evidence gap analysis for secondary outcomes. Tables 9-1 to 9-3 in the EAR provide further detail.

No evidence was found for:

- healthcare professional satisfaction
- secondary care referrals
- referrals for injections (i.e., corticosteroids)
- Activity impairment.

Limited evidence was found for:

- HRQoL
- Pain and stiffness
- Physical function
- Self-efficacy
- Psychological outcomes
- User satisfaction
- Surgery referrals
- Resource use (medication and appointments)
- Intervention adherence

- Adverse events
- Workplace productivity

Where evidence is available, this tends to be low quality, or not in the scope population.

Data for subgroup analysis was not found as outcomes were either reported for hip and knee combined or only include a single joint. Uptake and adherence data was limited to a few technologies. No evidence is on the long-term effects of the digital technologies, or rates of progression to more severe OA were found. HRQoL was very limited and not always in the preferred measure (EQ-5D). No evidence on resource use relevant to the scope population was available.

Table 5. Primary outcomes evidence availability summary

Technology	HRQoL	Pain and stiffness	Physical function	Self-efficacy	Referral for injections	Medication use and appointments
Group 1 – Technologies with healthcare professional communication and/or supervision (with available evidence)						
Joint Academy	1 RCT	1 RCT	1 RCT	No evidence	No evidence	1 single arm
Phio Engage	1 single arm	1 single arm	1 single arm	No evidence	No evidence	No evidence
Thrive	1 single arm	1 single arm	1 single arm	No evidence	No evidence	No evidence
Track Active Me	No evidence	1 single arm	No evidence	No evidence	No evidence	No evidence
Group 2 – Technologies with no direct healthcare professional communication (with available evidence)						
re.flex	1 RCT	1 RCT	1 RCT	No evidence	No evidence	No evidence
Hinge Health	No evidence	1 RCT	1 RCT	No evidence	No evidence	No evidence
getUbetter	No evidence	1 single arm	1 single arm	No evidence	No evidence	1 single arm
Group 3 – Digital technologies associated with group classes (with available evidence)						
Good Boost	No evidence	2 single arm	2 single arm	No evidence	No evidence	No evidence
ESCAPE pain	1 single arm	2 single arm	3 single arm	4 single arm	No evidence	No evidence
Group 4 – Technologies with uncertain features (no evidence identified)						
Pathway Through Arthritis	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence
Physio Wizard	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence
RCT – randomised controlled trial.						

Future models

The EAG note that the current model could be updated in the future if more evidence becomes available. This could include modelling on:

- Longer-term effects on disease progression (to more or less severe OA states)
- Longer-term effects and a wider range of resource use (i.e., onward referrals for injections or surgery, A&E visits, or secondary care appointments)
- Separate pathways according to baseline OA severity (mild or moderate) to better show the impact of technologies according to severity.
- Individual technologies costs (rather than an average) to show the cost-effectiveness of individual technologies.

Error! Reference source not found. of the EAR shows a potential structure for future modelling.

10. Key points, limitations and considerations

10.1 Clinical effectiveness

Key points

- RCT evidence was identified for 3 of the included technologies, re.flex, Joint Academy and Hinge Health. The technologies generally showed a benefit over usual care, with statistically significant improvements in pain, stiffness, physical function and HRQoL.

- Observational evidence was included for 5 technologies, ESCAPE-Pain, getUBetter, Good Boost, Phio Engage, and Thrive. The technologies showed a greater improvement in pain and physical function compared to standard care.

- No evidence was identified for Pathway Through Arthritis or Physio Wizard.

Limitations

- Limited data was found for many of the scoped outcomes, including psychological outcomes, self-efficacy, and activity-impairment.

- Limited direct, high-quality evidence on the population in the scope, with all RCTs either not reporting OA severity, or including patients with OA severities outside the scope of this evaluation. This results in uncertainty surrounding the efficacy of the intervention in mild and moderate OA specifically.

- Long-term follow-up is limited: for comparative studies it is limited to 12 weeks and for observational studies it is limited to 26 weeks.

- There is unclear generalisability of the evidence to clinical practice. The content of both the intervention and the usual care comparator was inconsistently reported, resulting in unclear feasibility of between-study comparisons. Notably, only the Hinge Health RCT utilised the intervention

as an adjunctive to usual care, with the other 2 RCTs investigating the technology as an alternative to usual care.

- Some of the evidence may not be generalisable to the NHS. Notably, only the Joint Academy RCT was done in the UK.

Considerations for committee:

• Do the technologies have the potential to address the unmet need? Do the studies suggest that the technologies have the potential to be clinically effective?

• Is the evidence of potential benefit sufficient to support a conditional recommendation for use in an evidence generation context? Is there sufficient evidence for each technology?

• Are the risks for use in an evidence generation context acceptable? Do any of these risks need to be, and can be, mitigated in the evidence generation plan? Is there any risk of harm to patients with any of the technologies?

• Can the technologies be integrated into the NHS and are they likely to be acceptable to health care professionals and patients?

10.2 Health economic evidence

Key points:

- Results of the deterministic base case modelling suggest that digital technologies have the potential to be cost effective over a 1-year time horizon. An ICER of £13,120 per QALY was produced using an average cost across included technologies, which suggests there is potential for individual technologies to have favourable ICER results.

- Small QALY gains mean the model is susceptible to volatile ICERs under varying assumptions, as indicated by differences between the deterministic and probabilistic results.

- The probabilistic analysis highlights uncertainty in the results, with the probability of cost-effectiveness being 51%. This is driven by uncertainty in model inputs.

Limitations:

- Due to a lack of available data, it was not possible to do modelling for each individual technology. Scenario analyses and optimal strategy plotting may help to understand the characteristics that make a technology more likely to be cost effective.

- There was inadequate data to do long-term modelling beyond a 1-year time horizon. As a result, the effect of digital technologies on disease progression, need for surgery and injections are uncaptured in the model.

Considerations for committee:

- Are the economic model structure, assumptions and clinical and cost parameters suitable to answer the decision question (see final scope) for this assessment?

- Do the model results suggest that the technologies have the potential to be cost effective?

- Do the uncaptured potential benefits, including reduced waiting list times, reduced absenteeism due to illness, slower disease progression and reduced need for surgery increase the likelihood that the technologies will be cost effective?

Appendix A - Abbreviations

Term	Definition
A&E	Accident and Emergency
ADL	Activities of daily living
AE	Adverse event
AI	Artificial intelligence
CEACs	Cost-effectiveness acceptability curves
CI	Confidence interval
EAG	External assessment group
EAR	External assessment report
EQ-5D	EuroQol 5 dimension
EQ-5D 3L	EuroQol 5-dimension 3 level
EVA	Early value assessment
GAD-7	Generalised Anxiety Disorder Assessment 7-Item scale
GBP	Great British pound
GP	General Practitioner
HCP	Health care practitioner
HOOS	Hip Injury and Osteoarthritis Score
HRQoL	Health-related quality of life
ICER	Incremental cost-effectiveness ratio
KOOS	Knee Injury and Osteoarthritis Outcome Score
MD	Mean difference
MSK	Musculoskeletal
MSK-HQ	Musculoskeletal Health Questionnaire
NA	Not applicable
NG	NICE guideline
NHS	National Health Service
NHSE	National Health Service England
NICE	National Institute for Health and Care Excellence
NL	The Netherlands
NMA	Network meta-analysis
NMB	Net monetary benefit
NR	Not reported
NRS	Numerical rating scale
OA	Osteoarthritis
ONS	Office of National Statistics
OWSA	One-way sensitivity analysis
PA	Probabilistic analysis
PAFM	Patient actuated functional measures
PHQ-9	Patient Health Questionnaire-9
PROMs	Patient-reported outcome measures
QALY	Quality-adjusted life year
QoL	Quality of life

RCT	Randomised controlled trial
SD	Standard deviation
TAU	Treatment as usual
TWSA	Two-way sensitivity analysis
UK	United Kingdom
USA	United States of America
VAS	Visual analogue scale
VAT	Value added tax
WHO	World Health Organization
WOMAC	Western Ontario and McMaster Universities Arthritis Index
WPAI	Work Productivity and Activity Impairment Questionnaire
WTP	Willingness-to-pay

Appendix B – deprioritised evidence

Intervention	Design	Comparator	Country	Sample size	Joint	Severity	Follow-up (weeks)	Outcomes
Group 1 – Technologies with healthcare professional communication and/or supervision (with available evidence)								
Joint Academy	Single-arm observational (full text)	NA	Sweden	53	Hip and knee	NR	12 weeks	• Adherence • Pain and stiffness • Self-efficacy
	Single-arm observational (abstract only)	NA	USA	101	Hip and knee	NR	6 weeks	• Pain and stiffness • Physical function
	Single-arm observational (full text)	NA	Sweden	920	Hip and knee	NR	48 weeks	• Adherence • HRQoL • Pain and stiffness
	Single-arm observational (abstract only)	NA	UK	110	Hip and knee	Severe	12 weeks	• Adherence • Pain and stiffness • Physical function
	Single-arm observational (abstract only)	NA	Sweden	21,688	Hip and knee	NR	12 weeks	• HRQoL • Pain and stiffness • Physical function • Self-efficacy
	Single-arm trial (abstract only)	NA	Sweden	350	Hip and knee	NR	6 weeks	• Adherence • Medication use • HRQoL

								• Pain and stiffness • Physical function • Self-efficacy
	Single-arm trial (abstract only)	NA	Sweden	350	Hip and knee	NR	6 weeks	• Adherence • Medication use • HRQoL • Pain and stiffness • Physical function • Self-efficacy
Group 2 – Technologies with no direct healthcare professional communication (with available evidence)								
Hinge Health	Single-arm observational (full text)	NA	USA	41	Single knee	NR	12 weeks	• Adherence • Pain and stiffness • Physical function • User satisfaction
Group 3 – Digital technologies associated with group classes (with available evidence)								
Good Boost	Single-arm observational (full-text)	NA	UK	34	Hip + knee + lower back	NR	Variable (up to 6 months)	• Adherence • Pain and stiffness • Physical function
HRQoL – health related quality of life; NA – not applicable; NR – not reported; UK – United Kingdom; USA – united states of America.								

Appendix C – Evidence gap analysis for secondary outcomes

Technology	Adherence	Activity impairment	Adverse events	Workplace productivity	Psychological outcomes	Satisfaction	Secondary care referral	Surgery referral
Group 1 – Technologies with healthcare professional communication and/or supervision (with available evidence)								
Joint Academy	1 RCT	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	1 single arm
Phio Engage	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence
Thrive	No evidence	No evidence	1 single arm	1 single arm	1 single arm	No evidence	No evidence	No evidence
Track Active Me	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence
Group 2 – Technologies with no direct healthcare professional communication (with available evidence)								
re.flex	1 RCT	No evidence	1 RCT	No evidence	No evidence	1 RCT	No evidence	No evidence
Hinge Health	1 RCT	No evidence	No evidence	No evidence	No evidence	1 single arm	No evidence	No evidence
getUbetter	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence
Group 3 – Digital technologies associated with group classes (with available evidence)								
Good Boost	1 single arm	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence
ESCAPE pain	1 single arm	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence
Group 4 – Technologies with uncertain features (no evidence identified)								
Pathway Through Arthritis	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence
Physio Wizard	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence	No evidence
RCT – randomised controlled trial.								

National Institute for Health and Care Excellence
Patient and carer organisation submission template

NICE HealthTech programme

Please read the guide to completing a submission fully before completing this template.

Information about your organisation	
Organisation name	Arthritis Action
Contact person's name	Dr Wendy Holden
Role or job title	Medical Advisor to Arthritis Action
Organisation type	Patient/carer organisation (e.g. a registered charity) x☐ Informal self-help group ☐ Unincorporated organisation ☐ Other, please state:
Organisation purpose (tick all that apply)	Advocacy x☐ Education x☐ Campaigning x☐ Service provider ☐ Research ☐ Other, please specify:
What is the membership of your organisation (number and type of members, region that your organisation represents, demographics, etc)? **Approximately 2000 members with arthritis plus we cater for all people with arthritis through our website and other media.**	

Please note, all submissions will be published on the NICE website alongside all evidence the committee reviewed. Identifiable information will be redacted.

If you haven't already, please register as a stakeholder by completing the stakeholder registration form and returning it to medtech@nice.org.uk

Further information about registering as a stakeholder is available on the NICE website.

National Institute for Health and Care Excellence
Patient and carer organisation submission template

Did you know NICE meetings are held in public? You can register on the NICE website to attend a meeting up to 20 working days before it takes place. Registration will usually close 10 days before the meeting takes place. Up to 20 places will be available, depending on the size of the venue. Where meetings are oversubscribed NICE may need to limit the number of places we can offer.

Sources of information

What is the source of the information about patients' and carers' experiences and needs that are presented in this submission?

YouGov surveys and members experience and stories

National Institute for Health and Care Excellence
Patient and carer organisation submission template

Impact of the symptoms, condition or disease

1. How do symptoms or the condition or disease affect people's lives or experiences?

People with arthritis live with pain, stiffness and sometimes disability which can impact their daily functioning and mental health as well as theiw work and social functioning

2. How do symptoms or the condition or disease affect carers and family?

Increased burden on carers and family, limitations of social life and finances due to impact on work

3. Are there groups of people that have particular issues in managing their condition?

All people with arthritis have issues managing their condition

Experiences with currently available technologies

4. How well do currently available technologies work?

The listed technologies have patchy availability, but more widespread digital use would likely give significant benefits.

5. Are there groups of people that have particular issues using the currently available technologies?

Yes, geographical restrictions and IT abilities

About the technology being assessed

6. For those with experience of this technology, what difference did it make to their lives?

A huge difference in terms of pain, muscle strength and functional ability as well as mental health benefits.

7. For those without experience of the technology being assessed, what are the expectations of using it?

As above

8. Which groups of people might benefit most from this technology?

People who are able to use digital technology. Anyone with significant osteoarthritis and localised joint pains as well as more generalised mobility issues due to arthritis

Additional information

9. Please include any additional information you believe would be helpful in assessing the value of the technology (for example ethical or social issues, or socio-economic considerations)

It must be very user friendly and available on multiple devices.

Key messages

10. In up to five statements, please list the most important points of your submission.

People with MSK conditions have significant unmet needs and anything that can help them access self-management support would be very useful

Thank you for your time. Please return your completed submission to medtech@nice.org.uk

National Institute for Health and Care Excellence
Patient and carer organisation submission template

NICE HealthTech programme

Please read the guide to completing a submission fully before completing this template.

Information about your organisation	
Organisation name	Versus Arthritis
Contact person's name	Adam Hunt
Role or job title	Innovation Manager
Organisation type	Patient/carer organisation (e.g. a registered charity) ☒ Informal self-help group ☐ Unincorporated organisation ☐ Other, please state:
Organisation purpose (tick all that apply)	Advocacy ☒ Education ☒ Campaigning ☒ Service provider ☒ Research ☒ Other, please specify:
What is the membership of your organisation (number and type of members, region that your organisation represents, demographics, etc)? We are reaching 10,000s of individuals with arthritis across the UK from young people and families through to older people with arthritis and care givers.	

Please note, all submissions will be published on the NICE website alongside all evidence the committee reviewed. Identifiable information will be redacted.

If you haven't already, please register as a stakeholder by completing the stakeholder registration form and returning it to medtech@nice.org.uk

National Institute for Health and Care Excellence
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Sources of information

What is the source of the information about patients' and carers' experiences and needs that are presented in this submission?

National Institute for Health and Care Excellence
Patient and carer organisation submission template

Impact of the symptoms, condition or disease

1. How do symptoms or the condition or disease affect people's lives or experiences?

2. How do symptoms or the condition or disease affect carers and family?

3. Are there groups of people that have particular issues in managing their condition?

Experiences with currently available technologies

4. How well do currently available technologies work?

We have delivered our own symptom tracking App in the past and this was co-designed for (and delivered) empowering young people to talk about the impacts of their condition. We are interested to see how the role of remote monitoring, symptom tracking and self-management can empower individuals with hop and knee OA.

Our App is not DTAC compliant but we are partnered with Ampersand Health who provide the My Arthritis app. It is interoperable with Health Systems, is a certified medical device and utilises PROMs, information and courses to support self-management. It goes beyond Rheumatoid Arthritis as it contains our health information on other conditions.

We are interested in how remote monitoring using a tool like this can help people to live well with their condition, create behaviour change and reduce unnecessary GP appointments.

5. Are there groups of people that have particular issues using the currently available technologies?

This relies on having a mobile device and data. It also requires some digital literacy which could be a barrier to people downloading in the first place. GPs can set a user up on the portal which

A. triages the person before moving forward i.e. the GP knows they are reluctant to use a device so does not pursue setting up an account

B. may reduce the anxiety over using an app to self-monitor.

About the technology being assessed

6. For those with experience of this technology, what difference did it make to their lives?

The website does have testimonials but Ampersand would be best placed to provide this answer: My Arthritis

7. For those without experience of the technology being assessed, what are the expectations of using it?

- Tracking as frequently as they want / need.
- Entering in appointment reminders.
- Communicating with health professionals.
- Viewing data and understanding impacts.
- Accessing and undertaking short courses.
- Reading articles and health information.

8. Which groups of people might benefit most from this technology?

- People who are newly diagnosed and are learning how to manage pain and their wellbeing.
- People where access to a GP is tough, this can bridge the gap between appointments and help GPs to target interventions earlier.
- GPs for remote monitoring and seeing behaviour changes that lead to better condition management.

Additional information

9. Please include any additional information you believe would be helpful in assessing the value of the technology (for example ethical or social issues, or socio-economic considerations)

National Institute for Health and Care Excellence
Patient and carer organisation submission template

Key messages

10. In up to five statements, please list the most important points of your submission.

- Remote monitoring has big impacts for individuals and health.
- Data can empower people with arthritis to make changes or have better conversations.
- Self-management is not just exercise but learning the skills and having the tools to make behaviour change happen.

Thank you for your time. Please return your completed submission to medtech@nice.org.uk

NICE National Institute for Health and Care Excellence

HealthTech Programme

Digital technologies for managing mild to moderate hip or knee osteoarthritis: early-value assessment (provisional title)

Professional organisation submission

Thank you for agreeing to give us your organisation's views on this technology and its possible use in the NHS.

You can provide a unique perspective on the technology in the context of current clinical practice that is not typically available from the published literature.

To help you give your views, please use this questionnaire. You do not have to answer every question – they are prompts to guide you. The text boxes will expand as you type.

Information on completing this submission

- Please do not embed documents (such as a PDF) in a submission because this may lead to the information being mislaid or make the submission unreadable
- We are committed to meeting the requirements of copyright legislation. If you intend to include **journal articles** in your submission you must have copyright clearance for these articles. We can accept journal articles in NICE Docs.
- Your response should not be longer than 13 pages.

Any confidential information provided should be underlined and highlighted. Please underline all confidential information, and separately highlight information that is 'commercial in confidence' in blue and all that is 'academic in confidence' in yellow.

About you **1. Your name**	Mike Carpenter
2. Name of organisation	Musculoskeletal Association of Chartered Physiotherapists (MACP)
3. Job title or position	Consultant Physiotherapist
4. Are you (please select Yes or No):	An employee or representative of a healthcare professional organisation that represents clinicians? Yes A specialist in the treatment of people with this condition? Yes A specialist in the clinical evidence base for this condition or technology? Yes Other (please specify):
5a. Brief description of the organisation (including who funds it).	The Musculoskeletal Association of Chartered Physiotherapists (MACP) is a membership organisation of physiotherapists who have reached a recognised standard of excellence in musculoskeletal physiotherapy. It represents over 1200 physiotherapists who have reached an international recognized standard of excellence in MSK physiotherapy at Advanced Practice level. It is the UK member organisation of the International Federation of Manual and Musculoskeletal Physical Therapists (IFOMPT) which has 22 Member Organisations and 16 Registered Interest Groups and is a recognised subgroup of the World Confederation of Physical Therapy.
5b. Has the organisation received any funding from any company with a technology included in the evaluation in the last 12 months? [Please refer to the final scope for a full list of technologies included. The final scope is due to be published on 2 July 2024]. **If so, please state the name of company, amount, and purpose of funding.**	No

5c. Do you have any direct or indirect links with, or funding from, the tobacco industry?	No

The aim of treatment for this condition

6. What is the main aim of this technology? (For example, initial diagnosis, **clinical monitoring, treatment triage** **assessing stages of disease progression or risk stratification.)**	To support patient's in the engagement and adoption of the first line care of Osteoarthritis of the hip and knee. This involves supported self-management in the form of engagement in exercise and adoption of lifestyle adjustment and changes.
7. In your view, is there an unmet need for patients and healthcare professionals in this condition?	First line treatments for Osteoarthritis (exercise and education) are often recommended in the primary care setting. Increasingly the provision of such first line management has become more self-directed and less supported in response to increasingly strained healthcare resources. It is therefore not uncommon for people to be advised briefly on the nature of first line treatments but without sustained support, to then be referred onto specialist services if things don't improve. Digital tools offer an opportunity for increased support at the early stage and more tailored and monitored application to occur.

What is the expected place of the technology in current practice?

8. How is the condition currently treated in the NHS?	Typically very early osteoarthritis causes little in the way of limitation and people will self-manage independently making lifestyle adjustment and using over the counter analgesia as required. Some people consult healthcare early and those people will typically be assessed by a GP or a first contact physiotherapist, and will be advised on basic exercises, along with general Osteoarthritis information, before being advised on general self-management to maintain, and to return for review if things fail to improve or worsen.

	Patients in some part of the country may be able to directly access their community NHS physiotherapy service via self-referral directly. Where self-referral is not available, a professional referral to physiotherapy would be made from primary care for those patients requiring additional support. (Some patients may choose to consult private practice physiotherapy providers outside the NHS setting). NHS Physiotherapy for Osteoarthritis will typically involve an exercise programme of strength and mobility exercises, tailored to the needs and capability of the patient. A process of progressive resisted exercise will typically be designed to be undertaken over a period of time, in line with the specific goals of the individual patient. People who have relevant lifestyle contributing factors (such as obesity) may receive coaching and support in accessing services designed to help in making healthy lifestyle change (such as weight management services). On occasions where patients have a persistent limitation to movement, the physiotherapist may try to assist in regaining this movement through the use of manual therapies as an adjunct to the exercise management. The setup of the service would determine if further adjuncts to care can be provided simultaneously (e.g. a corticosteroid injection; provision of orthotics) for those patients where this were deemed to be suitable. If failing to respond, people with moderate to late stage of hip or knee OA may be referred to a secondary care orthopaedic services to consider invasive management in the form of joint arthroplasty.
9a. Are any relevant clinical guidelines we should be aware of, and if so, which?	Existing NICE guidance NG226 There are numerous subject matter speciality group guidance publications Each regional commissioning area, typically has its own (usually slightly different per region) funding policies (often termed prior approval criteria/ PLVC/ HVLC criteria) which outline the requirement of specific management to have been followed before specialist care will be considered for funding.
9b. Is the pathway of care well defined? Does it vary or are there differences of opinion between professionals across the NHS? (Please state if your experience is from outside England.)	There is variation in Osteoarthritis management between different professions and across different geographical areas across England. As outlined above, the access to first line treatment support varies by area. Where MSK/ physiotherapy services have open-access , patients may be able to obtain this support directly. Even then, different MSK/physiotherapy services will provide a differing level of support for the patient, depending on their setup and commissioned model. The introduction of first contact physiotherapists (FCP), does provide a welcome access to MSK specialism within the primary care setting, but currently the remit of the FCP is for assessment only, thus providing ongoing management and specific intervention generally requires the patient to do this independently. It is not uncommon to see early radiographic imaging being undertaken some clinicians with the view that Osteoarthritis is considered a diagnosis requiring radiographic confirmation – albeit this is not guideline compliant. This kind of imaging is generally unwarranted, unless there are likely differentials that radiology can

	be useful to screen for. This can lead to variation and regions with higher radiographic utilisation, tend to have a more biomedically focussed subsequent pathway. Patient and public expectations and perceptions also contribute to some of the variance. There remain common held beliefs that as a process of 'wear and tear', Osteoarthritis is a progressive condition and will ultimately require surgical intervention at some point. This perception is not backed by evidence and the trajectory for longer term joint deterioration is not always clear. Several studies suggest suitable joint loading and maintenance of muscle function can be chondroprotective and have beneficial effects for long term joint health overall. Whilst total joint arthroplasty is a well-established biomedical treatment, with generally strong outcomes (hip > knee), the acceptance to consider/ adopt other 'core' (first line) treatments does vary i.e. some providers accept earlier referral for consideration of arthroplasty, whilst others follow the conservative pathway before arthropathy, as outlined above, more stringently.
9c. What impact would the technology have on the current pathway of care?	The introduction of digital technologies within Osteoarthritis pathways has already commenced and some tools have been commissioned in certain areas of the country. The assumptions made in those areas that have adopted digital technologies tends to be that by enabling additional support/ coaching/ monitoring/ guidance through digital tools, this is likely to lead to more successful early management and enhance optimal self-management (reducing the need for earlier referral to community or speciality services). This is intended to therefore reduce the need for more specialist input or reduce the intensity in healthcare demand.
10a. Will the technology be used (or is it already used) in the same way as current care in NHS clinical practice?	In principle, the addition of digital technology could provide further support to those in the early stage and would overlap with the existing typical pathway. It could/ would be synergistic. The assumption is that additional support (in digital form) would help enhance motivation, adherence, knowledge and understanding and thus enhance earlier outcomes.
10b. How does healthcare resource use differ between the technology and current care?	This has not been definitively proven. Modelling from commissioning bodies optimistically aspires to support self-management for around 20% of the population, whom would currently be referred into a community MSK/ speciality pathway. It is not clear however to what extent this is achieved.
10c. In what clinical setting should the technology be used? (For example, primary or secondary care, specialist clinics.)	Primary and community care would be the most logical (only moderate-severe/ severe Osteoarthritis should be being referred into secondary care – hence does not represent the particular cohort this evaluation aims to investigate).

10d. What investment is needed to introduce the technology? (For example, for facilities, equipment, or training.)	Each digital technology will have a different funding model – some will cost the price of a general licence (which can be used by any number of users/ patients); others will charge on a cost-per-user basis. This would likely be the largest investment required. Depending on the funding for the tool, there may be additional maintenance and administrative costs to update and keep the tool live and functional. Integrating the digital technology to existing IMT systems would be important and thus funding may be required to ensure this is enacted. Depending on the model of how the tool is integrated will depend on the material cost to clinician training and clinical utilisation. For example, if the tool is managed totally externally by a parent organisation this may be minimal. However if the tool generates alerts/ flags for the existing clinical team to interact with/ action, then training will be required to ensure these are managed and to ensure clinicians can interact with the tool appropriately. Organisations that are particularly digitally naïve may require investment in their overall IMT infrastructure overall, to be compliant to data sharing and digital security regulation.
11a. Do you expect the technology to provide clinically meaningful benefits compared with current care?	In principle you would anticipate better awareness, knowledge and understanding related to Osteoarthritis and the self-management of this. Should patients/ users obtain such additional awareness and knowledge it would be anticipated that their ability to manage their condition would be better and thus better outcomes achieved. It is likely there are mediators towards this change however. So for example, it has been shown that people who adopt suitable levels of physical loading, maintain healthy lifestyles and engage in fulfilling functional activity, both have lower likelihood of developing OA and better outcomes related to management of OA when it does occur. The digital technology would be assumed to be a mediator to this, by providing supporting information to enable people to gain the knowledge and confidence to adopt these sorts of behaviours.
11b. Do you expect the technology to increase length of life more than current care?	Not principally – MSK issues are a quality of life > quantity of life based issues (albeit by connecting people with valued, physical activity this can indirectly optimise quantity of life)
11c. Do you expect the technology to increase health-related quality of life more than current care?	Yes

12. Are there any groups of people for whom the technology would be more or less effective (or appropriate) than the general population?	Digitally-literate individuals may stand to gain the most, given their likely ability to engage and interact with digital tools (which in turn is likely to enhance adherence/ engagement). Typically with MSK related conditions, evidence suggests people with a positive expectation for an intervention often fare better than those with a negative expectation of it. Therefore the acceptability of digital means of delivery, would be an important likely predictor of benefit. Assumptions based on demographic factors may be unfounded. For example, whilst some older people may be less digitally enacted, some older people are very digitally literate. Equally if the tool enables translation of content material, this need not be a barrier to utilisation for non-English speaking people (in fact there is a possible trend that this may enhance access for some, as translation enables them to understand it in their own time). People from lower socioeconomic backgrounds may not be in the financial position to afford certain technological services (e.g. lack of WiFi at home; no access to Smart Phones/ Laptops or devices). Lack of access would impact on effectiveness. For further comments see accessibility box below.

The use of the technology

13. Will the technology be easier or more difficult to use for healthcare professionals than current care? Are there any practical implications for its use (for example, additional clinical requirements, factors affecting patient acceptability or ease of use or additional tests or monitoring needed.)	There will be elements that are considered more difficult (e.g. additional forms to review; new digital pathways to navigate; interfacing with other technologies a clinician may use) that would need to be considered. At the same time however, there are elements that would mean technology would make it easier (e.g. more successful self-management, reducing healthcare utilisation demand; having pre-populated patient subjective data prior to an appointment, if the patient were to consult; easy to sign post to rather than referring into a physiotherapy service).
14. Do you consider that the use of the technology will result in any substantial health-related	QALY should sufficiently measure the health related benefits

benefits that are unlikely to be included in the quality-adjusted life year (QALY) calculation?	
15. Do you consider the technology to be innovative in its potential to make a significant and substantial impact on health-related benefits and how might it improve the way that current need is met?	At a population level, it is anticipated that digital technology could have a significant beneficial impact. At the level of the individual this may be determined by a number of factors, for example, digital literacy, access to digital technology. The adoption of stratification (in terms of matching clinical need to the severity of the condition and its limitations caused e.g. matching people with early/moderate OA to first line management; whilst considering more specialist input for those with more significant disease + disease burden) via technology is innovative.
16. Does the use of the technology address any particular unmet need of the patient population?	Access to high quality, evidence based resources for management of OA is currently a substantial need for people living with OA.
17. Are there any side effects or adverse effects associated with the technology and how do they affect the patient's quality of life?	There are no direct side effects. Arguments can be made for and against the impact of not always seeing a human clinician first off.

Sources of evidence

17a. Do studies on use of the technology reflect current UK clinical practice?	Much of the early research in the field was undertaken in the USA and Sweden, where 2 of the more established technology offerings are from. The healthcare setting is different to the UK. Studies from larger countries, with more distributed populations, may fare to gain more for digital technologies, as travel to and from care providers may be hard and thus digital providers a more feasible care option. It is not always clear in the published studies at what point in time people were able to access the digital technology, nor how the technology was offered to people as a care option.

	Funding for the technology would likely be different in countries where there is no publicly funded healthcare service, like the UK.
17b. If not, how could the results be extrapolated to the UK setting?	
17c. What, in your view, are the most important outcomes, and were they measured in trials?	The most important outcomes to consider in relation to hip and knee OA are: Pain intensity; Physical function; Quality of Life; Personal goal attainment; Adverse events Pain intensity and function are typically included in trials for digital self-management for OA. Quality of Life is used in some of the published research. Goal attainment and reporting of adverse events are more variably reported. Secondary outcomes should include: Sleep; Wellbeing (Depression/ Anxiety/ Catastrophisation); Social connection/Participation These may not be specifically captured as independent outcome measures, but sometimes form part of broader PROM questionnaires/surveys so may indirectly be measured in the published research. There are condition/ joint specific outcome measures that often are used. There are pros and cons to each, depending on the cohort reporting them – the KOOS/WOMAC OA index (for example), is one specific measure validated in the group of interest. Some orthopaedic departments consider Oxford Hip and Knee Scores as useful outcome measures. These are valid to assess the degree of improvement/ change following a joint arthroplasty – so not strictly intended for use in the early stage measures of outcome. However it is not uncommon to see some services use these in this way.
17d. If surrogate outcome measures were used, do they adequately predict long-term clinical outcomes?	Oftentimes research in the field looks at participant acceptability (do people consider digital care acceptable to them); This is an important aspect to consider in an innovative care delivery, as a lack of acceptability would likely render the tool/technology worthless if people are not willing to use it. Self-efficacy change is another area often measured (under the assumption that an improvement in self-efficacy could potentially lead to a reduction in subsequent healthcare consulting/ utilisation, having a greater confidence to self-manage); There has not been definitive causative impact established that an improvement in self-efficacy does lead to less health-care utilisation/ better ability to self-manage however. One's ability to self-manage is notoriously a difficult thing to measure.

17e. Are there any adverse effects that were not apparent in clinical trials but have come to light subsequently?	Not aware of any
18. Are you aware of any relevant evidence that might not be found by a systematic review of the trial evidence?	Not aware of any
19. How do data on real-world experience compare with the available data? Are you aware of any ongoing studies?	As outlined above digital technologies are currently in use in services in the UK. It is anticipated that at this stage, much of the services using such technology would likely be evaluating this for effectiveness to determine their subsequent care pathway design. From the network we are aware of teams using a pilot and service evaluation methodology to establish evidence in real world setting.

Equality

20a. Are there any potential equality issues that should be taken into account when considering these technologies?	Digital literacy and access provide the greatest risk of inequity If tools are able to be delivered in different languages/ ability to translate the material, then this can mitigate the risk of exclusion by spoken language. The failure to be able to translate this would lead to possible exclusion. Social inequality poses a possible exclusion in so-much as those who cannot afford the required IT (smartphone/ laptop/ tablet) or the necessary internet access could stand to be excluded. However it is not clear that alternative healthcare provision is necessarily any more inclusive to their needs.
20b. Consider whether these issues are different from issues with current care and why.	As outlined above significant poverty is a barrier to access to healthcare generally (e.g. cost of travel, availability of appointments around conflicting demands) – and as such digital tools may counter-act some of these barriers for people (i.e. remove the need to travel; ability to engage with healthcare at the most convenient time for the patient)

Key messages

21. In up to 5 bullet points, please summarise the key messages of your submission.	• Digital technology has the potential to enhance the early management of people living with hip and knee Osteoarthritis, albeit the evidence to assess this is yet to be fully explored. • With increasing demand on primary care services, the ability to offer additional support, through the means of technology is a worthwhile option. • There are possible facilitators and barriers to adoption, which stand to mean digital technologies may suit some people more than others and should be considered in synergy with traditional pathways, rather than in replacement of them. • The ideal place to position such innovations in in primary or community care at the earlier stage of the pathway. • The likely benefits to the healthcare system, however, may occur downstream in terms of optimising care prior to referral for more specialist (and costly) services.

Thank you for your time.

Please log in to your NICE Docs account to upload your completed submission.

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GID-HTE10057 Digital technologies for managing mild-to-moderate hip or knee osteoarthritis; early value assessment for the National Institute for Health and Care Excellence

External Assessment Report

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Purpose of the early value assessment report

The purpose of this external assessment report (EAR) by an external assessment group (EAG) for early value assessment (EVA) is to review the evidence currently available for technologies within the decision problem and advise what further evidence should be collected to help inform future decisions on whether the technologies should be widely adopted in the National Health Service (NHS). The National Institute for Health and Care Excellence (NICE) has commissioned this work and provided the template for the report. The report forms part of the papers considered by the Committee when it is making decisions about the EVA.

Declared interests of the authors

Description of any declared interests with related companies, and the matter under consideration. See NICE's Policy on managing interests for board members and employees.

None.

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Responsibility for report

The views expressed in this report are those of the authors and not those of NICE. Any errors are the responsibility of the authors.

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External Assessment Report: Changes after stakeholder consultation

Editorial corrections made in response to stakeholder consultation and feedback from the NICE technical team on the Evidence Assessment Report.

Section	Description of change
Section 3	Corrected description of Table 3-1.
Table 3-1	Added detail from stakeholder consultation and as requested by NICE technical team.
Section 6.2	Added information on Joint Academy.
Section 6.3	Added discussion of single arm study quality.
Section 6.4	Confidential marking removed from TrackActiveMe outcomes as per the latest company evidence request (15th July 2025).
Table 6-5	Added footnote to explain apparent error in reported outcomes.
Section 6.5	Added information from EQL company evidence request.
Section 7.1	Updated text to clarify the number of included studies in Table 7-1.
Section 7.2 and Table 7-4	Technology cost calculation is revised.
Section 7.2 and Table 7-4	Technology cost calculation given additional disclaimers.
Table 7-14	Updated due to change in technology costs.
Table 7-16	Scenario 2 technology costs description is revised.
Section 7.3	Updated base-case, and scenarios 2 and 4 results due to change in technology costs, added caveat to interpretation of scenario 2.
Section 7.4	Added caveat to interpretation of scenario 2.
Section 9-1	Added information provided by companies as part of stakeholder consultation.
Section 9-3	Added a sentence on accessibility and digital safety/privacy as suggested in stakeholder consultation.
Appendix G	Summary of anonymized clinical experts' opinion is added.

Contents

Abbreviations

Abbreviations Term	Definition
A&E	Accident and Emergency
ADL	Activities of daily living
AE	Adverse event
BMI	Body mass index
BNF	British National Formulary
CBT	Cognitive behavioural therapy
CCG	Clinical Commissioning Group
CDSR	Cochrane Database of Systematic Reviews
CEACs	Cost-effectiveness acceptability curves
CENTRAL	Cochrane Central Register of Controlled Trials
CI	Confidence interval
CIC	Circle Integrated Care
CKS	Clinical knowledge summaries
CRD	Centre for Reviews and Dissemination
EAG	External assessment group
EAR	External assessment report
ED	Emergency department
EED	Economic Evaluation Database
EQ-5D	EuroQol 5 dimension
EQ-5D 3L	EuroQol 5-dimension 3 level
EVA	Early value assessment
EVPI	Expected value of information
FCP	First contact practitioner
GAD-7	Generalised Anxiety Disorder Assessment 7-Item scale
GBP	Great British pound
GP	General Practitioner
HADS	Hospital Anxiety and Depression Scale
HCP	Health care practitioner
HCRU	Healthcare resource utilisation
HOOS	Hip Injury and Osteoarthritis Score
HRQoL	Health-related quality of life
ICER	Incremental cost-effectiveness ratio

ICS	Integrated care system
ICTRP	International Clinical Trials Registry Platform
KOOS	Knee Injury and Osteoarthritis Outcome Score
KSR	Kleijnen Systematic Reviews Ltd
LBP	Lower back pain
LYs	Life years
MCID	Minimally clinically important difference
MCS	Mental Component Score
MD	Mean difference
MeSH	Medical Subject Headings
MSK	Musculoskeletal
MSK-HQ	Musculoskeletal Health Questionnaire
NA	Not applicable
NG	NICE guideline
NHB	Net health benefit
NHS	National Health Service
NHSE	National Health Service England
NICE	National Institute for Health and Care Excellence
NL	The Netherlands
NMB	Net monetary benefit
NR	Not reported
NRS	Numerical rating scale
NSAID	Non-steroidal anti-inflammatory drug
OA	Osteoarthritis
ONS	Office of National Statistics
OWSA	One-way sensitivity analysis
PA	Probabilistic analysis
PAFM	Patient actuated functional measures
PCS	Physical Component Score
PGA	Patients Global Assessment
PHQ-9	Patient Health Questionnaire-9
PROMs	Patient-reported outcome measures
PSC	Patient specific complaint
PSS	Personal Social Services

PSSRU	Personal Social Services Research Unit
PT	Physical therapist
QALY	Quality-adjusted life year
QoL	Quality of life
RCT	Randomised controlled trial
SBRI	small business research initiative
SD	Standard deviation
SEL	South East London
SoC	Standard of care
SWL	South West London
TAU	Treatment as usual
TWSA	Two-way sensitivity analysis
UK	United Kingdom
UMC+	University Medical Centre+
USA	United States of America
US$	United States dollar
VAS	Visual analogue scale
VAT	Value added tax
WHO	World Health Organization
WOMAC	Western Ontario and McMaster Universities Arthritis Index
WPAI	Work Productivity and Activity Impairment Questionnaire
WTP	Willingness-to-pay

1. Executive summary

Background

Osteoarthritis (OA) is a long-term disorder of synovial joints which occurs when damage triggers a repair processes. This leads to structural changes within a joint, with features of localised loss of cartilage, remodelling of adjacent bone and the formation of osteophytes, and mild synovitis (inflammation of the synovial membrane that lines the joint capsule). The target population for this assessment are people aged 16 and over with hip and/or knee OA who are eligible for digital technology management. This early value assessment (EVA) summarises the clinical and economic evidence for digital technologies, while also outlining the current evidence gaps for these technologies.

Quality and relevance of the clinical evidence

The EAG identified evidence for nine of the 11 scoped interventions from three randomised controlled trials (RCTs), three single arm trials, one single arm observational study, an audit (unpublished), a service evaluation, and some company data, of which three were unpublished. Overall, the evidence base suggests that digital technologies used alongside or instead of usual care may result in greater improvement of pain and physical function than usual care alone in people with hip and/or knee OA. Evidence on the other scoped outcomes was limited. The external assessment group (EAG) had concerns regarding the generalisability of the identified evidence to the NHS setting, the heterogeneity of outcome measures, and lack of clear reporting of the content of standard care.

Quality and relevance of the economic evidence

The economic analysis conducted by the EAG was a cost-utility model designed to capture the potential benefit that could be provided from the digital technologies over a 1-year time horizon. The analysis found that the incorporation of digital technologies to support the management of OA of hip/knee into the NHS has the potential to be cost saving and improve quality

of life (QoL). However, the results are based on naïve and limited data with a high level of uncertainty, particularly due to the heterogeneity of the digital technologies and the placement of each in the care pathway. Model inputs were primarily sourced though clinical advice, company-provided detail and literature reviews.

Evidence gap analysis

Future evidence generation should focus on addressing the key components of the value proposition of digital technologies for managing hip and/or knee OA. This includes:

- More RCTs, which compare interventions with usual care, as would be applied in UK clinical practice.
- Use of common and applicable outcome measures in the evidence base to facilitate comparison of the different technologies to the current care pathway. These should include those outcomes for which evidence was most lacking, especially clinical.
- The differences in healthcare resource use from using digital technologies alongside standard care.

Greater reporting of the placement of the technology in the care pathway, and the healthcare resource use will all expand the evidence base. RCTs are the gold standard for answering this research question. However, since digital technologies have already been implemented by the NHS to support management of OA hip/knee, comparative data could be obtained through prospective collection of relevant outcomes in controlled cohort studies or non-RCTs.

The EAG recommends that future evaluations should not look to treat all digital technologies as homogenous healthcare technologies given their heterogenous nature in terms of the digital platform itself and interaction with healthcare professionals. Any future economic modelling should be designed

to be flexible enough to be adapted to all digital technologies, ideally using a cohort state transition model.

2. Decision problem

The decision problem is described in the scope. The EAG made no further changes or comments.

Table 2-1: Decision problem

Populations	Adults aged 16 and over with mild-to-moderate hip or knee OA that have been assessed as suitable for digital self-management
Interventions (proposed technologies)	Digital technologies for managing mild-to-moderate hip or knee OA, including: • ESCAPE-Pain • getUBetter • Good Boost • Hinge Health • Joint Academy • Pathway Through Arthritis • Phio Engage • Physio Wizard • re.flex • Thrive • TrackActiveMe
Comparators	Non-pharmacological standard care for people aged 16 and over with mild-to-moderate hip or knee OA. Standard care varies across primary and community care, but should include therapeutic exercise, weight management (if appropriate) and information and support, delivered alongside pharmacological interventions. Manual therapy and devices (such as walking aids) may also be offered alongside therapeutic exercise, where appropriate.
Healthcare setting	Primary and community care
Outcomes	The outcome measures to consider include: **Primary outcomes** Patient reported outcomes • HRQoL • Pain and stiffness • Physical function • Self-efficacy

	Clinical outcomes
	• Referrals for injections
	• Medicine use and appointments
	
	Secondary outcomes
	
	Patient reported outcomes
	• Psychological outcomes
	• User satisfaction and acceptability
	• Activity impairment
	Intermediate outcomes
	• Intervention adherence, rates of attrition and completion (including but not limited to the number of exercise/therapy sessions completed, interaction with health professionals, education contents reviewed)
	• Intervention related adverse events
	• Work productivity/return to full activity
	• Healthcare professional satisfaction
	Clinical outcomes
	• Secondary care referrals
	• Referrals for surgery
	
	Costs will be considered from an NHS and PSS perspective. Costs and resource use outcomes for consideration should include:
	• Costs of the technologies (including license fees and maintenance)
	• Cost related to supporting digital technologies (including but not limited to additional hardware or software, cost of staffing and training)
	• Cost of resource use
	  ○ Primary, community and secondary care appointments
	  ○ Medicine use, manual therapy and device use
	  ○ Healthcare professional grade and time

Time horizon	The time horizon for estimating the clinical and economic value should be sufficiently long to reflect any differences in costs or outcomes between the technologies being compared.
HRQoL = health-related quality of life; NHS = National Health Service; OA = osteoarthritis; PSS = Personal Social Services	

3. Technologies

Included in this EVA are digital technologies for managing mild-to-moderate hip and/or knee OA. They are designed to help people manage their condition remotely in the community, at a time that is convenient to their lifestyle. They can be accessed online or via a mobile app through a smart phone or tablet. They provide access to specialist information and advice related to managing OA, as well as exercise programmes through videos or group sessions. Technologies have varying levels of support from healthcare professionals that can be contacted through online messenger, chat functions or video calls. They should also have ongoing risk monitoring to make sure users are signposted to the appropriate support in response to their progress when using the technologies.

These technologies can offer an alternative option to in-person appointments or can be used to in addition to a reduced number of in-person appointments. Using these technologies could reduce the number of General Practitioner (GP) or first contact practitioner (FCP) visits, as well as the need for onward referral to musculoskeletal (MSK) providers. But some people may need support in accessing and using digital technologies and some people may prefer not to use digital technologies.

In total, there are 11 digital technologies (see Table 3.1 for their key features), see the scope for further details.

It should be noted that interventions which provide two-way communication involve the most healthcare professional involvement. This is often in the form of a physiotherapist employed by the company. These interventions include:

- Joint Academy UK for Joint Academy
- EQL for Phio Engage (also an NHS physiotherapy option)
- Sword for Thrive

Table 3-1: Included technologies: key features

Intervention	Mobile	Web	Exercise rehab	Education	Self-referral	Healthcare professional involvement	Interaction with the device	Place in the care pathway
ESCAPE-Pain	Yes	Yes	Yes	Yes	Unclear (no information)	Unclear (no request for information received from company)	No information provided.	No information provided.
getUBetter	Yes	Yes	Yes	Yes	Yes (also healthcare professional)	No direct communication. Option to send user reports to NHS professional if requested.	Exercises tailored to joint, duration of condition and symptoms. Also an educational component.	Available across entire care pathway and all services, including primary care, secondary care, and pharmacy.
Good Boost (through We Are Undefeatable app)	Yes	No	Yes	Yes	Yes (also healthcare professional)	One-way - option for professionals to review/engage with user profiles, including selecting exercise programmes manually and sending messages.	Exercises tailored via AI (expert clinical algorithm). Includes use for in swimming pool and as part of a class (community or virtual).	As a complement to a treatment plan or as a discharge plan into self-management in the community.
Hinge Health Programme	Yes	Unclear	Yes	Yes	[redacted]	[redacted]	Exercises tailored based on movement evaluation. [redacted]	Home setting.

						[redacted]	[redacted]	
Joint Academy UK	Yes	Yes	Yes	Yes	Yes	Two-way – The patient books an initial assessment call (via video or phone, depending on their preference) with a Joint Academy physiotherapist to evaluate suitability for digital treatment. Appointment times are selected through a digital calendar. Weekly check-ins are conducted via chat, with a follow-up video consultation at six weeks and a final discharge call. Additional calls or chats are available if needed.	Exercises tailored by personal physiotherapist.	In primary care as an alternative to face-to-face physiotherapy, group classes, and telephone-based physiotherapy.
Pathway through Arthritis	Yes	Yes	Yes	Yes	No	One-way - patients can request contact with healthcare	Delivered through pre-recorded video sessions led by a multidisciplinary	For patients who have experienced osteoarthritis for six months or more and

						professional (company) via email, phone request through the support helpline, or directly through the program interface.	expert team. The program combines physical and psychological therapies, including educational content, guided exercises, mindfulness techniques, cognitive strategies for pain management, behavioural change approaches, and lifestyle advice on weight management.	where a digital pain and self-management approach is considered appropriate by community/primary care health care professional.
PhioPhio Engage	Yes	No	Yes	Yes	Yes (also healthcare professional)	Two-way - chat function available during office hours with professional (either internal specialist (EQL clinical services) or trained clinician from an external health provider organisation e.g. NHS clinical team, depending on configuration).	Exercises tailored by a physiotherapist.	No additional information.

Physio Wizard	Yes	Unclear	Yes	Yes	Unclear (no information)	Unclear (no request for information received from company)	No information provided.	No information provided.
re.flex	Yes	No	Yes	Yes	No	No direct communication.	Exercises tailored via real-time 3D tracking, using AI.	No additional information.
Thrive	Yes	Unclear	Yes	Yes	Yes (also healthcare professional)	Two-way - messaging or video calls enabled. Sword physiotherapist performs initial assessment and regular check-ins with users.	Exercises tailored by initial physiotherapy assessment, followed by real-time feedback using Thrive Pad (with computer vision technology). Also access to educational resources.	In primary or secondary care.
TrackActive Me	Yes	Yes	Yes	Yes	Yes	One-way - patient to professional communication, patients can manually request contact with a healthcare professional via email through the program interface or be automatically directed for health professional input if	Exercises tailored by feedback from the user in preceding session. Also access to educational resources.	If health care professional considers patient suitable for self-managed treatment/exercises.

						triggering flags that deem the person unsuitable for self-management.		

Sources: Company info requests,[1-9] and from stakeholder consultation.[10]

NHS = National Health Service

4. Clinical context

Joint pain can negatively impact a person's quality of life (QoL), affecting their ability to work, socialise and carry out daily tasks. OA is the most prevalent condition causing joint pain, with an estimated 350,000 people diagnosed each year in the UK. Treatment of OA depends on the severity of symptoms.[11] Face-to-face self-management programmes for mild-to-moderate OA typically include information and advice, exercise plans, coping strategies, sleep management, anxiety management and strategies to increase energy. They aim to improve QoL and control disease progression. OA and joint pain affect around 10 million people in the UK and is one of the UK's main causes of disability.[11] In 2018, the management of musculoskeletal conditions cost the NHS and healthcare system over £10 billion, which is estimated to reach £118.6 billion over the following decade.[12] Digital technologies for self-management of OA may be able to increase access to MSK services, reduce treatment waiting times and reduce the burden on wider healthcare services.

5. Clinical evidence methods

5.1 Search strategies and study selection

The searches were conducted as specified in the protocol and shown in Appendix A with the strategies.

5.2 Study selection

Study selection was conducted as specified in the protocol.

As specified in the protocol, any design of study from the following was included, but prioritised by reduced risk of bias:

- RCTs
- Prospective controlled studies
- Retrospective controlled studies
- Single arm studies

This means that all but extremely poor RCTs were included, but evidence of a lower quality was only included for data extraction where there were no RCTs, with the aim of including at least one study per intervention. In addition, a table of all studies, regardless of study design, by outcome was produced for the Evidence Gap Analysis. Reasons for exclusion of studies at the stage of full paper screening are presented in Appendix B.

5.3 Data extraction strategy

Data were extracted in accordance with the protocol.

5.4 Quality assessment strategy

All RCTs had a formal risk of bias assessment using the Cochrane Risk of Bias tool, version 2.[13] Although there was no formal quality assessment of non-RCTs, a brief discussion is included in the EAG report on potential biases in key studies (published or unpublished) and how the risk of bias could affect key outcomes.

5.5 Methods of synthesis and analysis

A narrative approach was taken, given that there was no more than one RCT per technology.

6. Clinical evidence review

6.1 Evidence search strategy and study selection

The EAG searches retrieved a total of 5,269 records, and after elimination of duplicates, left 3,261 records to screen. All records were screened by one reviewer and a proportion of records were independently screened by a second reviewer, as detailed below. Titles and abstracts were sifted by one reviewer (the first 10% assessed by two reviewers independently). A total of 28 full text papers were retrieved and examined by one reviewer (first 10% assessed by two reviewers) to select those meeting the inclusion criteria. From these, eight records referring to six studies were included. Fifteen reviews were also reference checked, this included a mixture of systematic reviews, narrative reviews, and umbrella reviews.[14-28] From these reviews, a further nine records of eight studies were included. From the evidence requests, five further studies were included, which brought the total to 19 studies reported in 22 papers.

6.2 Included and excluded studies

A total of 19 studies (reported in 22 papers) of nine interventions were identified in the clinical review. Of these studies, 10 were prioritised for further data extraction and are summarised in Table 6-2. Nine studies were deprioritised and are summarised in Appendix C. Studies were deprioritised if there was also an RCT available for that technology, or if the study reported on a broader population (e.g. musculoskeletal pain) and studies reporting on hip or knee OA were also available. These studies are still included in the gap analysis. Note that, in order to include at least one study per intervention, studies were included even if they did not fulfil all of the inclusion criteria for population. This meant that only two studies were included in patients with mild or moderate hip and/or knee OA.

Table 6-1 provides a comprehensive overview of key studies evaluating digital interventions for OA management. It includes details such as interventions, comparators, study designs, countries, sample sizes, OA severity, affected

joints, follow-up durations, and outcome measures. Note that there is only evidence for nine interventions, getUBetter, re.flex, Joint Academy, Hinge Health, ESCAPE-Pain, Good Boost, Phio Engage, Thrive and TrackActiveMe, and only three RCTs, which are re.flex, Joint Academy and Hinge Health.[29-31] The rest are single-arm trials, and observational studies. The studies involve different follow-up durations, of 6 weeks,[30, 32] 12 weeks,[29, 31, 33-36] 26 weeks,[37] and two studies where the follow-up duration was not reported.[38, 39] Note that only two studies, both single arm studies of Phio Engage, are in the correct population i.e. mild or moderate hip and/or knee OA .[34, 35] The populations in the other studies include more severe OA, or pain of unknown aetiology, or joints other than hip or knee.

The outcomes cover intervention adherence, health-related quality of life (HRQoL), pain and stiffness, physical function, psychological effects, user satisfaction, and intervention-related adverse events (AEs). However, pain was the only outcome measure by all 10 studies, and there is only one study reporting work productivity. No studies reported self-efficacy, or clinical outcomes.

It is important to note that two of the RCTs compared the intervention to usual care,[29, 30] but one compared the intervention (Hinge Health) plus treatment as usual (TAU) with TAU.[31] Also, the interventions were often quite complex, as shown in Appendix D, which reports the details each intervention, emphasising their multifaceted nature, in terms of:

- Technology Integration: Use of apps, wearable sensors (e.g., re.flex, Hinge Health), and AI-driven personalised programs (e.g., Good Boost).
- Exercise Components: Progressive training regimens targeting muscle strengthening, joint mobilization, balance, and core stability, with adaptations based on user feedback (e.g., Joint Academy).
- Educational and Behavioural Elements: Incorporation of educational sessions, quizzes, cognitive behavioural therapy (CBT), and self-management strategies (e.g., ESCAPE-Pain, Hinge Health, Joint Academy).

- Support Systems: Remote coaching, peer support teams, and facilitator-led sessions (e.g., Hinge Health, Good Boost).
- Adherence Mechanisms: Reminders via notifications, emails, and progress tracking (e.g., re.flex, Joint Academy).
- Personalisation: Tailored exercise programs based on user input, pain levels, and functional limitations (e.g., Good Boost, Joint Academy, Phio Engage).
- Healthcare professional involvement: many studies reported substantial professional involvement, including all three RCTs for re.flex, Joint Academy and Hinge Health.

Table 6-1: Description of key studies in the evidence base

Study name	Intervention; Mean age; %Male	Comparator; Mean age; %Male	Study ID	Design	Country	Sample size	OA/ severity	Joint	Follow-up (weeks)	Intervention adherence	HRQoL	Pain and stiffness	Physical function	Psychological outcomes	User satisfaction	Intervention related AEs
DRKS00030932	re.flex; 61.6; 29	Usual care; 62.1; 35	Dieter (2025)[29] Also reported in: Dieter (2024)[40] and Krauss (2024)[41]	RCT	Germany	194	Moderate + severe OA	One knee	12	Yes	Yes	Yes	Yes	Yes	Yes	Yes
iBEAT-OA	Joint Academy; 65.2; 29.2	Usual care; 68; 35.1	Gohir (2021)[30] Also reported in: Gohir (2020)[42]	RCT	UK	146	OA, NR severity	Both knees	6	Yes	Yes	Yes	Yes	No	No	No
ISRCTN 13307390	Hinge Health + TAU; 46; 57	TAU; 47; 74	Mecklenburg (2018)[31]	RCT	USA	162	77% OA, NR severity	Both knees	12	Yes	No	Yes	Yes	No	No	No
NR	ESCAPE-Pain; 63; NR	NA	Hurley (2016)[32]	Single arm trial	UK	136	OA, NR severity	Hip+ knee	6	Yes	Yes	Yes	Yes	No	Yes	No
NR	getUBetter	NA	Walker n.d.[38]	Single arm service	UK	160	OA/ severity NR	Knee (28%),	NR	No	No	Yes	Yes	No	Yes	No

Study name	Intervention; Mean age; %Male	Comparator; Mean age; %Male	Study ID	Design	Country	Sample size	OA/ severity	Joint	Follow-up (weeks)	Intervention adherence	HRQoL	Pain and stiffness	Physical function	Psychological outcomes	User satisfaction	Intervention related AEs
				evaluation (unpublished)				other (72%)								
NR	Good Boost; 58.7; 21	NA	Waller (2024)[33]	Audit (unpublished)	UK	4429	29% OA, NR severity	Hip (14%), knee (33%), other 53%)	12	No	No	Yes	Yes	No	Yes	No
NR	Phio Engage; 54.63; 35	N/A	Thacker (2025)[34]	Single arm observational	UK	120	Mild + moderate OA	Hip+ knee	12	No	No	Yes	Yes	No	No	No
NR	Phio Engage; 59.5; 31.31	NA	Thacker (2025)[35]	Single arm observational	UK	272	Mild + moderate OA	Hip+ knee	12	No	Yes	Yes	Yes	No	No	No
NR	Thrive	NA	Janela (2022)[36]	Single arm observational	USA	534	19.9% OA, NR severity	Hip	12	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NR	TrackActiveMe	NA	NICE (2025)[39] *	Company data	NR	25	OA, NR severity	Hip + knee	NR	No	No	Yes	No	No	No	No

* Data received from NICE company information request

AE = adverse event; HRQoL = health related quality of life; NA = Not applicable; NR = Not reported; OA = osteoarthritis; RCT = randomised control trial; TAU = treatment as usual; UK = United Kingdom; USA = United States of America

6.3 Quality appraisal of studies

As specified in the protocol, a formal risk of bias assessment was carried out for the three RCTs. Appendix E presents the risk of bias assessments for three included RCTs across five key domains. Gohir (2021)[30] was judged to have low risk of bias in randomisation, intervention deviations, and outcome measurement, but demonstrated some concerns due to missing outcome data and selective reporting, leading to an overall bias rating of “some concerns”. Similarly, Mecklenburg (2018)[31] had a low risk of bias in the randomisation process but was rated as having “some concerns” in all other domains, resulting in an overall judgement of “some concerns”. Dieter (2025)[29] exhibited the most favourable assessment, with low risk of bias in randomisation, intervention adherence, missing data, and selective reporting, but had “some concerns” regarding the measurement of outcomes, leading to an overall “some concerns” classification. No study was rated as having a high risk of bias in any domain, indicating generally acceptable methodological quality, though limitations related to incomplete data and outcome reporting remain noteworthy.

As referred to in Section 6.2, there are also questions about the applicability of the results of the RCTs to clinical practice given the complexity of the intervention. Most notably, Joint Academy was accompanied by physiotherapy communication and Hinge Health by a personal coach (see Appendix D). However, although the company specifies two-way communication with a physiotherapist for Joint Academy, the company information request for Hinge Health states that there is no direct communication with a healthcare professional (see Table 3-1). Also, applicability will be affected by the nature of usual care, which varied between the three trials (see Appendix D). This variation might be mitigated if the intervention was added to usual care, assuming additive independence. However, two of the RCTs, of re.flex and Joint Academy, compared the intervention to some form of usual care i.e. they were not added to usual care.[29, 30]

All of the other studies are considered to be of much lower quality given the lack of comparator. Although all studies reported either change from baseline

or both baseline and follow-up outcome values, by which it might be inferred that the intervention made a difference relative to a comparator pre-intervention, this is no substitute for comparison to a control group. Therefore, although these single arm studies can be differentiated to some degree in terms of quality, even the one with the highest quality is of little value in inferring the value of the intervention in comparison with usual care. Bearing this in mind, one might nevertheless consider that a study conducted in the UK that is large and includes only patients with mild to moderate OA followed up for a long time would be preferred. Five studies were conducted in the UK, only two of which were in mild to moderate OA of the hip and knee, both of Phio Engage.[34, 35] They were of moderate size (n=120 and 272) and followed up patients for 12 weeks. Only one other study in the UK, of Good Boost, followed up patients for as long as this and it was much larger (n=4,429), but the OA severity was unknown and over 50% of patients had OA of other joints.[33]

6.4 Results from the evidence base

All outcome data are presented in Table 6-2 to Table 6-8.

Patient reported outcomes – primary (Table 6-2 to 6-4)

Health-related quality of life

HRQoL outcomes are detailed in Table 6-2.

re.flex

In the DRKS00030932 RCT by Dieter (2025)[29], participants using re.flex experienced greater improvements than those receiving usual care across several metrics. Knee Injury and Osteoarthritis Outcome Score (KOOS-QoL) improved by 4.1 (mean difference of 2.4; 95% CI: -1.6 to 6.5), Veterans RAND VR-12 Physical Component Score (PCS) increased by 1.7 with a statistically significant difference (2.4; 95% CI: 0.3 to 4.5), while changes in VR-12 Mental Component Score (MCS) and Patients Global Assessment (PGA) scores were negligible.

Joint Academy

In the iBEAT-OA RCT by Gohir (2021),[30] both arms showed small improvements in the Musculoskeletal Health Questionnaire (MSK-HQ), with a non-significant MD of -0.3; 95% CI: -3.3,2.6.

ESCAPE-Pain

The single arm study by Hurley (2016)[32] showed an increase in KOOS-QoL from a mean (standard deviation [SD]) of 31 (23) at baseline to 39 (21) at 6 weeks follow-up.

Phio Engage

The single arm study by Thacker (2025)[34] showed an increase in 'musculoskeletal health', as measured by the Musculoskeletal Health Questionnaire (MSK-HQ), from a mean (SD) of 31.46 (NR) at baseline to 38.2 (NR) at 12 weeks follow-up, resulting in a mean (SD) change from baseline of 6.84 (8.91).

Thrive

The single arm study by Janela (2022)[36] showed a mean increase in the Hip Injury and Osteoarthritis Score quality of life (HOOS-QoL) of 14.08 at 12 weeks.

Table 6-2: Health-related quality of life

Trial	Study ID	Outcome name	Arm	N	Follow-up (weeks)	Baseline mean (SD)	Follow-up mean (SD)	Mean change from baseline (SD)	Mean difference (95% CI)
RCTs									
DRKS00030932	Dieter (2025)[29]	KOOS-QoL	Re.flex	98	2	NR	NR	4.1 (15.6)	2.4 (-1.6,6.5)
			Usual care	96				1.6 (13.5)	
		PGA of knee OA	Re.flex	98				-0.1 (0.8)	-0.1 (-0.3,0.1)
			Usual care	96				-0.1 (0.7)	
		VR-12 PCS HRQoL	Re.flex	98				1.7 (8.6)	2.4 (0.3,4.5)
			Usual care	96				-0.4 (6.6)	
		VR-12 MCS HRQoL	Re.flex	98				-0.6 (10.2)	-0.1 (-2.6,2.5)
			Usual care	96				-0.3 (7.8)	
iBEAT-OA	Gohir (2021)[30]	MSK-HQ	Joint Academy	48	6	30.7 (9.9)		1.2 (NR)	-0.3 (-3.3,2.6)
			Usual care	57		28.4 (10.1)		1.6 (NR)	
Single arm studies									
NR	Hurley (2016)[32]	KOOS-QoL	ESCAPE-Pain	117	6	31 (23)	39 (21)	NR	NA
	Thacker (2025)[34]	MSK-HQ	Phio Engage	121	12	31.46 (NR)	38.2 (NR)	6.84 (8.91)	
NR	Janela (2022)[36]	KOOS-QoL	Thrive	515	12	52.44 (NR)	66.52 (NR)	14.08 (NR)	NA

CI = confidence interval; HRQoL = health-related quality of life; KOOS = Knee Injury and Osteoarthritis Outcome Score; MCS = Mental Component Score; MSK-HQ = Musculoskeletal Health Questionnaire; NA = not applicable; NR = not reported; OA = osteoarthritis; PCS = Physical Component Score; PGA = Patients Global Assessment; QoL = quality of life; RCT = randomised control trial; SD = standard deviation

Pain and stiffness

Table 6-3 highlights outcomes related to pain and stiffness.

re.flex

In the DRKS00030932 RCT by Dieter (2025),[29] re.flex yielded a greater reduction in KOOS pain than usual care, with a significant MD of 4.8 (95% CI: 0.7 to 8.9). Note that a higher score is better.

Joint Academy

In the iBEAT-OA RCT by Gohir (2021)[30] Joint Academy participants showed a statistically significant reduction versus usual care in the Western Ontario and McMaster Universities Arthritis Index (WOMAC) pain (mean -1.39; 95% CI: -2.2,-0.55) and stiffness (mean -1; 95% CI: -1.5, -0.5). Changes in conditional and pressure pain modulation measures were variable and sometimes inconsistent. For example, the superolateral patella pain threshold improved more in the intervention arm (MD of 25.1), but CIs were wide (95% CI: -19.9, 70.1).

Hinge Health

In the ISRCTN13307390 RCT by Mecklenburg (2018)[31], Hinge Health + TAU participants experienced statistically significant reductions in KOOS pain (0-100) (mean -7.7: 95% CI:-12.3,-3), visual analogue scale (VAS) (0-100) pain (mean -12.3; 95% CI: -19.1,-5.4)), and VAS (0-100) stiffness (mean -13.4; 95% CI: -21.1,-5.6), versus TAU.

ESCAPE-Pain

The single arm study by Hurley (2016)[32] showed an increase in KOOS pain from a mean (SD) of 46 (20) to 54 (18) at baseline and follow-up respectively. Note that a higher score is better.

getUBetter

The service evaluation (unpublished) by Walker n.d.[38] showed that about 62% of patients experienced some reduction in pain, but it was only regarded as ‘a great deal’ in 13.8%, and the follow-up period was not reported.

Good Boost

In a single arm study by Wilson (2024),[37] the Good Boost programme reduced VAS (0-100) pain by mean (SD) of 7.54 (26.7) over 26 weeks. Waller (2024)[33] also showed a [redacted] of patients at 6 and 12 weeks respectively.

Phio Engage

The single arm study by Thacker (2025)[35] reported a mean (SD) change in numerical rating scale (NRS) 0-100 of -9.7 (1.66) over 12 weeks.

Thrive

The single arm study by Janela (2022)[36] showed an increase in HOOS pain from a mean increase of 13.32 from baseline to 12 weeks follow-up. Note that a higher score is better. Pain, measured using an NRS, also decreased by 2.22.

TrackActiveMe

Active Health Tech Ltd reported data taken from the TrackActiveMe device,[39] which showed a reduction in VAS pain of -2.45 and -1 in hip and knee OA users respectively. The baseline value is stated to be the “user’s first symptom rating”, and the users were described as having completed at least one program.

Table 6-3: Pain and stiffness

Trial	Study ID	Outcome name	Arm	N	Follow-up (weeks)	Baseline mean (SD)	Follow-up mean (SD)	Mean change from baseline (SD) /%	Mean difference (95% CI)
RCTs									
DRKS00030932	Dieter (2025)[29]	KOOS pain	re.flex	98	13	NR	NR	-9.7 (15.9)	4.8 (0.7,8.9)
			usual care	96				-4.5 (14)	
iBEAT-OA	Gohir (2020)[42]	VAS pain	Joint Academy	57	6			NR	-1.39 (-2.2,-0.55)
			usual care	48					
	Gohir (2021)[30]	WOMAC - NRS pain	Joint Academy	48		8 (3.9)		-2.2 (NR)	-1.1 (-2,-0.2)
			usual care	57		7.8 (3.7)		-1.2 (NR)	
		Conditional pain modulation	Joint Academy	48		53.4 (97.6)		-23.8 (NR)	-18.9 (-55,17.2)
			usual care	57		52.8 (110.7)		-4.9 (NR)	
		Pressure pain threshold - Medial joint line	Joint Academy	48		318.7 (159)		-18.9 (NR)	30.2 (-17.8,78)
			usual care	57		355.1 (202.5)		-49.1 (NR)	
		Pressure pain threshold - Superolateral patella	Joint Academy	48		314.4 (153.7)		-30.5 (NR)	25.1 (-19.9,70.1)
			usual care	57		317.3 (170.2)		-55.6 (NR)	
			Joint Academy	48		326 (149.9)		-22.3 (NR)	21.8 (-20.2,63.9)

Trial	Study ID	Outcome name	Arm	N	Follow-up (weeks)	Baseline mean (SD)	Follow-up mean (SD)	Mean change from baseline (SD) /%	Mean difference (95% CI)
		Pressure pain threshold - Superomedial patella	usual care	57		334.1 (147.7)		-44 (NR)	
		Pressure pain threshold - Tibialis anterior muscle	Joint Academy	48		386.4 (175.8)		-11.4 (NR)	43.2 (-3.6,89.9)
			usual care	57		367 (182.4)		-54.6 (NR)	
		WOMAC - stiffness	Joint Academy	48		4 (1.7)		-0.8 (NR)	-1 (-1.5, -0.5)
			usual care	57		3.1 (1.6)		0.2 (NR)	
ISRCTN 13307390	Mecklenburg (2018)[31]	KOOS pain	Hinge Health + TAU	101	12	41 (14.1)	30.3 (17.1)	NR	-7.7 (-12.3,-3)
			TAU	54		41.4 (16.5)	38.4 (17.2)		
		VAS pain	Hinge Health + TAU	101		45.2 (21.4)	26.6 (22)		-12.3 (-19.1,-5.4)
			TAU	54		44.7 (20.3)	38.3 (22.2)		
		VAS stiffness	Hinge Health + TAU	101		42.6 (23.4)	25.1 (22.3)		-13.4 (-21.1,-5.6)
			TAU	54		47.4 (21.9)	43.2 (21.6)		
Single arm studies									
NR	Hurley (2016)[32]	KOOS pain	ESCAPE-Pain	117	6	46 (20)	54 (18)	NR	NA

Trial	Study ID	Outcome name	Arm	N	Follow-up (weeks)	Baseline mean (SD)	Follow-up mean (SD)	Mean change from baseline (SD) /%	Mean difference (95% CI)
	Walker n.d.[38]	Pain improvement – a great deal	getUBetter	159	NR	NA	NA	13.8%	
		Pain improvement – somewhat						16.4%	
		Pain improvement – a little						31.4%	
		Pain improvement – not at all						38.4%	
	Thacker (2025)[35]	NRS pain	Phio Engage	272	12	NR	NR	-9.7 (1.66)	
	Waller (2024)[33]	15% (MCID) change in pain	Good Boost	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
								[redacted]	
	Wilson (2024)[37]	VAS pain		26	26		41.7 (26.1)	-7.54 (26.7)	
	Janela (2022)[36]	HOOS pain	Thrive	515	12	65.59	78.91	13.32 (NR)	
		NRS pain		534		4.82	2.6	2.22 (NR)	
	Active Health Tech Ltd[39]	VAS pain	TrackActiveMe in hip OA	9	NR	5.78	3.33	-2.45	
			TrackActiveMe in knee OA	16		4.13	3.13	-1	

CI = confidence interval; HOOS = Hip Injury and Osteoarthritis Outcome Score; KOOS = Knee Injury and Osteoarthritis Outcome Score; MCID = minimally clinically important difference; NA = not applicable; NR = not reported; NRS = numerical rating scale; RCT = randomised controlled trial; SD = standard deviation; TAU = treatment as usual; VAS = visual analogue score; WOMAC = Western Ontario and McMaster Universities Arthritis Index

Physical function

Table 6-4 presents the functional outcomes from various clinical trials evaluating digital and in-person interventions for knee OA.

re.flex

In the DRKS00030932 RCT by Dieter (2025)[29] participants using re.flex showed small improvements in the 30-second sit-to-stand test (mean change from baseline 1.7 ± 1.9) compared to usual care (1.4 ± 1.9), with a modest MD of 0.3 (95% CI: -0.3 to 0.9). Similarly, improvements were observed in the KOOS Sport/Rec, KOOS Symptoms, and KOOS-activities of daily living (ADL) subscales favouring re.flex, with a statistically significant difference seen in ADL (MD 3.9; 95% CI: 0 to 7.9).

Joint Academy

In the iBEAT-OA RCT by Gohir (2021)[30], participants in the Joint Academy digital program exhibited significantly greater functional improvements than usual care in sit-to-stand repetitions (MD of 3.4; 95% CI: 2.2,4.5). The improvements were statistically significant for timed up and go test (MD of -1.8: -3,-0.5), and WOMAC physical function scores (MD of -3.4; 95% CI: -6.2,-0.7).

Hinge Health

The ISRCTN13307390 RCT by Mecklenburg (2018)[31] RCT found a statistically significant improvement in KOOS physical function for Hinge Health + TAU users versus TAU (MD of -7.2; 95% CI: -11.5,-3).

ESCAPE-Pain

The single arm study, Hurley (2016)[32] showed an increase in the activities of daily living domain of KOOS (KOOS-ADL) from a mean (SD) of 48 (22) to 56 (20) at baseline and follow-up respectively.

Good Boost

The single arm study Waller (2024),[33] reported within-group improvements in the outcome patient specific complaint (PSC) of a mean (95% CI) of

[redacted] at 6- and 12-weeks follow-up respectively. In a single arm study by Wilson (2024),[37] participants reported a decrease in PSC with a substantial mean change of -15.6 (SD of 24.5), based on a follow-up at 26 weeks. However, due to the single-arm design, comparative effectiveness remains unestablished.

getUBetter

The unpublished service evaluation by Walker n.d.[38] showed that about 59% of patients experienced some reduction in pain, but it was only regarded as 'a great deal' in 10.7%, and the follow-up period was not reported.

Phio Engage

The single arm study by Thacker (2025),[35] reported a mean (SD) change in Primary PAFM (patient actuated functional measures) and Secondary PAFM of 7.76 (2.39) and 7.11 (2.39) respectively over 12 weeks. PAFM included nine different activities, including walking, domestic chores, work related and caring related.

Thrive

The single arm study by Janela (2022),[36] showed a mean increase in HOOS function and HOOS sport of 11.01 and 13.55 respectively from baseline to 12 weeks follow-up.

Table 6-4: Physical outcomes

Trial	Study ID	Outcome name	Arm	N	Follow-up (weeks)	Baseline (SD)	Follow-up mean (SD)	Mean change from baseline (SD) /%	Mean difference (95% CI)
RCTs									
DRKS00030932	Dieter (2025)[29]	30 s sit-to-stand test	re.flex	98	13	NR	NR	1.7 (1.9)	0.3 (-0.3,0.9)
			usual care	96				1.4 (1.9)	
		KOOS Sport/Recreation	re.flex	98				9.5 (18.7)	4.5 (-0.8,9.7)
			usual care	96				5.2 (16.9)	
		KOOS Symptoms	re.flex	98				9.6 (17.9)	4.1 (-0.2,8.5)
			usual care	96				5 (14.4)	
		ADL	re.flex	98				9 (16.2)	3.9 (0,7.9)
			usual care	96				4.7 (11.5)	
iBEAT-OA	Gohir (2021)[30]	30 s sit-to-stand test	Joint Academy	48	6	9.3 (2.7)		4.5 (NR)	3.4 (2.2,4.5)
			usual care	57		9.2 (4.3)		1.2 (NR)	
		Timed up and go test	Joint Academy	48		8 (3.9)		-1.4 (NR)	-1.8 (-3,-0.5)
			usual care	57		9.9 (3.6)		0.4 (NR)	
		WOMAC - physical function	Joint Academy	48		26.8 (12.9)		-7.8 (NR)	-3.4 (-6.2,-0.7)
			usual care	57		28.3 (12.8)		-4.3 (NR)	

ISRCTN 13307390	Mecklenburg (2018)[31]	KOOS physical function	Hinge Health + TAU	101	12	53.8 (12.3)	44.6 (16.7)	NR	-7.2 (-11.5,-3)
			TAU	54		54.5 (15.7)	52.5 (16.2)		
Single arm studies									
NR	Hurley (2016)[32]	KOOS-ADL	ESCAPE-Pain	117	6	48 (22)	56 (20)		NA
	Walker n.d.[38]	Improvement in ability to do normal activities – a great deal	getUBetter	159	NR	NA	NA	10.7%	
		Improvement in ability to do normal activities – somewhat						27.7%	
		Improvement in ability to do normal activities – a little						20.7%	
		Improvement in ability to do normal activities – not at all						40.9%	
	Thacker (2025)[35]	Primary PAFM	Phio Engage	272	12	NR	NR	7.76 (2.39)	
		Secondary PAFM						7.11 (2.39)	
	Waller (2024)[33]	Patient specific complaint	Good Boost	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	
					[redacted]		[redacted]	[redacted]	
	Janela (2022)[36]	HOOS - function	Thrive	251	12	75.08	86.09	11.01	
		HOOS - sport				65.37	78.92	13.55	

ADL = activities of daily living; CI = confidence interval; HOOS = Hip Injury and Osteoarthritis Score; KOOS = Knee Injury and Osteoarthritis Outcome Score; NA = not applicable; NR = not reported; PAFM = patient actuated functional measures; RCT = randomised controlled trial; SD = standard deviation; TAU = treatment as usual; WOMAC = Western Ontario and McMaster Universities Arthritis Index

Self-efficacy

No studies reported this outcome.

Patient reported outcomes – secondary

Treatment satisfaction

Treatment satisfaction outcomes were reported for only two studies, which are reported in Table 6-5.

re.flex

In the DRKS00030932 RCT, as reported in Krauss (2024)[41], categorical outcomes were only reported for the re.flex intervention group. This showed that 63% of patients were satisfied or very satisfied, and only 10% were not satisfied or very unsatisfied.

getUBetter

The service evaluation (unpublished) by Walker n.d.[38] showed that about 75% of patients found the intervention to be at least acceptable, but it was only regarded as ‘very good’ in 16.4%, and the follow-up period was not reported.

Table 6-5: Treatment satisfaction

Trial	Study ID	Outcome name	Arm	N	Follow-up (weeks)	Follow-up mean (SD)/ %	Mean change from baseline (SD)	Mean difference (95% CI)
RCTs (data only for intervention arm)								
DRKS00030932	Krauss (2024)*[41]	very satisfied	re.flex	98	12	26%	NR	NA
		satisfied				37%		
		neither/nor satisfied				29%		
		not satisfied				8%		
		very unsatisfied				2%		
Single arm studies								
NR	Walker n.d.[38]	very good	getUBetter	159	NR	16.4%	NA	NA
		Good				33.3%		
		acceptable				23.9%		
		poor				18.2%		
		very poor				6.9%		

CI = confidence interval; NA = not applicable; NR = not reported; RCT = randomised control trial; SD = standard deviation

*Percentages as reported sum to 102% - probably due to rounding.

Psychological outcomes

Psychological outcomes were reported for two studies, which are reported in Table 6-6.

ESCAPE-Pain

The Hospital Anxiety and Depression Scale (HADS) results were reported in the single arm study by Hurley (2016),[32] showing a decrease from baseline at 6 weeks (from mean (SD) 8.3 (4.5) to 7.0 (4.5) after HADS-anxiety and 7.5 (4.1) to 6.2 (4.3) for HADS-depression, respectively).

Thrive

The single arm study by Janela (2022),[36] showed a decrease in anxiety and depression, as measured by the Generalised Anxiety Disorder Assessment 7-Item scale (GAD-7) and Patient Health Questionnaire-9 (PHQ-9), of 1.13 and 1.16 respectively from baseline to 12 weeks follow-up.

Table 6-6: Psychological outcomes

Trial	Study ID	Outcome name	Arm	N assessed	Follow-up (weeks)	Baseline mean	Follow-up mean (SD)	Mean change from baseline (SD)	Mean difference (SD)
NR	Hurley (2016)[32]	HADS-anxiety	ESCAPE-Pain	117	6	8.3 (4.5)	7 (4.5)	NR	NA
		HADS-depression				7.5 (4.1)	6.2 (4.3)		
NR	Janela (2022)[36]	GAD-7	Thrive	534	12	3.05	1.92	-1.13	NA
		PHQ-9	Thrive			2.66	1.55	-1.16	

GAD-7 = Generalised Anxiety Disorder Assessment 7-item scale; HADS = Hospital Anxiety and Depression Scale; NA = not applicable; NR = not reported; PHQ-9 = Patient Health Questionnaire-9; SD = standard deviation

Activity impairment

No studies reported this outcome separately, although domains of the physical function measures (see above) could be regarded as also measuring activity impairment.

Clinical outcomes

No studies reported these outcomes.

Intermediate outcomes

Work productivity

Thrive

Only one study reported this outcome, which was about Thrive.[36] As detailed in Table 6-7, it showed an increase in productivity, as measured by a decrease in the Work Productivity and Activity Impairment Questionnaire (WPAI) – overall, work and activity domains of 6.77, 5.86 and 11.39 respectively at 12 weeks follow-up.

Table 6-7: Work productivity

Trial	Study ID	Outcome name	Arm	N	Follow-up (weeks)	Baseline mean	Follow-up mean (SD)	Mean change from baseline (SD)	Mean difference (SD)
NR	Janela (2022)[36]	WPAI Overall	re.flex	430	12	15.82	9.05	-6.77	NA
		WPAI Work		430		14.91	9.05	-5.86	
		WPAI Activity		534		26.07	14.68	-11.39	

NA = not applicable; NR = not reported; SD = standard deviation; WPAI = Work Productivity and Activity Impairment Questionnaire

Intervention adherence

Table 6-8 presents the intervention adherence related outcomes from various clinical trials evaluating digital and in-person interventions for knee OA. Three RCTs and two single-arm studies showed variable adherence.

re.flex

In the DRKS00030932 RCT by Krauss (2024),[41] 28% of participants in the re.flex arm were lost to follow-up over 12 weeks. Among those retained, 63% adhered to prescribed exercise repetitions and 77% adhered to scheduled exercise sessions

Joint Academy

The iBEAT-OA RCT by Gohir (2021) reported similar dropout rates between the Joint Academy (21.5%) and usual care arms (22.4%) at 6 weeks.[30]

Hinge Health

In the ISRCTN13307390 RCT by Mecklenburg (2018),[31] attrition was 28.7% in the Hinge Health + TAU group and 29.5% in the TAU group over 12 weeks.

ESCAPE-Pain

In the ESCAPE-Pain program (Hurley 2016),[32] 64% of participants attended at least nine sessions.

Good Boost

A second single arm study was performed in the Good Boost study (Wilson 2024)[37] had a 30.6% attrition rate over 26 weeks, with 73.5% completing the programme. Among completers, 73.5% attended six or more exercise sessions, 11.8% attended between three to five sessions, and 14.7% attended two or fewer.

Table 6-8: Intervention adherence

Trial	Study ID	Outcome name	Arm	N	Follow-up (weeks)	% with event
DRKS00030932	Krauss (2024)[41]	Attrition	re.flex	98	12	28
		Exercise repetition adherence				63
		Exercise session adherence			13	77
iBEAT-OA	Gohir (2021)[30]	Dropouts	Joint Academy	79	6	21.5
			usual care	67		22.4
ISRCTN 13307390	Mecklenburg (2018)[31]		Hinge Health + TAU	101	12	28.7
			TAU	61		29.5
NR	Hurley (2016)[32]	Attended ≥9 sessions	ESCAPE-Pain	117	6	64
	Wilson (2024)[37]	Attrition	Good Boost	49	26	30.6
		Completion		34		73.5
		Attended ≥ 6 exercise sessions				73.5
		Attended between 3–5				11.8
		Attended ≤ 2 sessions				14.7
NR = not reported; TAU = treatment as usual						

6.5 Adverse events and clinical risk

Adverse events

Three studies (one RCT,[29] one single-arm observational study,[36] and data received from NICE company information request[39]) reported relevant information.

re.flex

The RCT, DRKS00030932, reported safety data for the intervention, which was re.flex.[29] 12.2% patients experienced an AE with 5.1%, 5.1% and 2% likelihood of being related to the intervention categorised as sure, likely and possible respectively. 7.14% and 4.1% of patients discontinued and sought medical care due to an AE respectively.

Thrive

It was reported that there were no serious AEs in the study by Janela (2022).[36]

TrackActiveMe

The company reported that:[39]

[redacted] The EAG notes that EQL stated that *"no reportable adverse incidents to date"* (p. 12) have been reported in the Clinical Safety Case Report.

6.6 Evidence synthesis

Findings across studies are discussed narratively. It was not feasible to undertake meta-analysis within the constraints of this EVA.

6.7 Clinical evidence summary and interpretation

For three of the interventions there is potentially high quality evidence in the form of an RCT, i.e. re.flex, Joint Academy and Hinge Health.[29-31] All three generally showed improvements versus usual care/TAU in all reported outcomes, although some of the differences were small and non-significant. There were statistically significant improvements in:

- HRQoL: one of four measures (VR-12) for re.flex
- Pain: both measures for re.flex (KOOS pain), both measures for Joint Academy (VAS and WOMAC), and both measures for Hinge Health (VAS and KOOS),
- Stiffness: one measure for Joint Academy (WOMAC) and Hinge Health (VAS)
- Physical function: two of three measures for Joint Academy (timed up and go test and WOMAC) and the only measure for Hinge Health (KOOS physical function)

Note that follow-up was limited to no more than 12 weeks, although all three RCTs were regarded as of generally acceptable methodological quality. However, none of the RCTs were in the population in the scope i.e. mild or moderate OA of the hip or knee: one included severe OA, and two patients with unknown severity, one of those including only 77% patients with OA, as opposed to chronic knee pain. Also, none included patients with involvement of the hip. However, one of the most important limitations is the generalisability to clinical practice, given the complexity of the interventions, which is liable to lead to variation in implementation. For example, although the RCT included a personal coach for Hinge Health, the company stated in the information request that there is no direct communication with a healthcare professional. Also, applicability will be affected by the nature of usual care, which varied between the three trials, and the Hinge Health trial was the only one to investigate the addition of the intervention to some kind of usual care, as opposed to a replacement for usual care.

For the other five interventions, ESCAPE-Pain, getUBetter, Good Boost Phio Engage, and Thrive, for which there is evidence, this was much more limited i.e. with no comparative data and only change from baseline, which was generally an improvement in all outcomes.

Finally, for the remaining two interventions, the EAG could find no evidence i.e. for Pathway Through Arthritis, or Physio Wizard.

7. Economic evidence

7.1 Existing economic evidence

Literature review

Methods

While a single set of searches was conducted to identify both clinical and economic evidence for the included technologies (see Section 4.1 and Appendix A for search methods), an additional search was conducted to identify HRQoL evidence. Titles and abstracts were sifted by one reviewer. Full texts were assessed to select those meeting the scope definition. Both the clinical/economic evidence review and the HRQoL review were sifted for economic evaluations, and studies reporting resource use and cost estimates or HRQoL estimates.

Results

Economic evaluations

The results of the clinical evidence review are shown in Section 6. None of the studies included in the clinical evidence review (based on exclusion criteria detailed in Section 5.2) reported economic evaluations on any of the included technologies.

Resource use and cost estimates

None of the studies included in the clinical evidence review (based on exclusion criteria detailed in Section 5.2) included resource use estimates.

Health-related quality of life estimates

None of the studies included in the clinical evidence review (based on exclusion criteria detailed in Section 5.2) included HRQoL estimates, as

measured by EuroQol 5 dimension (EQ-5D) (in line with NICE's reference case). The only RCTs that included HRQoL estimates used KOOS-QoL (Dieter [2025][29] on re.flex) arand MSK-HQ (Gohir [2021][30] on Joint Academy), which were both on knee OA. For Dieter (2025),[29] no baseline estimates were provided and only relative changes from baseline were available, which was not sufficient for inclusion in the model on its own, where estimates for baseline and improvements for both arms are needed. For Gohir (2021),[30] a UK based study, the baseline estimates were not balanced, the sample size was relatively small, and the difference in improvement at 6 weeks between the two arms was in favour of standard care but was not statistically significant. Gohir (2021)[30] was therefore not used in the economic modelling, but Dieter (2025)[29] improvements from baseline for the standard care arm were used to supplement baseline estimates derived from another study which was identified through the HRQoL search and is described below.[43]

From the HRQoL search, 34 records were retrieved. After title/abstract screening, a total of eight full texts were assessed. Only one study, Nero (2017),[43] included a technology from the scope (Joint Academy) and reported EuroQol 5-dimension 3 level (EQ-5D-3L) utility scores. This was not shown in Table 6.2 because a RCT was identified on Joint Academy[30] and the Nero (2017) study[43] was therefore de-prioritised. Evidence from this single-arm study is included in the EAG economic model to inform baseline HRQoL and potential HRQoL improvement in the digital technology arm (see Table 7-1 and section 7.2 Health state utilities).

Company evidence

A total of eight evidence request documents were received from Joint Academy, TrackActive Me, Thrive, Phio Engage, Hinge Health, re.flex, Good Boost and getUBetter, including several clinical effectiveness studies and economic evidence studies. After examination of all submitted studies for relevance to the decision problem, four studies from the company evidence request documents were included to inform the EAG economic model (three for cost and resource inputs, and one study for utility inputs, see Table 7-1).

All companies indicated that there was a potential for cost-savings to the healthcare system. The provided studies for economic evidence reported data on the impact of the technologies on resource utilisation. Three studies from getUBetter containing real-world data were used in the economic model and are summarised below in Table 7-1. The getUBetter studies were conducted in the UK, contained relevant cost items and had large sample sizes. However, the studies were conducted in all MSK pain populations, not solely in populations with hip and/or knee OA. Given the limited evidence on resource use, a pragmatic approach was taken to include them, but the generalisability to the population of interest in this assessment is unclear.

Companies also indicated that there is a potential for improved clinical outcomes and HRQoL. However, the provided studies did not report relevant HRQoL outcomes for the economic model (EQ-5D-3L). Only Jonsson (2022)[44] reported EQ-5D VAS but was a retrospective cohort study conducted in Sweden, where Joint Academy replaced standard care for 6 weeks, and showed larger improvement in utility scores for standard care. This study is not shown in Table 6.5 because a RCT was identified on Joint Academy,[30], and it was therefore de-prioritised. As was described above, the model includes evidence from Nero (2017)[43] and Dieter (2025)[29] (see Table 7-1).

Table 7-1: Key economic and clinical evidence for EAG economic model

Study ID	Title	Study type	Narrative summary
RW-11[45]	Real-world system wide evaluation of the impact of getUBetter across Frimley INTEGRATED CARE SYSTEM	Unpublished Real word INTEGRATED CARE SYSTEM evaluation	Evaluation between get Better (n=6,000) and matched cohort (n=64,000) for 12 months. Relevant economic outcomes and HCRU costs reported in the study: [redacted] EAG comment: population includes all MSK pain and limited information, presented in graphs, which require digitising
RW-9[46]	A blueprint for wider deployment of getUBetter: Key Insights from Lambeth and Southwark in the Southeast London Integrated Care System (INTEGRATED CARE SYSTEM)	Unpublished Real word INTEGRATED CARE SYSTEM evaluation Cohort Comparison	Comparisons of trends with or without getUBetter in primary care in the SEL ICS. Relevant economic outcomes and HCRU costs reported in the study: [redacted] EAG comment: population includes all MSK pain and limited information on study (e.g. population size and source for information on comparator is missing)
RW-12[47]	NHS Birmingham and Solihull Integrated Care System (BSOL INTEGRATED CARE SYSTEM): Outcome data for getUBetter digital self-	Unpublished Real word INTEGRATED CARE SYSTEM evaluation	Before and after study of the Royal Orthopaedic Hospital patient cohorts (n>2000) over a 12-month time period. Relevant economic outcomes and HCRU costs reported in the study include: [redacted] EAG comment: population includes all MSK pain and no information on comparator.

Study ID	Title	Study type	Narrative summary
	management for MSK pain		
Nero (2017)[43]	A 6-week web-based osteoarthritis treatment program: observational quasi-experimental study	Single-arm study	An observational quasi-experimental study on Joint Academy which aimed to evaluate joint pain, physical function, and HRQoL over a 6-week time period in Sweden. The population was individuals with clinically verified hip or knee OA. Of the study cohort (n=350 patients; 239 women, mean age 62 years) 250 completed the 6-week program. The separate dimensions within EQ-5D-3L were also investigated. Mobility and pain or discomfort were significantly improved from baseline to follow-up, while changes in self-care, usual activities, and anxiety or depression were not significant. EAG comment: single-arm study, short treatment duration and conducted in Sweden, not the UK.
Dieter (2025)[29]	Effectiveness of the self-directed m-health (mobile health) exercise intervention re.flex in patients with knee osteoarthritis: a randomized controlled trial [Preprint]	RCT	A monocentric, two-arm, randomised controlled parallel-group trial which aimed to investigate the effectiveness of re.flex in Germany. The intervention group included patients with moderate to severe knee OA (n=98) who received a 12-week self-directed app-based and sensor-assisted exercise program, while the comparison received usual care (n=96). KOOS subscale pain was the primary outcome. Secondary outcomes included KOOS-QoL, a HRQoL measure.

Study ID	Title	Study type	Narrative summary
			EAG comment: population included knee OA only, KOOS is a condition specific measure, and the study was conducted in Germany, not the UK.

A&E = Accident and Emergency; EAG = external assessment group; EQ-5D-3L = EuroQoL 5 dimensions 3 levels; GP = General Practitioner; HCRU = healthcare resource utilisation; HRQoL = health-related quality of life; ICS = integrated care system; KOOS = Knee Injury and Osteoarthritis Outcome Score; MSK = musculoskeletal; NHS = National Health Service; OA = osteoarthritis; QALY = quality-adjusted life year; QoL = quality of Life; RCT = randomised controlled trial; SEL = South East London; UK = United Kingdom

Relevant economic models

A total of two economic models on Phio Engage,[48] and getUBetter,[49] were received with the company evidence requests and are summarised below in Table 7-2.

[redacted]

Table 7-2: Summary of companies' models

Title	Narrative summary
EQL-PEN Phio Engage Economic Model Documentation: Hip and Knee OA[48]	[redacted]
getUBetter Economic modelling[49]	[redacted]

EAG = external assessment group; GP = General Practitioner; HRQoL = health-related quality of life; MSK = musculoskeletal; NHS = National Health Service; OA = osteoarthritis; SBRI = Small business research initiative; SWL = South West London

7.2 Early economic model

The primary purpose of this analysis was to assess whether it is plausible that using digital technologies for managing mild-to-moderate hip or knee OA is a cost-effective intervention when used (partly) instead of standard care for people aged 16 years and over who have been assessed as suitable for digital management. The secondary aim of the analysis was to identify the value of future evidence generation, understand the likely key drivers of the results, and highlight the current evidence gaps.

There were no cost utility analyses relevant to the decision problem: hence a de novo model was developed. A simple cost-utility model in R was designed to capture the potential benefit from these technologies over a 1-year time horizon (with possible extension to lifetime). For more information on the implementation of the computational model in R see Appendix F.

Model structure

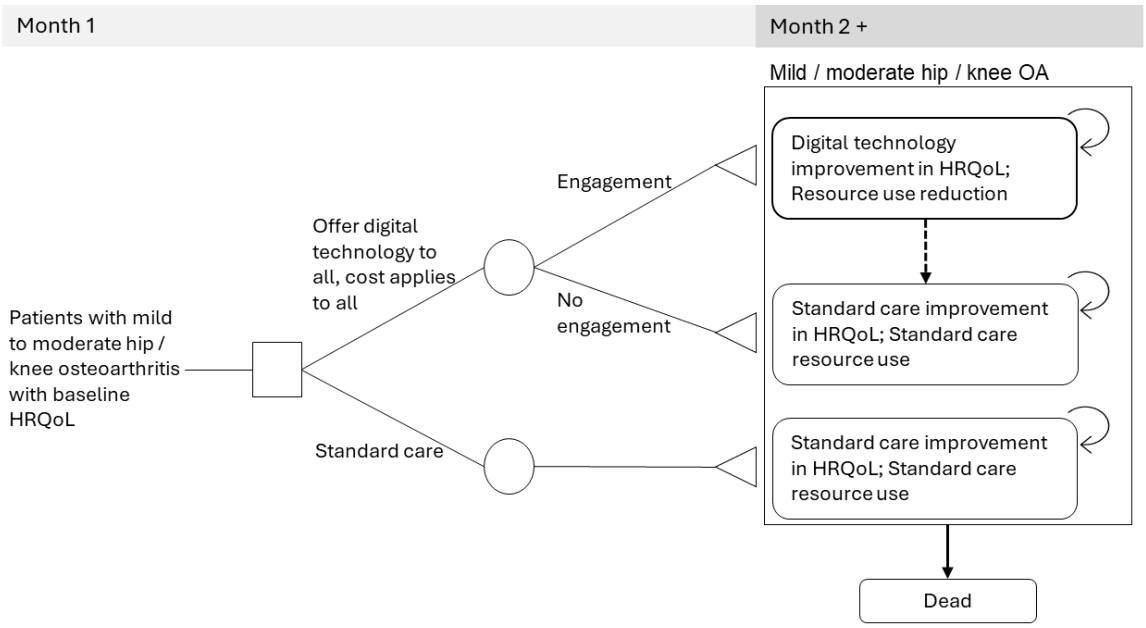
A probabilistic decision-analytic state-transition cohort model was developed in R to compare non-pharmacological standard care (standard care in the following) with reduced or no standard care + digital technologies.

The model includes a decision tree element in the first model cycle, with an engagement parameter defining whether patients do or do not engage with digital technology, based on companies' evidence requests and expert opinion. While there is currently no evidence on other health states (i.e. other than patients residing in mild-to-moderate hip or knee OA, and potentially dying from unrelated causes), patients' symptoms may improve with the use of digital technology and standard care. The model captures this through an improvement in HRQoL, which can differ according to whether patients use digital technology or standard care, and a reduction in resource use for patients that use digital technology. The benefits of using digital technology accrue for those patients that engage with them from month 2 in the model and are assumed to hold for a certain duration (9 months in the model base-case) due to lack of evidence on long-term benefit and based on expert

opinion. Costs of the technologies are applied to all patients being offered the digital technology independently of whether they engage with it or not because of the way technology costs are calculated, although there was limited information on whether all technologies had included uptake in their cost estimates. The patient flow in the model is represented in Figure 7-1.

The model backbone follows a cohort of patients transitioning between mutually exclusive health states: mild-to-moderate hip/knee OA and dead. The mild-to-moderate hip/knee OA state is further divided into patients that have symptom improvement (with HRQoL improvement and resource use reduction) and those that do not have symptom improvement. Additional health states can easily be included. Inclusion of a severe OA health state was considered, but no evidence was available to populate transitions to a progressed disease or severe OA health state for both arms and, therefore, the model base-case does not include this. Such simplifications are common in early models.[50] When more evidence becomes available on progression to severe OA and potential joint replacement with digital technologies and without, this model can be extended to incorporate this (see Figure 7-2).

Figure 7-1: Illustration of patient flow in the model

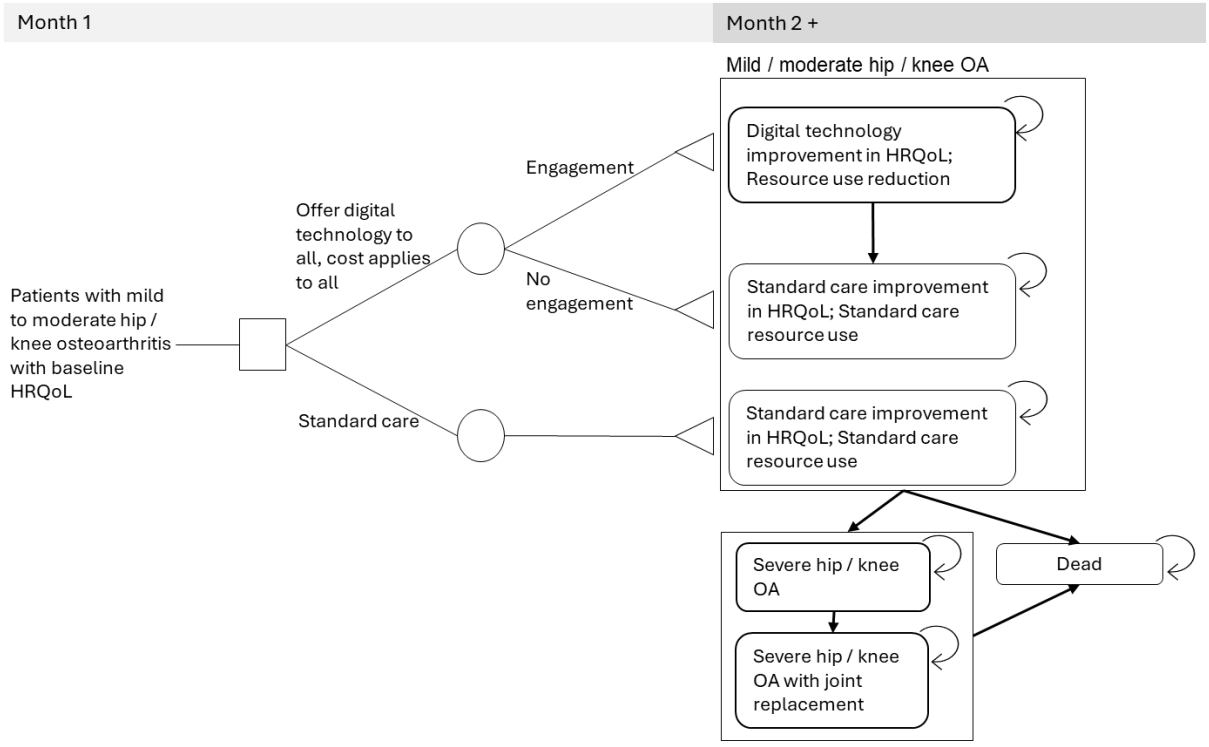


HRQoL = health-related quality of life; OA = osteoarthritis

Arrows represent transitions that are possible at every model cycle. Dashed arrows represent transitions only possible at a fixed timepoint X, the duration in months for which patients experience improvement; this can vary in the model but is set to 9 months in the base-case. Patients can die from unrelated causes at any time in the model.

The state transition model backbone allows for iterative use, adding more granularity than a decision tree as it includes time, and enables flexibility for uncertainty analyses regarding uptake, duration, and magnitude of impact on both HRQoL and costs. The model can estimate the expected costs and health outcomes in terms of quality-adjusted life years (QALYs) and life years (LYs), if needed, for different strategies over a 1-year time horizon, using a monthly cycle length, which can be extended to lifetime. General population mortality is informed by Office of National Statistics (ONS) lifetables 2021-2023.[51] General population utility is informed by the HSE 2014 dataset.[52] The utility cap ensures that utility values cannot be higher than general population utility values.

Figure 7-2: Potential future extension of current model



HRQoL = health-related quality of life; OA = osteoarthritis

Arrows represent transitions that are possible at every model cycle. Patients can move to severe OA or die from related or unrelated causes at any time in the model. It may also be useful to split up mild and moderate OA states.

Interventions

There is heterogeneity in the types of digital technologies and their placement in the care pathway (see Section 3). All digital technologies provide access to specialist information and advice related to managing OA, as well as exercise programmes. They can offer an alternative option to in-person appointments over a certain time period or can be used in addition to a reduced number of in-person appointments. Clinical expert consultation highlighted that digital technologies will likely be used in conjunction with visits to health care professionals and potentially lead to resource use reduction *(*Expert 1*:* "In summary, digital technologies can offer a meaningful HRQoL boost (approx. +0.05–0.08 EQ-5D) for patients with mild-to-moderate OA, with the potential to sustain improvements for at least 6 months, especially when used in conjunction with primary care support"*.,* Expert 3: "Potentially, if it improved self-efficacy it may reduce the number of follow ups required during a course of physiotherapy for example."*,* Expert 4: "With digital technologies I would expect to see a 30% reduction in GP/FCP use. […] Digital technologies should reduce physiotherapy activity by 30%.", see Appendix G for more detail). This is also in line with evidence provided by getUBetter,[45] which showed a reduction in GP visits and physiotherapy sessions as well as medicine use. The model base-case thus assumes that digital technologies lead to reduced primary, community care and medication resource use reduction, but do not replace standard care entirely.

While all digital technologies are designed to help people manage their condition remotely, the components vary. For example, Thrive includes hardware (e.g. Thrive Pad with in-built computer-vision technology tracking patients' movements), and an initial assessment with regular check-ins by a physiotherapist, while getUBetter is a self-management tool that does not include company-provided contact with health care professionals or hardware, but does provide read-out in 14 languages to be inclusive. Because of these differences, it is difficult to group the technologies in one in the model base-case. Individual comparisons of each technology with standard care, however, are not possible because it is unclear whether all benefits were reported by all

companies and there is no evidence on effectiveness and resource use reduction for all technologies.

Some technologies have no evidence, while others have (limited) evidence that is not directly relevant to the decision problem. While a base-case is presented in which all technologies are grouped together in one intervention arm, it should be noted that in reality these technologies may affect patients' HRQoL and resource use in different ways. Due to the limitations with the evidence, this evaluation cannot capture these effects for each individual technology. However, the model can be used to explore the potential impact or value of digital technologies for mild-to-moderate hip/knee OA, given the current limitations of the evidence and the variation in the technologies. Moreover, conditions that should be met for digital technologies to represent value for money can be explored.

Model assumptions

As decision-analytic models are simplified representations of reality, making assumptions is common in health economic modelling processes. The main assumptions related to:

- A state-transition cohort model with a monthly cycle length and 1-year time horizon was used. The 1-year time horizon can be a limitation as it is based on the assumption that no differences occur between intervention and comparator in the long run. When more evidence becomes available, this assumption can be relaxed and longer time horizons explored.

- The first model cycle includes a decision tree element to reflect the proportion of patients engaging with digital technologies, with the remainder experiencing the same improvement in symptoms and resource use as patients in the standard care arm.

- Patients are assumed to remain in a mild-to-moderate disease state for the entire time horizon, unless they die of unrelated causes. Including mortality does not induce bias but ensures face validity. Their health

state can improve from baseline, with differential symptom improvement per treatment (i.e. digital technology versus standard care). Since there is no evidence for transitions to severe OA or joint replacement, this health state and transitions to it are not modelled, which means that it is implicitly assumed that digital technologies do not have an effect on long-term progression or survival.

- The impact on (differential) utility and cost is applied over time using a duration parameter, which was set to 9 months in the model base-case and specified separately for costs and HRQoL. This defines how long any increase or decrease in costs or HRQoL lasts, starting 1 month after first engagement with the digital technology.

- The average effect size is modified based on assumptions around patient uptake, allowing the model to explore imperfect engagement or varying degrees of technology adoption.

- General population mortality (ONS lifetables, 2021–2023)[51] and utility (HSE 2014)[52] data are used. Utility values are capped at general population levels.

Clinical parameters

Clinical parameters used in the model related to model population, patient engagement with digital technologies and the duration of impact of digital technologies on patients' HRQoL and resource use (see Table 7.3).

Model population

The population model inputs are derived from Nero (2017),[43] a single-arm study on Joint Academy that was de-prioritised in Section 6, but used for the HRQoL evidence in the economic model (see Table 7-3). The total population (n=350) were individuals with clinically verified knee or hip OA with 239 women (68.3%) and a mean age of 62 years (SD=10) in Sweden. Out of the total study population, 71.4% (n=250) completed the 6-week programme and were included in the study.

Engagement

Patient engagement with digital technology varies. Evidence submitted by companies included various ways of estimating patient engagement, including initial activation/adoption (e.g. [redacted] activation rate according to getUBetter RW-5,[53] or [redacted] of Phio adoption according to the Phio Engage Economic model[48]), and continued use (for which definitions vary, e.g. [redacted] of people who initially adopted Phio 1st onboard Phio Engage). A published article reporting on a service evaluation (unpublished) of Phio Engage[54] in the UK reported that out of 618 patients who were offered use of Phio Engage (that had self-referred, completed a triage and were considered appropriate), 515 (83.3%) accepted but only 378 (i.e. 61% of the 618) downloaded and registered on the app and completed their supported self-management with the digital tool. When consulted by the EAG, all four clinical experts stated that uptake and adherence estimates were likely less than 100% but their estimates varied. Experts estimates included 66.71% activation rate with getUBetter in NHS England (NHSE) South East & East of England (Expert 4), 60-70% willing to try digital technology (Expert 1), and a 50% uptake rate (Expert 3) (see Appendix G). One expert stated that an estimated 50% of those who started dropped out after 2-3 weeks (Expert 4), and another clinical expert that of those who started, 40-50% were likely to engage appropriately (Expert 1), while further attrition was to be expected in the long term: “by 12 months, around 25–35% may continue to use the technology regularly” (Expert 1). A third expert considered long-term adherence to be a challenge (Expert 3). To reflect this evidence and expert opinion, in the model, 50% of engagement was assumed.

Duration of impact

Clinical experts, including a GP, a consultant physiotherapist, and a physiotherapist, were consulted in April 2025 via email to determine how long the impact on HRQoL and costs would last. Based on their input, which suggested potential improvements lasting at least 6 months and possibly longer depending on various factors like patient compliance, behavioural changes and continued primary care support, the economic model's base-

case assumed an impact duration of 9 months, starting in the second month (for detailed answers see Appendix G).

Both, the engagement and duration of impact parameters reflect imperfect uptake, initial engagement and attrition, but are uncertain.

Table 7-3: Main clinical parameters

Variable	Value	Source	EAG commentary on availability, quality, reliability and relevance of the source/s
Starting age	62 (fixed)	Nero (2017)[43]	In accordance with NHS CSK, where median age of symptom onset was stated to be 55 years. Relevant population characteristics: Of the study cohort (n=350 patients; 239 women, mean age 62 years, mean BMI 27 kg/m2), 71.4% (n=250) completed the 6-week programme and were included in the study. EAG comment: This single-arm study was selected due to it being in the mild-to-moderate hip/knee OA population, including a digital technology from the scope and relevant outcome measure (EQ-5D-3L). Limitations include the missing comparator, short duration and that this was conducted in Sweden, not the UK.
Proportion female	68.3% (fixed)	Nero (2017)[43]	In accordance with NHS CKS which state a higher prevalence in women than men. EAG comment: In line with expectations that women have a higher prevalence.
Proportion of patients with engagement	50% (SD 0.15)	Assumption based on clinical expert input, company's information and Burgess et al[54]	Estimates of initial uptake and long-term engagement with digital technology vary and depend on signposting, encouragement by health professionals and technology features such as usability.
Duration of impact on costs and HRQoL	9 months (SD 2.7)	Assumption based on clinical expert input	Based on communication with a GP, a consultant physiotherapist and a physiotherapist via email in April 2025. This is assumed to capture that some patients will have longer lasting effect, while others will discontinue (stop engagement with digital technologies) and no longer experience an effect.

Variable	Value	Source	EAG commentary on availability, quality, reliability and relevance of the source/s
BMI = body mass index; CKS = clinical knowledge summaries; EAG = external assessment group; EQ-5D-3L = EuroQoL 5 dimensions 3 levels; GP = General Practitioner; HRQoL = health-related quality of life; NHS = National Health Service; OA = osteoarthritis; SD = standard deviation; UK = United Kingdom			

Resource use and cost parameters

Resource use and cost parameters relate to digital technology costs, health state costs and the reduction in resource use that can be achieved with digital technology.

Costs of digital technology

The average one-off cost per year for all digital technologies (where costs were available) is derived from information provided by companies (see Table 7-4). The base-case average one-off cost per person per year for the digital technologies to support mild or moderate OA is £160.51 based on information from Good Boost (through We Are Undefeatable app), Hinge Health Programme, Thrive, re.flex, Joint Academy UK, Phio Engage, and getUBetter. While a cost estimate was provided for TrackActiveMe, this was commercial in confidence, and not included in the model, as it would be possible to back-calculate it. Although companies were asked to submit a breakdown of costs (e.g., for hardware, software, training, maintenance, etc.), the level of detail and transparency varied considerably between technologies. To avoid comparing non-equivalent cost structures, a single average cost was used in the model base-case rather than modelling costs per technology separately. The costs per technology in Table 7-4 should be interpretated with caution because there is uncertainty in the cost calculations.

Table 7-4: Digital technology one-off costs per person per year

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Joint Academy UK	£112.50	Joint Academy evidence request document[55, 56]	Company provided minimum and maximum value per person. EAG calculation: Mid-point of £75 to £150 per 12 weeks per patient was calculated as £112.50 (exclusive of VAT). This price includes software, quality control and maintenance, data processing, training, three physiotherapist visits, and chat as needed. The company stated that patients bear the cost of resistant bands, which are needed only if you progress to the more challenging exercise levels. EAG comment: The higher cost may reflect that physiotherapy costs are included, and usual treatment length is 12 weeks. It is unclear whether uptake is included in the cost.
Thrive	£375	Thrive evidence request document[57, 58]	Company provided minimum and maximum value per person. EAG calculation: Mid-point of £250 to £500 per treated member per year was calculated as £375 (exclusive of VAT). This price includes software and license, package and delivery of the Thrive Pad, data processing, training and, unlimited access to a qualified physiotherapist throughout the year. The company stated that there are no requirements for quality control.

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
			EAG comment: The higher cost may reflect that physiotherapy costs and hardware are included. Another reason why the costs might be higher is that the costs also likely apply only to the patients who will use it for an entire year.
Phio Engage	£45.28	Phio Engage evidence request document[59, 60]	Company provided three values per person based on different population sizes (£0.30, £0.40,£0.50).After stakeholder consultation, the company provided more information. Data from SWBH NHS Trust, which is the largest individual NHS trust served by Phio with a population of 530,000, gives a cost per capita per year of 0.40. The estimated number of patients using Phio Engage in the SWBH NHS Trust in 2024 was 4,682. Company's revised calculation: (530,000 x £0.40) / 4682 = £45.28 This price includes software, quality control and maintenance, data processing, training and chat interactions with a physiotherapist. EAG comment: The company's revised cost calculation appears to have face validity. Further information on uptake in different trusts or cost to the NHS will remove any residual uncertainty.
Hinge Health Programme	£296.25	Hinge Health evidence request document[61]	Company provided one value per person. Cost per person per year = $395 (exclusive of VAT). EAG calculation: converted to GBP: 1 US$ = 0.75 GBP in May 2025, so may not be generalisable to the UK.

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
			EAG comment: It is unclear what is included in this cost. Company only stated that there are no deployment or integration costs.
Good Boost (through We Are Undefeatable app)	£46.15 (for year 2+, i.e. excluding the set-up cost; £84.61 if set-up cost included)	Good Boost evidence request document[62]	Company provided one value per venue. Good Boost costs £5,500 (exclusive of VAT) to set-up a community venue in Year 1. The renewal price for Year 2+ is £3,000 per year (exclusive of VAT). EAG calculation: (Deployment charge/(number of patients per community venue). Number of people per community venue assumed 65 (MSK Hub evaluation report[63]; Waller 2024[33]) The company stated that this price includes software license, hardware (10 x waterproof/rugged tablet computers per venue), venue set-up, on-going technical/customer support and data reporting, and training for staff. The company stated that they work in partnership with the 'We Are Undefeatable' campaign, which represents the largest health charities in the UK. The We Are Undefeatable app is powered by Good Boost technology and is free for the general public to access, with the running costs of the We Are Undefeatable app, powered by Good Boost, being funded by the charities. EAG comment: It is unclear what the average number of patients per community venue is, what the uptake is, whether clinician's time is included, if there are additional self-funded costs for patients per session (Waller 2024[33]). The cost for the first year set-up are excluded in the average total base-case cost.

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
getUBetter	£18.86	getUBetter evidence request document [64, 65]	Company provided two values, with minimum and maximum range, per site or 10,000 people. EAG calculation: Mid-point license fee of £1,500 (£1,200 to £1,800 ex VAT) per 10,000 adults plus an annual deployment charge of £1,200 per site, covering license, quality control & maintenance, data processing, consumables and training have been converted by EAG into per-patient costs using an assumed hip + knee OA prevalence of 1.51% in England (EAG interpretation of Jordan (2014)[66] primary-care OA prevalence of 176 per 10,000 split into 54% knee/32% hip and combined) and an average GP-practice list size of 8,900 adults (EAG use of NHS digital April (2025)[67]). EAG calculation: 1. License fee per affected adult = £1,500 ÷ (10,000 × 1.51%) ≈ £9.93 2. Deployment charge per affected adult = £1,200 ÷ (8,900 × 1.51%) ≈ £8.93 3. Total annual cost per affected adult ≈ £18.86 EAG comment: “per site” remains unclear (could be GP practice, MSK physiotherapy service, urgent care centre or MATs/CATs). Uptake is not included in the cost calculation. The total estimated cost per patient for getUBetter is highly uncertain and the deployment cost should have been excluded, based on consultation with the company at a later stage.
re.flex	£229.50	re.flex evidence request document [68, 69]	Company provided minimum and maximum value per person.

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
			EAG calculation: Mid-point of 210 to 330 euros per patient per 12 weeks was calculated as 270 euros. Converted to GBP: 1 EUR = 0.85 GBP (May 2025), so may not be generalisable to UK. This price includes software and license, two hardware sensors and consumables. The company stated that costs for quality control and maintenance, data processing and training are not applicable. EAG comment: The higher cost may reflect the additional hardware sensors and usual treatment length is 12 weeks. It is unclear whether uptake is included in the cost.
TrackActive Me	[redacted]	TrackActive Me evidence request documents[70]	[redacted] This price is excluded in the results because of confidentiality.

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Costs as used in the model			
Base-case costs	£160.51 (SD 48.15)	Good Boost, Hinge, Thrive, re.flex, getUBetter, Phio Engage and Joint Academy	EAG comment: This base-case cost was calculated as the average cost of all digital technologies (where costs were available and not marked as confidential, as detailed in the previous rows). The large range from £18.86 (getUBetter) to £375 (Thrive) may reflect differences in technology features and their inclusion in the health care pathway.
Scenario 1: Technologies that offer self-management with additional features	£211.88 (SD 63.56)	Good Boost, Hinge, Thrive, re.flex and Joint Academy	EAG comment: The average cost of the mentioned digital technologies (where costs were available and not marked as confidential), which are digital technologies that have additional features, such as physiotherapist sessions, hardware or other technology that allows giving real-time feedback, and / or group or community exercise sessions. These technologies are on average more costly than the technologies without these additional features. The range is relatively large, from £46.15 (Good Boost) to £375 (Thrive), and it is unclear whether this reflects differences in technology features or their inclusion in the health care pathway, or other causes.
Scenario 2: Technologies that offer self-management without additional features	£32.06 (SD 9.62)	getUBetter and Phio Engage	EAG comment: This was calculated as the average cost of the mentioned digital technologies (where costs were available and not marked as confidential), which are technologies that do not have additional features like the ones described in scenario 1. These technologies are on average less costly than those with additional features. The provided costs ranged from £18.86

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
			(getUBetter) to £45.28 (Phio Engage) and it is unclear what causes these differences.
Scenario 3: Technologies that are meant to be used for a short duration	£171.00 (SD 51.30)	re.flex and Joint Academy	EAG comment: This was calculated as the average cost of the mentioned digital technologies, (where costs were available and not marked as confidential), which are digital technologies that are meant to be used for a short duration. No cost estimate was provided for Pathway through Arthritis.
EAG = external assessment group; GBP = great British pound; GP = General Practitioner; MSK = musculoskeletal; NHS = National Health Service; OA = osteoarthritis; SD = standard deviation; UK = United Kingdom; US$ = United States dollar; VAT = value added tax			

Health state costs

Resource use inputs were primarily derived from clinical expert consultation. For scenario analysis 2, which explores the value of digital technologies without additional features such as physiotherapist sessions, hardware or other technology that allows giving real-time feedback, and/or group or community exercise sessions, the getUBetter real-world evaluation reports[45-47] were used. Primary care appointments, community care appointments, and medication resource use are calculated per month and are outlined in Tables 7-5 to 7-7. The inclusion of secondary care costs was considered but deemed not applicable to patients with mild-to-moderate OA, in line with expert opinion (Expert 4, see details in Appendix G). The use of manual therapy and devices, such as walking aids, were also considered but not taken into account in the economic model since there is limited evidence on usage and expected reduction in usage.

Unit prices related to health care use were derived from Personal Social Services Research Unit (PSSRU)[71], the British National Formulary (BNF)[72] and the National Cost Collection for the 2023/24[73] cost year. Device costs, primary care costs, community care costs, and medication costs are calculated per month and outlined in Tables 7-8 to 7-11, respectively. Costs for some medications (e.g., topical capsaicin and some corticosteroid injections) were considered but not available but the impact of omitting these from the model is likely low.

Table 7-5: Primary care resource use per month

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
GP activity (face-to-face and telephone)	0.208 (SD 0.0625) [redacted]	Clinical expert RW-11 getUBetter[45]	Base-case: Clinical expert 4 (physiotherapist) estimated 2-3 appointments per person per year 2.5/12 = 0.2083 Scenario 2: [redacted]The graph is digitised by using Engauge Digitizer.[redacted]
Medication prescription	0.025 (SD 0.0075) [redacted]	Clinical expert RW-12 getUBetter[47]	Base-case: Clinical expert 4 (physiotherapist) estimated 300 medical prescriptions per 1000 patients per year but is not 100% sure. Scenario 2: [redacted]
EAG = external assessment group; GP = General Practitioner; MSK = musculoskeletal; SD = standard deviation			

Table 7-6: Community care resource use per month

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Physiotherapy activity	0.375 (SD 0.1125) [redacted]	Clinical experts RW-9 getUBetter[46]	Base-case: The estimated average of three clinical experts is 4.5 face-to-face community care physiotherapy appointments (see Appendix G). Scenario 2: [redacted]

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
			[redacted]
EAG = external assessment group; MSK = musculoskeletal; SD = standard deviation			

Table 7-7: Medication use prescription per month

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Topical diclofenac (10 mg per 1 gram, pack size 100 gram)	0.060 (SD 0.018)	BNF (NICE 2025)[72] and assumption	BNF recommendation: If drug treatment is needed to manage OA, it should be used alongside non-pharmacological treatments and to support exercise. The lowest effective dose should be used for the shortest possible time. Offer a topical NSAID to people with knee OA. Consider a topical NSAID for people with OA that affects other joints. Apply three to four times a day review after 28 days. Use an amount about the size of a cherry or walnut (2 to 4 grams). Do not use diclofenac gel more than four times in any 24-hour period. Assumption: applied three times a day with an amount of 2 grams every month.
Topical ketoprofen (25 mg per 1 gram, pack size 50 gram)	0.080 (SD 0.024)	BNF (NICE 2025)[72] and assumption	BNF recommendation: Offer a topical NSAID to people with knee OA. Consider a topical NSAID for people with OA that affects other joints. Apply two to four times a day for up to 7 days, ketoprofen 2.5% gel to be administered; maximum 15 grams per day. Assumption: applied two times a day with an amount of 2 grams every month.

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Topical ibuprofen (50 mg per 1 gram, pack size 50 gram)	0.320 (SD 0.096)	BNF (NICE 2025)[72] and assumption	BNF recommendation: Offer a topical NSAID to people with knee OA. Consider a topical NSAID for people with OA that affects other joints. Apply up to four times a day, therapy should be reviewed after 14 days. Assumption: applied four times a day with an amount of 2 grams, two times per month.
Topical piroxicam (5 mg per 1 gram, pack size 60 gram)	0.100 (SD 0.030)	BNF (NICE 2025)[72] and assumption	BNF recommendation: Offer a topical NSAID to people with knee OA. Consider a topical NSAID for people with OA that affects other joints. Apply three to four times a day, 0.5% gel to be applied; review treatment after 4 weeks. Assumption: applied three times a day with an amount of 2 grams per month.
Paracetamol (500 mg caplets, pack size 100)	0.120 (SD 0.036)	BNF (NICE 2025)[72] and assumption	BNF recommendation: Paracetamol or weak opioid should only be used infrequently for short-term pain relief if all other pharmacological treatments are unsuitable, not tolerated, or ineffective. Take 0.5–1 g, every 4–6 hours; maximum 4 grams per day. Assumption: taken 0.5 gram every 6 hours for 3 days per month.
Codeine (30 mg tablets, pack size 28)	0.143 (SD 0.043)	BNF (NICE 2025)[72] and assumption	BNF recommendation: Paracetamol or weak opioid should only be used infrequently for short-term pain relief if all other pharmacological treatments are unsuitable, not tolerated, or ineffective Take 30-60 mg every 6 hours for a maximum of 3 days for both codeine and co-codamol. Assumption: taken 30 mg every 6 hours for 3 days per month.

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Co-codamol (8 mg/500 mg tablets, pack size 100)	0.040 (SD 0.012)	BNF (NICE 2025)[72] and assumption	BNF recommendation: Paracetamol or weak opioid should only be used infrequently for short-term pain relief if all other pharmacological treatments are unsuitable, not tolerated, or ineffective Take one to two tablets every 4–6 hours as required; maximum eight tablets per day. Assumption: taken one tablet every 6 hours for 3 days per month.
Dihydrocodeine (30 mg tablets, pack size 28)	0.143 (SD 0.043)	BNF (NICE 2025)[72] and assumption	BNF recommendation: Paracetamol or weak opioid should only be used infrequently for short-term pain relief if all other pharmacological treatments are unsuitable, not tolerated, or ineffective Take 30 mg every 4–6 hours. Assumption: taken 30 mg every 6 hours for 3 days per month.
Ibuprofen (200 mg tablets, pack size 84)	0.107 (SD 0.032)	BNF (NICE 2025)[72] and assumption	BNF recommendation: If topical medicines are ineffective or unsuitable, consider an oral NSAID for people with OA. Take 300–400 mg three to four times a day; maintenance 200–400 mg three times a day, increased, if necessary, up to 600 mg four times a day. Assumption: taken 200 mg three times a day for 3 days per month.
Naproxen (250 mg tablets, pack size 56)	0.054 (SD 0.016)	BNF (NICE 2025)[72] and assumption	BNF recommendation: If topical medicines are ineffective or unsuitable, consider an oral NSAID for people with OA. Take 250 mg every 6–8 hours as required. Four tablets per day. Assumption: taken 250 mg every 8 hours for 3 days per month.

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Piroxicam (20 mg tablets, pack size 28)	0.107 (SD 0.032)	BNF (NICE 2025)[72] and assumption	BNF recommendation: If topical medicines are ineffective or unsuitable, consider an oral NSAID for people with OA. Take up to 20 mg once daily. Assumption: taken 20 mg every day for 3 days per month.
Diclofenac (50 mg tablets, pack size 28)	0.214 (SD 0.064)	BNF (NICE 2025)[72] and assumption	BNF recommendation: If topical medicines are ineffective or unsuitable, consider an oral NSAID for people with OA. Usual dose is 75 mg to a maximum of 150 mg a day. Usually take diclofenac tablets or capsules two to three times a day. Assumption: taken twice a day (100 mg) for 3 days per month.
Nefopam hydrochloride (30 mg tablets, pack size 90)	0.100 (SD 0.030)	BNF (NICE 2025)[72] and assumption	BNF recommendation: If topical medicines are ineffective or unsuitable, consider an oral NSAID for people with OA. Take 60 mg three times a day, adjusted according to response; usual dose 30-90 mg 3 times a day. Assumption: taken one tablet three times a day for 3 days per month.
Methylprednisolone with lidocaine (40 mg/mL)	0.167 (SD 0.050)	BNF (NICE 2025)[72] and assumption	BNF recommendation: Intra-articular corticosteroid injections can be considered to provide short-term relief when other pharmacological treatments are ineffective or unsuitable, or to support exercise. 4–80 mg, dose adjusted according to size, where appropriate may be repeated at intervals of 7–35 days. Assumption: 40 mg taken every 6 months (based on information from clinical expert)

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Triamcinolone acetonide (Adcortyl) (10 mg/mL)	0.167 (SD 0.050)	BNF (NICE 2025)[72] and assumption	BNF recommendation: Intra-articular corticosteroid injections can be considered to provide short-term relief when other pharmacological treatments are ineffective or unsuitable, or to support exercise. 2.5–15 mg, adjusted according to size (for larger doses use *Kenalog*®). Where appropriate dose may be repeated when relapse occurs. Assumption: 10 mg taken every 6 months (based on information from clinical expert).
BNF = British National Formulary; EAG = external assessment group; NG = NICE guideline; NICE – National Institute for Health and Care Excellence; NSAID = non-steroidal anti-inflammatory drug; OA = osteoarthritis			

Table 7-8: Primary care unit costs

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
GP face-to-face appointments	£45.00 (fixed)	PSSRU 2024 (Jones [2024])[71]	Table 9.4.2: Unit costs for a GP. Per surgery consultation lasting 10 minutes (average GP consultation length). Qualification costs included.
Prescription costs per consultation	£27.00 (fixed)	PSSRU 2024 (Jones [2024])[71]	Table 9.4.2: Unit costs for a GP. Prescription costs per consultation (actual cost).
EAG = external assessment group; GP = General Practitioner; PSSRU = Personal Social Services Research Unit			

Table 7-9: Community care unit costs

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Physiotherapist one-to-one session	£41.00 (fixed)	PSSRU 2024 (Jones [2024])[71]	Table 6.2.1: Unit costs for community health services. Physiotherapist, adult, one-to-one.
EAG = external assessment group; PSSRU = Personal Social Services Research Unit			

Table 7-10: Medication costs

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Topical diclofenac (10 mg per 1 gram, pack size 100 gram)	£7.35 (fixed)	BNF (NICE 2025)[72] and assumption	Alliance Healthcare Ltd Drug tariff price.
Topical ketoprofen (25 mg per 1 gram, pack size 50 gram)	£2.70 (fixed)	BNF (NICE 2025)[72] and assumption	Alliance Healthcare Ltd Drug tariff price.
Topical ibuprofen (50 mg per 1 gram, pack size 50 gram)	£1.34 (fixed)	BNF (NICE 2025)[72] and assumption	A A H Pharmaceuticals Ltd. Drug tariff price.
Topical piroxicam (5 mg per 1 gram, pack size 60 gram)	£1.98 (fixed)	BNF (NICE 2025)[72] and assumption	Alliance Healthcare Ltd Drug tariff price.

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Paracetamol (500 mg caplets, pack size 100)	£1.94 (fixed)	BNF (NICE 2025)[72] and assumption	A A H Pharmaceuticals Ltd. Drug tariff price.
Codeine (30 mg tablets, pack size 28)	£1.18 (fixed)	BNF (NICE 2025)[72] and assumption	Alliance Healthcare Ltd Drug tariff price.
Co-codamol (8 mg/500 mg tablets, pack size 100)	£8.80 (fixed)	BNF (NICE 2025)[72] and assumption	A A H Pharmaceuticals Ltd. Drug tariff price.
Dihydrocodeine (30 mg tablets, pack size 28)	£3.00 (fixed)	BNF (NICE 2025)[72] and assumption	A A H Pharmaceuticals Ltd. Drug tariff price.
Ibuprofen (200 mg tablets, pack size 84)	£2.31 (fixed)	BNF (NICE 2025)[72] and assumption	Milpharm Ltd. Drug tariff price.
Naproxen (250 mg tablets, pack size 56)	£0.86 (fixed)	BNF (NICE 2025)[72] and assumption	A A H Pharmaceuticals Ltd. Drug tariff price.
Piroxicam (20 mg tablets, pack size 28)	£12.52 (fixed)	BNF (NICE 2025)[72] and assumption	A A H Pharmaceuticals Ltd. Drug tariff price.
Diclofenac (50 mg tablets, pack size 28)	£2.94 (fixed)	BNF (NICE 2025)[72] and assumption	Alliance Healthcare Ltd. Drug tariff price.
Nefopam hydrochloride (30 mg tablets, pack size 90)	£3.51 (fixed)	BNF (NICE 2025)[72] and assumption	A A H Pharmaceuticals Ltd. Drug tariff price.

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
Triamcinolone acetonide (Adcortyl) (10 mg/mL)	£3.63 (fixed)	BNF (NICE 2025)[72] and assumption	Bristol-Myers Squibb Pharmaceuticals Ltd. Drug tariff price.
Methylprednisolone with lidocaine (40 mg/mL)	£3.94 (fixed)	BNF (NICE 2025)[72] and assumption	Pfizer Ltd. Drug tariff price
BNF = British National Formulary; EAG = external assessment group; NICE – National Institute for Health and Care Excellence			

Resource use reduction

Estimates of reduction in resource use with digital technology were derived from clinical expert consultation and company evidence requests. Three clinical experts expected a reduction in GP consultations. All four clinical experts expected a reduction in physiotherapy visits. Two clinical experts mentioned it could reduce medication usage. Clinical expert 4 provided quantitative estimates for the expected reductions, which are used in the EAG base-case (see Appendix G). getUBetter provided real-world evaluation reports with estimates of the expected consultation and treatment use reduction (see Table 7-11): the estimates from RW-11[45] were selected for scenario 2 since that was an evaluation between getUBetter registered users (n=6,000) and a matched cohort (n=64,000). There was no information on physiotherapy and medication, therefore RW-12[47] and RW-9[46] were used to supplement RW-11. Using real-world studies comes with limitations since the data often has inherent uncertainties. Table 7-12 provides a cost break-down for digital technologies compared to standard care per person per month.

Table 7-11: Consultation and treatment reduction

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
GP activity reduction	-30% (SD 0.09) [redacted]	Clinical expert RW-11 getUBetter[45]	Base-case: Clinical expert 4 (physiotherapist) estimates a 30% reduction in GP activity. [redacted]
Medication prescription reduction	-10% (SD 0.03) [redacted]	Clinical expert RW-12 getUBetter[47]	Base-case: Clinical expert 4 (physiotherapist) estimates 10% reduction in medication prescription but is not 100% sure. [redacted]
Physiotherapy activity reduction	-30% (SD 0.09) [redacted]	Clinical expert RW-9 getUBetter[46]	Base-case: Clinical expert 4 (physiotherapist) estimates 30% reduction in physiotherapy activity. [redacted]
Inpatient activity reduction	0% (fixed) [redacted]	Clinical expert RW-11 getUBetter[45]	Base-case: Clinical expert 4 (physiotherapist) does not expect secondary care activity to change. [redacted]

Parameter	Value	Source	EAG commentary of availability, quality, reliability and relevance of the source/s
A&E activity reduction	0% (fixed) [redacted]	Clinical expert RW-11 getUBetter[45]	Base-case: Clinical expert 4 (physiotherapist) does not expect secondary care activity to change. [redacted]
Medication use reduction	-10% (SD 0.03) [redacted]	Clinical expert RW-12 getUBetter[47]	Base-case: Clinical expert 4 (physiotherapist) estimates 10% reduction in medication prescription but is not 100% sure. [redacted]
A&E = Accident and Emergency; EAG = external assessment group; GP = General Practitioner; MSK = musculoskeletal; SD = standard deviation			

Table 7-12: Health state cost breakdown for base-case per person per month (deterministic)

	Digital technologies for mild-to-moderate hip/knee OA	Standard care	Incremental digital technologies versus standard care
Digital technology costs	£13.38	NA	£13.38
Primary care	£7.16	£10.04	-£2.88
Community care	£10.76	£15.38	-£4.62
Medications	£5.62	£6.24	-£0.62
Total	£36.92	£31.66	£5.26
NA = not applicable; OA = osteoarthritis			

Health state utilities

The quasi-experimental study by Nero (2017)[43] was selected to inform utility values in the model base-case. This study was de-prioritised in Section 6 but was the only one that reported EQ-5D-3L utility values. The population included individuals with clinically verified knee or hip OA, utility scores were derived using EQ-5D-3L, and the intervention included one of the technologies from the scope (Joint Academy). However, limitations were the single-arm study design, short intervention time (6-weeks), and the study was conducted in Sweden, not the UK. Despite the short intervention time in this study, two of the dimensions in the EQ-5D-3L scale improved (mobility and pain or discomfort). This is in line with the information from two clinical experts (see Appendix G). Expert 4: “The expected improvement is likely to very likely for mobility and pain, neutral to likely for self-care usual activities and anxiety/depression.” Expert 1: “In summary, digital technologies can offer a meaningful HRQoL boost of approximately +0.05 to 0.08 EQ-5D.” However, the index from Nero (2017)[43] (+0.04), did not reach the change that is considered clinically significant (i.e., a change of 0.074[74]).

Since Nero (2027)[43] is a single-arm study, information for the standard care arm was missing. It is assumed that the standard care arm has the same utility values as the digital technologies group at baseline. The improvement in utility scores for standard care is based on Dieter (2025),[29] a RCT study on re.flex (as there was none for Joint Academy) that showed similar improvements in utility scores (+4.1, note the different scale, which is 0 to 100 rather than 0 to 1) for the digital technologies arm, and was assessed to have a low risk of bias (see Section 6.2). The digital technologies group in Dieter (2025)[29] received a 3 month training programme with exercises guided by use of an app and two wearable motion sensors attached proximally and distally to the OA-affected knee joint. Dieter (2025)[29] found a larger improvement in utility scores for the digital technologies group compared to the standard care arm. The published pain-measuring instrument, KOOS, is a condition specific measure, therefore not preferred in the NICE reference case. However, the overlap between KOOS and EQ-5D-3L has been reported in existing literature

and the only dimension of the EQ-5D-3L that is not covered directly by the KOOS is anxiety/depression. The KOOS subdomain QoL has been compared with EQ-5D too, but only showed a moderate correlation.[75] Other limitations of Dieter (2025)[29] were the focus on knee OA only, and the study was conducted in Germany, not the UK. Due to the lack of evidence, it was assumed that the values reported by Dieter (2025),[29] even though the population included knee OA patients only, would be generalisable to the hip/knee OA population.

EQ-5D-3L[43] and KOOS QoL[29] were included in the model base-case to estimate utility scores in association with knee and hip OA at baseline and after 1 month (Table 7-13).

Table 7-13: HRQoL estimates used in the model base-case

Parameter	Value	Source	EAG commentary on availability, quality, reliability and relevance of the source/s
Standard care			
Baseline	0.65 (SD 0.14)	Assumption, Nero (2017)[43] and Dieter (2025)[29]	The baseline utility value for standard care is assumed to be the same as in the digital technology arm, which is based on Nero (2017)[43]. The improvement is based on information from Dieter (2025): +1.6 KOOS QoL score for standard care (n=96). KOOS has a range of 0-100 so the change is divided by 100 because EQ-5D-3L goes from 0-1. Even though mapping functions from KOOS-QoL to EQ-5D-3L are available, these are not used here as they require individual patient level data, which were not available to us. Knee and hip OA are assumed to have equal utilities, even though the study focused on patients with knee. The duration of HRQoL improvement is assumed to be 9 months. The data is scaled up to one year by weighting the
Improvement with standard care	0.666 (SD 0.135)		

Parameter	Value	Source	EAG commentary on availability, quality, reliability and relevance of the source/s
			QALYs by the time spent in the health state.
Digital technology to support knee and hip OA			
Baseline	0.65 (SD 0.14)	Nero (2017)[43]	EQ-5D-3L score for the digital technology arm (n=250). Knee and hip take the same value. The duration of HRQoL improvement is assumed to be 9 months. The data is scaled up to 1 year by weighting the QALYs by the time spent in the health state.
Improvement with digital technologies	0.69 (SD 0.15)		

EAG = external assessment group; EQ-5D-3L = EuroQoL 5 dimensions 3 levels; HRQoL = health-related quality of life; KOOS = Knee Injury and Osteoarthritis Outcome Score; OA = osteoarthritis; QALY = quality-adjusted life year; QoL = quality of life; SD = standard deviation

Summary of model input parameters

Table 7-14: Overview of model input parameters used in the base-case

Explanation for parameters	Parameter name in R	Distribution	Deterministic	Mean	SD	95 CI-	95 CI+
HRQoL baseline value for standard care	utility_alive_base_SoC	Beta	0.650	0.651	0.14	0.36	0.89
HRQoL improvement for standard care	utility_alive_SoC	Beta	0.666	0.665	0.14	0.38	0.90
HRQoL baseline value for digital technologies	utility_alive_base_intervention	Beta	0.650	0.651	0.14	0.36	0.89
HRQoL improvement for digital technologies	utility_alive_intervention	Beta	0.690	0.691	0.15	0.36	0.93
HRQoL value for death state	utility_death	Fixed	0.000	0.000	0.00	NA	NA
One-off cost for strategy 1 (standard care)	cost_t1	Fixed	£0.00	£0.00	0.00	NA	NA
One-off cost for strategy 2 (digital technologies)	cost_t2	Gamma	£161	£160	£48	£80	£264
Monthly health state cost for medication/drugs	cost_medication	Gamma	£6	£6	£1	£5	£8
Monthly health state cost for GP activity	cost_gp	Gamma	£9	£9	£3	£5	£16
Monthly health state cost for medication prescriptions	cost_prescriptions	Gamma	£1	£1	£0	£0	£1
Monthly health state cost for physiotherapy activity	cost_physio	Gamma	£15	£15	£5	£12	£25
Monthly health state cost for death	cost_death	Gamma	£0	£0	£0	£0	£0
Reduction in medication use due to digital technologies	p_red_medication_digital	Beta	0.100	0.100	0.03	0.05	0.17
Reduction in GP activity due to digital technologies	p_red_gp_digital	Beta	0.300	0.298	0.06	0.14	0.49
Reduction in prescriptions due to digital technologies	p_red_prescription_digital	Beta	0.100	0.100	0.03	0.05	0.17
Reduction in physiotherapy due to digital technologies	p_red_physio_digital	Beta	0.300	0.300	0.05	0.14	0.49
Duration of improvement for HRQoL	duration_utility_impact	Gamma	9.000	8.926	2.69	4.00	15.00
Duration of improvement for health state costs	duration_cost_impact	Gamma	9.000	9.026	2.71	5.00	15.00

Explanation for parameters	Parameter name in R	Distribution	Deterministic	Mean	SD	95 CI-	95 CI+
Engagement with digital technology	uptake	Beta	0.500	0.500	0.15	0.21	0.79
CI = confidence interval; GP = General Practitioner; HRQoL = health-related quality of life; NA = not applicable; SD = standard deviation; SoC = standard of care							

Key assumptions

Table 7-15: Overview of key assumptions

Assumption	Source
Population, intervention and comparator	
The modelled population is a mixed population of patients with mild-to-moderate hip or knee OA aged 16 years and over who have been assessed as suitable for digital management.	Two clinical experts
The model explores the potential value of digital technologies in general – in the absence of evidence, individual technologies are not modelled. The impact of different features (additional features, HCP interaction, duration) are explored based on assumptions.	Two clinical experts
Digital technology replaces part of standard care but does not replace standard care entirely. This is in line with clinical expert opinion on GP visit and physiotherapy resource use reduction being possible with digital technology. Complete replacement of standard care is explored in a scenario.	Three clinical experts
Effectiveness	
The addition of digital technology does not affect survival, it may only affect HRQoL and resource use.	Two clinical experts
In the base-case, HRQoL benefit is assumed based on two studies (one single-arm study[43] and an RCT with a condition-specific outcome measure)[29] due to the absence of robust EQ-5D evidence.	Best available evidence, Nero (2017)[43] and Dieter (2025)[29]
Engagement and uptake	
The effect on HRQoL and health care resource use is assumed to last 9 months, starting 1 month after treatment initiation, which reflects both early disengagement and longer-lasting impact among some users.	Based on opinions from three clinical experts
50% of patients are assumed to engage with and benefit from the digital technology, based on expert opinion and limited evidence.	RW-5[53], Phio economic model[48], Burgess (2024)[54] and four clinical experts
Resource use and costs	
Technology costs are incurred for all patients regardless of individual engagement or attrition (though this may vary by technology), assuming that technology per patient cost estimates provided by the	One clinical expert

Assumption	Source
companies were based on number of patients who take up digital technology.	
An average one-off cost per person per year was applied for digital technologies, based on evidence requests, in the first model cycle. This average was used because submitted cost breakdowns varied in detail and transparency, and modelling individual costs risked comparing non-equivalent inputs.	Two clinical experts
Resource use estimates were obtained from clinical expert elicitation. For scenario 2, getUBetter real-world studies in the general MSK population are used and are assumed to apply to the population with mild-to-moderate hip/knee OA.	One clinical expert
Resource use reduction estimates were obtained from clinical expert elicitation. For scenario 2, getUBetter real-world studies in the general MSK population are used and are assumed to apply to the population with mild-to-moderate hip/knee OA.	One clinical expert
Model implementation and uncertainty	
A standard error of 30% of the mean was assumed to inform parameter uncertainty, in the absence of evidence.	A standard assumption
EQ-5D = EuroQoL 5-dimension; GP = General Practitioner; HCP = health care practitioner; HRQoL = health-related quality of life; MSK = musculoskeletal; OA = osteoarthritis	

Model validation

Clinical expert opinion was sought to assess the face validity of model structure, model inputs and assumptions. Two of the four clinical experts responded to the EAG via email in May 2025, which resulted in some alternative model inputs for resource use and clarification that digital technologies are more likely a (partial) replacement rather than an addition to standard care.

The technical implementation of the model has been reviewed by a second health economist. Stress tests (black box testing) as well as sensitivity and scenario analyses were performed to assess that the model behaves in a way that is, and produces outcomes that are as, expected.

Model analyses

Base-case analysis

The increment cost-effectiveness ratio (ICER) is the main model output. It is calculated based on the difference of total costs for digital technologies minus total costs for standard care, divided by the total QALYs for digital technologies minus total QALYs for standard care.

Probabilistic analysis (PA) is performed with 5,000 iterations. Results are shown in cost-effectiveness planes and cost-effectiveness acceptability curves (CEACs). The expected risk per strategy is calculated, which is composed of expected value of information (EVPI) for the decision and the expected loss that would be incurred if adopting a strategy that was not considered cost-effective. Expected loss curves visualise this expected risk at different thresholds.[76, 77]

Sensitivity analyses

One-way sensitivity analysis (OWSA) and two-way sensitivity analysis (TWSA) (between the parameters uptake, digital technology costs and HRQoL improvement for digital technologies) are performed.

Scenario analyses

Specific scenarios have been performed with this model, including on different categories of technologies, as much as this was possible. This includes different pricing structures and specific mechanisms by which digital technologies may add value for patients and the health care system. The distinguishing features of the digital technologies may have an impact on estimates of technology costs, uptake, effectiveness, i.e. resource use reduction and HRQoL gain, and the duration of these effects. Four scenario analyses were performed to explore these variations between technologies (Table 7-16):

1. Technologies that offer self-management with additional features, such as physiotherapist sessions, hardware or other technology that allows giving real-time feedback, and/or group or community exercise sessions.

Technology costs are increased compared to the base-case, using costs only by the companies with technologies that have these additional features.

2. Technologies that offer self-management without these additional features. Technology costs are decreased compared to the base-case, using costs only provided by the companies with technologies that do not have additional features. Resource use and resource use reduction are directly sourced from a study on a technology without additional features.

3. Technologies that are meant to be used for a short duration and may therefore have shorter effectiveness. A shorter effect duration of 4 months (starting from month 2 to end of month 5) is assumed for these – this is not based on any evidence but is intended to explore the possibility of a shorter duration.

4. Technologies that replace non-pharmacological standard care, i.e. primary and community care, entirely.

Any categorisation is subject to considerable uncertainty and results should be interpreted with caution.

Table 7-16: Analyses based on technology features

Analysis	Technologies likely reflected in analysis	Technology costs	Resource use	HRQoL	Uptake	Duration of effect on resource use/QoL
Base-case	Base-case groups all technologies	Based on all technologies	Based on expert opinion, which may be reflective of technologies with additional features, such as: Good Boost, Hinge, Thrive, Joint Academy, re.flex,	Based on studies (on Joint Academy and re.flex) which may be reflective of technologies with additional features, such as: Good Boost, Hinge, Thrive, Joint Academy, re.flex,	Based on expert opinion, assumption that it does not differ per technology	Assumption based on expert opinion, potentially reflecting technologies with longer duration of use, such as: Good Boost, Hinge, Thrive, getUBetter, Phio Engage, TrackActive Me
Scenario 1, scenario with higher technology costs and additional features	Scenario 1 may be reflective of Good Boost, Hinge, Thrive (but only initial assessment with physiotherapist), Joint Academy and re.flex, but the shorter duration of the last two is separately explored in the dedicated scenario 3	Based on Good Boost, Hinge, Thrive, Joint Academy, re.flex	As in the base-case	As in the base-case	As in the base-case	As in the base-case
Scenario 2, self-management with lower technology costs and limited additional features	This may be most reflective of getUBetter, Pathway through Arthritis, Phio Engage (although Phio Engage includes two-way communication via chat with a physiotherapist so there is uncertainty about where it would be best reflected), TrackActive Me	Based on getUBetter, Phio Engage	Real-world studies on getUBetter resource use reduction	As in the base-case	As in the base-case	As in the base-case
Scenario 3, technologies with shorter duration	This may be most reflective of Joint Academy, re.flex, Pathway through Arthritis	Based on Joint Academy, re.flex	As in the base-case	As in the base-case	As in the base-case	Shorter duration of effect, i.e. 4 months instead of 9 months

Analysis	Technologies likely reflected in analysis	Technology costs	Resource use	HRQoL	Uptake	Duration of effect on resource use/QoL
Scenario 4, technologies that replace standard care	Unclear which technologies can replace standard care	As in the base-case	Assumption, 100% reduction in primary and community care resource use	As in the base-case	As in the base-case	As in the base-case
Disclaimer: Any generalisations/categorisations in this table are subject to uncertainty. HRQoL = health related quality of life; QoL = quality of life						

7.3 Results from the economic modelling

Base-case results

This Section presents exploratory results from the cost-utility model. Due to the heterogeneity across the digital technologies and limited evidence to populate the economic model, the base-case is designed to represent an indicative average, rather than a definitive representation of every digital technology for mild-to-moderate hip/knee OA. The base-case therefore gives an indication of what the cost effectiveness of digital technologies may be under the base-case assumptions. The deterministic base-case model results (ICER of £13,833) suggest that digital technologies for mild-to-moderate hip/knee OA may be cost-effective compared with standard care alone and using a willingness-to-pay (WTP) threshold of £20,000 per QALY (Table 7-17).

The PA indicated similar results to the deterministic base-case. The probabilistic incremental cost per person was calculated as £126 and incremental QALYs as 0.0110 QALYs per person for people using digital technologies compared to standard care, based on 5,000 model iterations (see Table 7-18). This resulted in an ICER of £11,405. A graphical distribution of the results are presented on a cost-effectiveness plane in Figure 7-3 and the incremental net benefit plot in Figure 7-4. The CEAC (see Figure 7-5) indicates that at WTP thresholds of £20,000 and £30,000 per QALY gained the probabilities of digital technologies being cost-effective are 51% and 52%, respectively due to the large uncertainty in model inputs. The expected risks per patient associated with adding digital technologies, at WTP thresholds of £20,000 and £30,000 per QALY gained, were £499 and £717, respectively (these were £593 and £922, respectively, with standard care; see expected loss curve in Figure 7-6). Since the population with mild-to-moderate hip/knee OA in the UK is large (the overall OA and joint pain population was estimated at approximately 10 million patients), this indicates that there may be value in reducing decision uncertainty through further research.

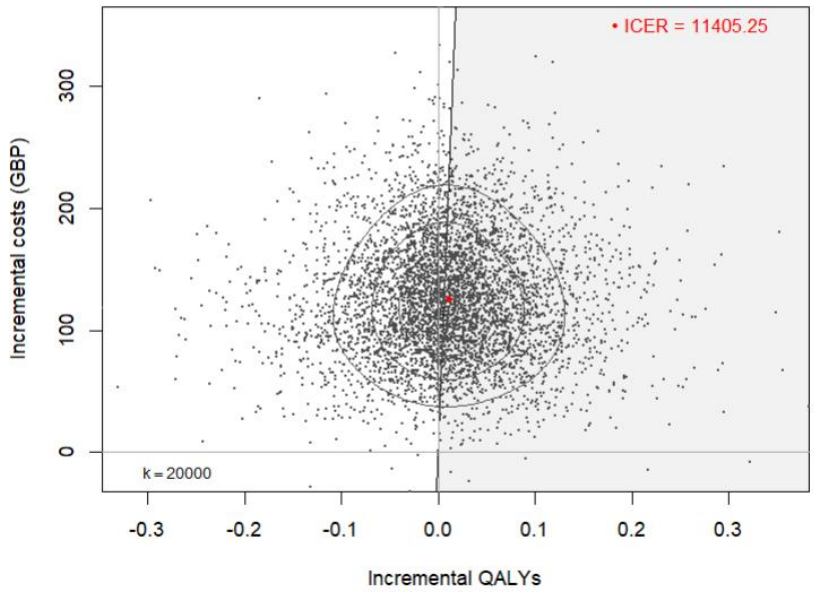
Table 7-17: Deterministic base-case results with 1-year year time horizon

Treatment	Total costs	Total QALYs	Incremental costs	Incremental QALYs	ICER	NMB	NHB
Standard care	£379	0.6624	-	-	-	£12,870	0.6435
Digital technologies (base-case)	£503	0.6714	£124	0.0090	£13,833	£12,925	0.6462
ICER = incremental cost-effectiveness ratio; NMB = net monetary benefit; NHB = net health benefit; QALY = quality-adjusted life year; WTP = willingness-to-pay NMB and NHB were calculated based on a £20,000 per QALY WTP							

Table 7-18: Probabilistic base-case results with 1-year year time horizon

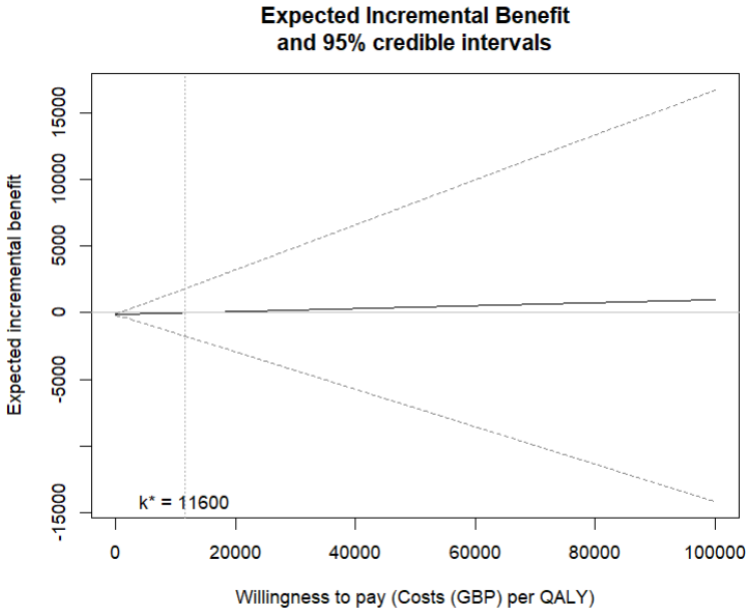
Treatment	Total costs	Total QALYs	Incremental costs	Incremental QALYs	ICER	NMB	NHB
Standard care	£378	0.6571	-	-	-	£12,763	0.6382
Digital technologies	£504	0.6681	£126	0.0110	£11,405	£12,858	0.6429
ICER = incremental cost-effectiveness ratio; NMB = net monetary benefit; NHB = net health benefit; QALY = quality-adjusted life year; WTP = willingness-to-pay NMB and NHB were calculated based on a £20,000 per QALY WTP							

Figure 7-3: Cost-effectiveness plane



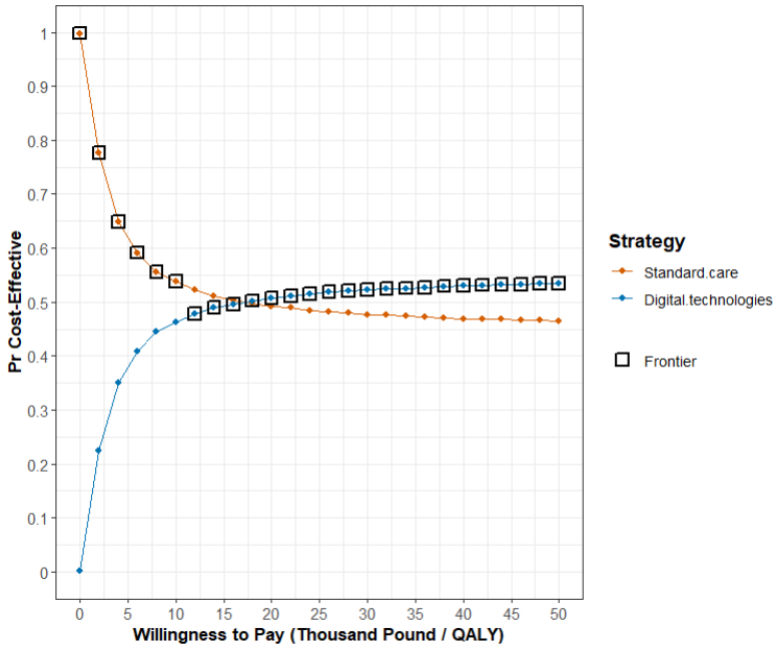
GBP = great British pound; ICER = incremental cost-effectiveness ratio; QALYs = quality-adjusted life years

Figure 7-4: Expected incremental benefit plot



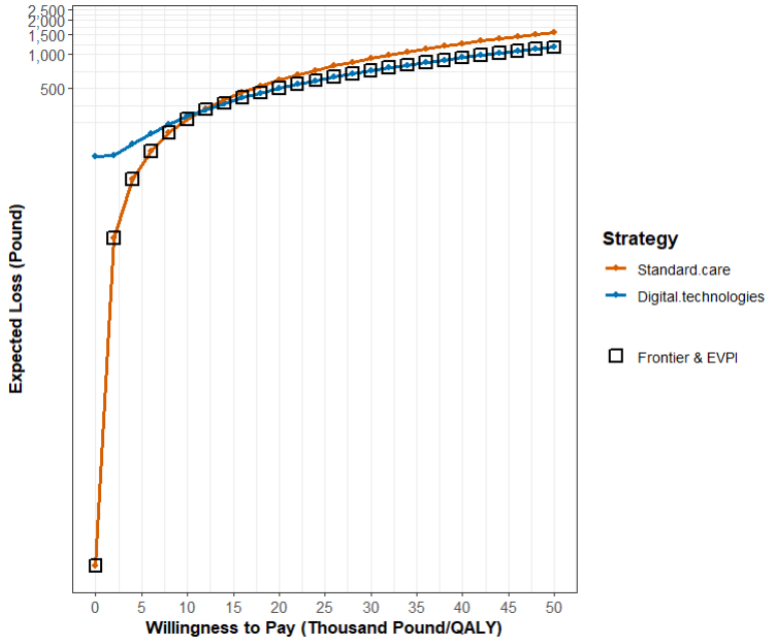
GBP = great British pound; QALY = quality-adjusted life year

Figure 7-5: Cost-effectiveness acceptability curve



QALY = quality-adjusted life year

Figure 7-6: Expected loss curve



QALY = quality-adjusted life year

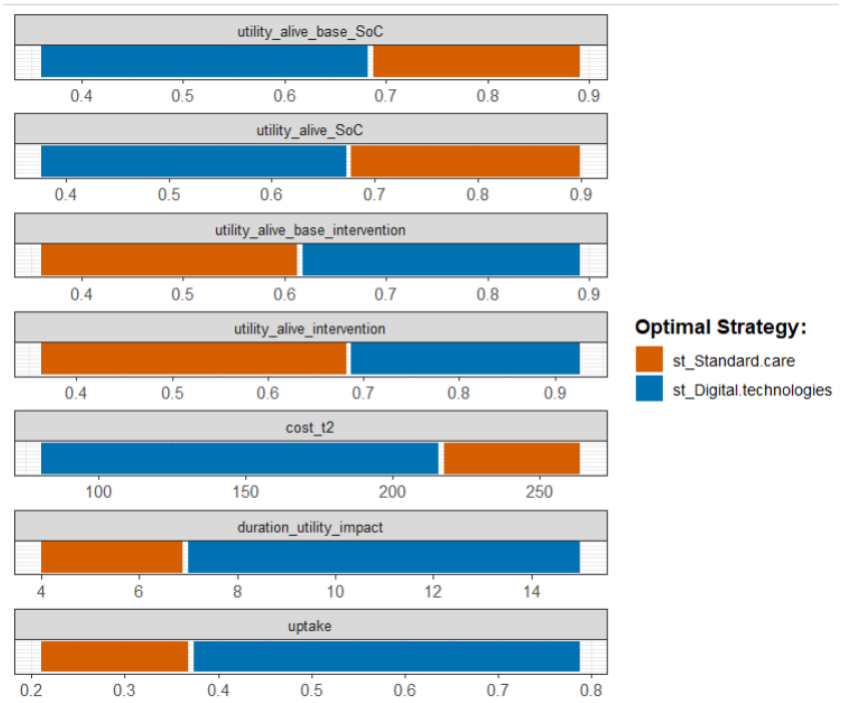
Sensitivity analysis results

The optimal strategy plot (see Figure 7-7) indicated that the utility values are important to determine the most optimal strategy in terms of net monetary benefit (NMB). Given base-case assumptions, the duration of utility impact should be at least 7 months for digital technologies to be cost-effective. Furthermore, given the base-case assumptions, costs of the digital technologies should not exceed £220, and the uptake rate should exceed 37% for digital technologies to be cost-effective.

A OWSA was conducted on all model parameters. The results of this analysis are presented in tornado diagrams in Figures 7-8 to 10. The NMB analysis (see Figure 7-10) suggests that the key drivers of the results are: utility improvement with standard care, utility values at baseline, and costs of the digital technologies.

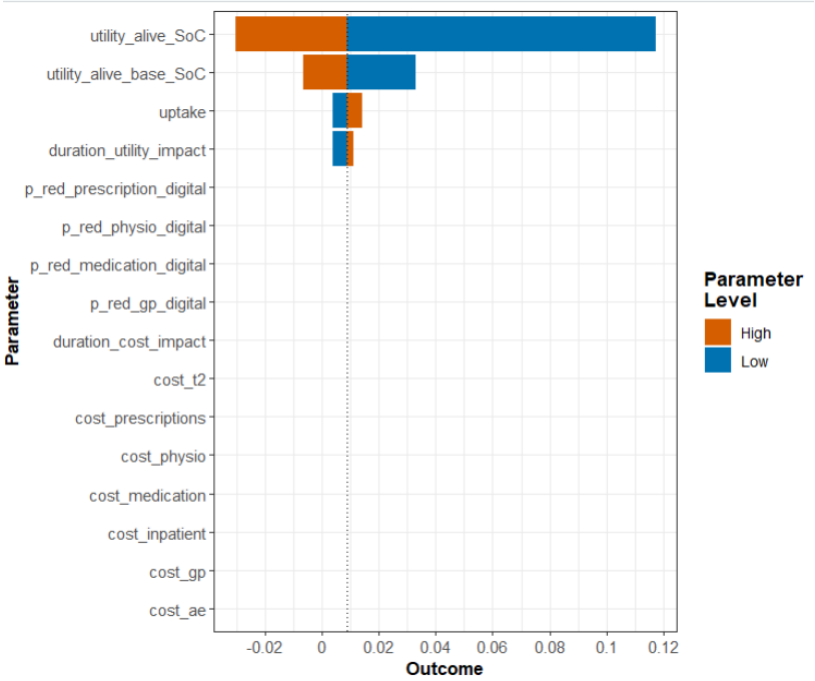
Figures 7-11, 7-12 and 7-13 illustrate deterministic TWSAs evaluating how the NMB changes depending on the level of uptake of the digital technologies, the size of the utility gain attributed to the digital technologies and the additional costs of the digital technologies. The results indicate that digital technologies remained cost-effective regardless of variations in technology costs or uptake levels (within the specified ranges) when the improvement in utility compared to standard care was sufficiently large. However, when technology costs are increased, higher uptake rates are necessary for digital technologies to maintain cost-effectiveness (see Figure 7-13).

Figure 7-7: Optimal strategy plot (NMB)



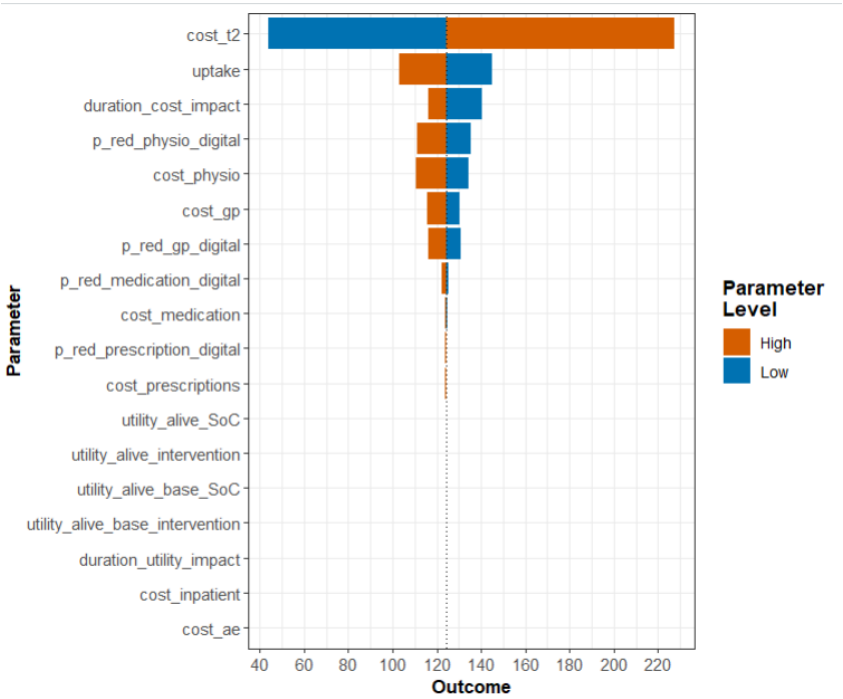
Cost_t2 = digital technologies cost, NMB = net monetary benefit; St = strategy, SoC = standard of care

Figure 7-8: Tornado diagram (incremental QALYs)



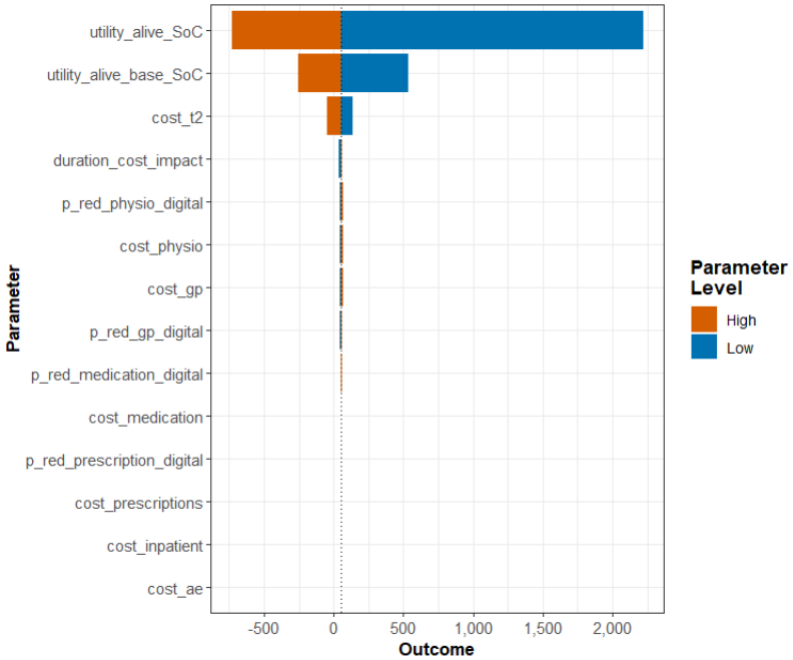
ae = Accident and Emergency; Cost_t2 = digital technologies cost; gp = General Practitioner; St = strategy; SoC = standard of care; p_red = probability of reduction; QALYs = quality-adjusted life year

Figure 7-9: Tornado diagram (incremental costs)



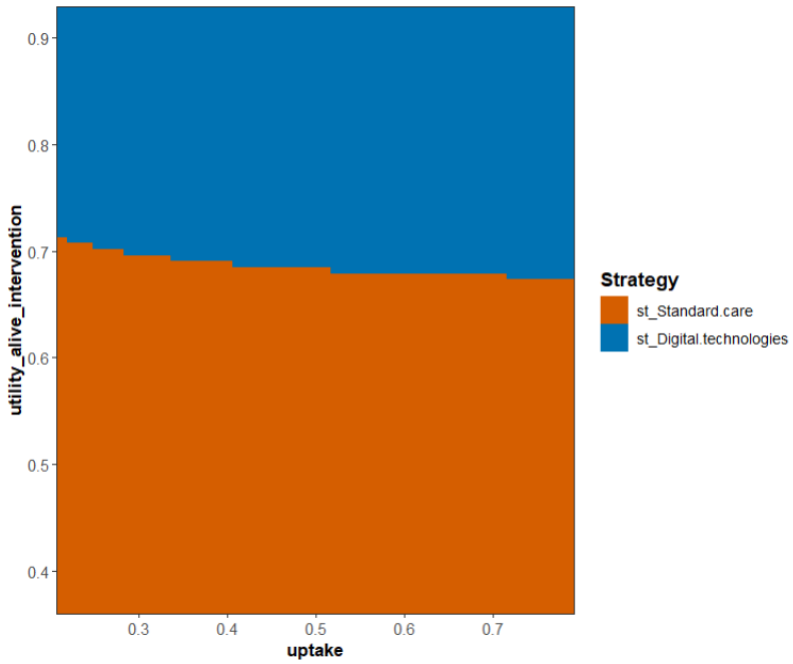
Cost_t2 = digital technologies cost; St = strategy; SoC = standard of care; p_red = probability of reduction; gp = General Practitioner; ae = Accident and Emergency

Figure 7-10: Tornado diagram (incremental NMB)



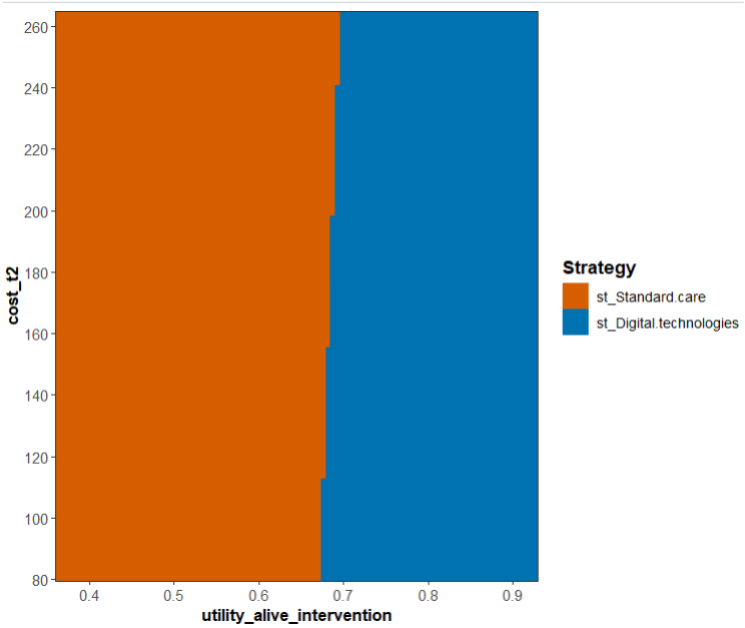
ae = Accident and Emergency; cost_t2 = digital technologies cost; gp = General Practitioner; NMB = net monetary benefit; p_red = probability of reduction; St = strategy; SoC = standard of care

Figure 7-11: Deterministic TWSAs between uptake and HRQoL improvement for digital technologies (NMB)



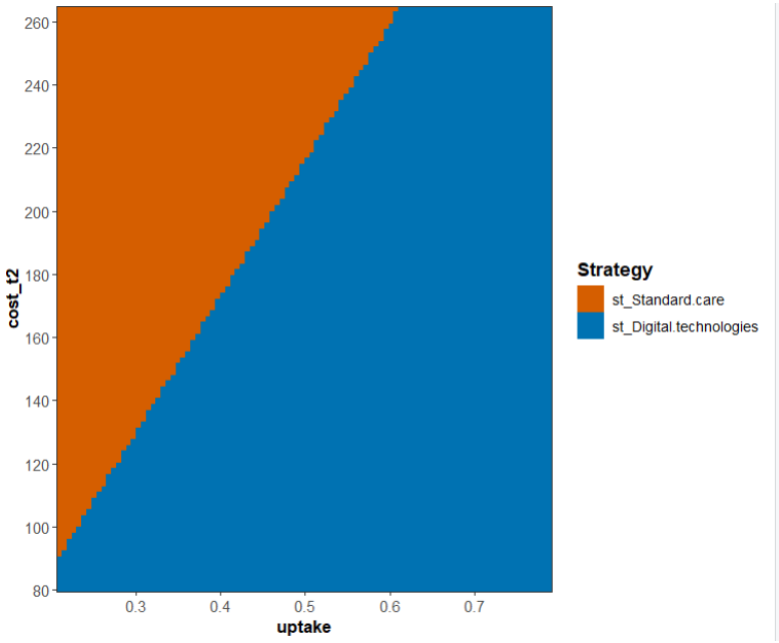
HRQoL = health-related quality of life; NMB = net monetary benefit; St = strategy; TWSAs = two-way sensitivity analyses

Figure 7-12: Deterministic TWSAs between digital technology costs and HRQoL improvement for digital technologies (NMB)



Cost_t2 = digital technologies cost; HRQoL = health-related quality of life; NMB = net monetary benefit; St = strategy; TWSAs = two-way sensitivity analyses

Figure 7-13: Deterministic TWSAs between uptake and digital technology costs (NMB)



Cost_t2 = digital technologies cost; NMB = net monetary benefit; St = strategy; TWSAs = two-way sensitivity analyses

Scenario analysis results

Given the potential variation in digital technologies for mild-to-moderate hip/knee OA, such as pricing, and the uncertainty in input values due to limited evidence, a range of scenarios were considered. Results are presented in Table 7-19 (deterministic) and Table 7-20 (probabilistic). For scenario 1, digital technologies with higher costs and additional features, the probabilistic incremental cost per person was calculated as £179 and the incremental QALYs as 0.0110 QALYs gained per person for people using digital technologies compared to standard care, based on 5,000 model iterations. This resulted in an ICER of £16,191. The deterministic results showed an ICER of £19,559. The volatility of the ICER is explained by the small QALY gains expected.

For scenario 2, digital technologies with lower costs and limited additional features had slightly higher costs (£333) than standard care (£323) and an

incremental QALY gain of 0.0110 QALYs per person, which resulted in an ICER of £934. The QALY gain per person is unchanged as compared to the base-case because there was no evidence of HRQoL impact in the lower cost technologies.

For scenario 3, digital technologies with shorter duration, the probabilistic incremental cost per person was £156 and there was an incremental QALY gain of 0.0056 QALYs per person, resulting in an ICER of £27,903 Probabilistic and deterministic ICERs differ significantly, which is likely caused by the duration parameter being skewed and potentially also by rounding to the next integer.

For scenario 4, which explored the impact of digital technologies replacing all primary and community care appointments, incremental costs were £52 and incremental QALY gains 0.0110, resulting in an ICER of £4,711.

Table 7-19: Deterministic scenario results with 1-year year time horizon

Treatment	Total costs	Total QALYs	Incremental costs	Incremental QALYs	ICER	NMB	NHB
Scenario 1: Technologies with additional features							
Standard care	£379	0.6624	-	-	-	£12,870	0.6435
Digital technologies with higher technology costs and additional features	£554	0.6714	£175	0.0090	£19,559	£12,873	0.6437
Scenario 2: Technologies without additional features							
Standard care	£321	0.6244	-	-	-	£12,927	0.6463
Digital technologies with lower technology costs and	£331	0.6714	£10	0.0090	£1,033	£13,097	0.6548

Treatment	Total costs	Total QALYs	Incremental costs	Incremental QALYs	ICER	NMB	NHB
fewer additional features							
Scenario 3: Technologies used for a limited duration							
Standard care	£379	0.6624	-	-	-	£12,870	0.6435
Digital technologies with shorter duration	£533	0.6664	£155	0.0040	£38,760	£12,795	0.6397
Scenario 4: Digital technologies that replace standard care							
Standard care	£379	0.6624	-	-	-	£12,870	0.6435
Digital technologies with shorter duration	£425	0.6714	£46	0.0090	£5,175	£13,003	0.6501

ICER = incremental cost-effectiveness ratio; NHB = net health benefit; NMB = net monetary benefit; QALY = quality adjusted life year

Table 7-20: Probabilistic scenario results with 1-year year time horizon

Treatment	Total costs	Total QALYs	Incremental costs	Incremental QALYs	ICER	NMB	NHB
Scenario 1: Technologies with additional features							
Standard care	£378	0.6571	-	-	-	£12,763	0.6382
Digital technologies with higher technology costs and additional features	£557	0.6681	£179	0.0110	£16,191	£12,805	0.6403
Scenario 2: Technologies without additional features							
Standard care	£323	0.6571	-	-	-	£12,818	0.6409

Digital technologies with lower technology costs and fewer additional features	£333	0.6681	£10	0.0110	£934	£13,029	0.6514
Scenario 3: Technologies used for a limited duration							
Standard care	£378	0.6571	-	-	-	£12,763	0.6382
Digital technologies with shorter duration	£534	0.6626	£156	0.0056	£27,903	£12,719	0.6359
Scenario 4: Technologies that completely replace standard care (i.e. no GP/physiotherapy visits)							
Standard care	£378	0.6571	-	-	-	£12,763	0.6382
Digital technologies with shorter duration	£430	0.6681	£52	0.0110	£4,711	£12,932	0.6466
GP = General Practitioner; ICER = incremental cost-effectiveness ratio; NHB = net health benefit; NMB = net monetary benefit; QALY = quality adjusted life year							

7.4 Summary and interpretation of the economic evidence

Based on base-case assumptions, it appears plausible that digital technologies for managing mild-to-moderate hip or knee OA could be a cost-effective intervention for the NHS. While the base-case results do not aim to represent every digital technology provider precisely, they offer an indication of the potential impact these technologies might have if implemented. However, the findings should be interpreted with caution due to the limited and preliminary nature of the available data. Some companies either lack evidence for their technologies or did not submit evidence for this evaluation,

and the model relies on pragmatic use of the data that is available. To support an early assessment, the model incorporates a number of simplifying assumptions throughout.

Our exploratory analyses indicated that technologies with higher costs and potentially larger effects (in terms of resource use reduction and HRQoL) may have increased ICERs versus standard care compared with the model base-case that grouped all technologies, while technologies with lower costs and potentially lower effects (in terms of resource use reduction and HRQoL) may have lower ICERs or even dominate standard care, i.e. save costs and provide QALY gains. This is, however, based on very limited evidence and crucially relying on the assumption that HRQoL benefits do not differ between high and low cost technologies, an assumption which was made in the absence of evidence on differential HRQoL benefits between technologies.

Key areas of uncertainty

There was uncertainty in all model parameter groups, including standard care HRQoL and resource use, the improvements in HRQoL and reduction in resource use attainable with digital technology, engagement and long-term adherence (or discontinuation), and technology costs. Further evidence is needed on all these aspects and per technology in order to determine the cost-effectiveness of individual digital technologies for the self-management of mild-to-moderate hip or knee OA.

Sensitivity analyses showed that the key drivers of the results were the impact on HRQoL of digital technologies and standard care, digital technology costs, the reduction in physiotherapy and GP resource use and the duration of the impact of digital technology on resource use. While the potential impact of digital technologies on the progression to severe OA was not modelled, this remains another area of uncertainty. TWSAs showed that technology costs and engagement parameters were not as influential on whether digital technology was cost-effective as long as the utility improvement gained with these over standard care was large enough. In addition, when technology

costs are higher, higher engagement rates are required for digital technology to be considered cost-effective.

Potential additional and long-term impact

This economic evaluation does not include some potential benefits because there was no evidence supporting these or because they are outside of the NICE reference case. First, some companies stated that their digital technology may shorten waiting lists as patients required fewer face-to-face appointments. The EAG found this difficult to quantify and found no evidence that would allow inclusion in the health economic modelling. A reduction in absenteeism due to illness was also not modelled because productivity losses are outside the NICE reference case. There may be a reduction in surgery but there is limited evidence, and this is unlikely to be impactful in a model with a 1-year time horizon in the mild-to-moderate OA population.

In the future, it may be relevant to include long-term effects when evidence on the potential impact of digital technologies on disease progression becomes available. The model structure can be revised to include disease progression, with a severe or generalised OA state with and without joint replacements, and to split up mild and moderate OA states (as depicted in Figure 7-2). Mild, moderate and severe OA health states could be differentiated based on physical functioning, e.g. using the KOOS questionnaire for knee OA. This extended model would also include injection and secondary care referrals, and A&E visits. Furthermore, subgroups of hip and knee OA are likely relevant and should be explored.

Conclusion

The presented analyses showed that there is potential for digital technology to be a cost-effective use of NHS resources in the management of mild-to-moderate hip or knee OA when compared with standard care. Further information is needed to determine the cost-effectiveness of individual digital technologies versus standard care. When evidence becomes available, the model developed for this assessment is flexible enough to include this

evidence, extend the time horizon, add health states that are currently not included and produce analyses per digital technology.

8. Integration into the NHS

ESCAPE-Pain is available, but there is no further information on its use.

getUBetter is reported to be available and used in 17 Integrated Care Systems, and the company claims that no major changes to facilities or infrastructure are needed to adopt the technology, aside from updating websites to include access links.[1] It can be accessed through healthcare professionals, non-clinicians, or by self-referral.

Good Boost is reported to be available and used in the NHS in South Wales, South London, Shropshire and St. Helen's, and the company claims that no system changes are required for adoption.[2] It can be accessed through healthcare professionals, or by self-referral.

Hinge Health is not currently available in the NHS.[3] The company reports that they would not expect any changes to facilities or infrastructure. They expect [redacted]

Joint Academy is reported to be available and used in Bedfordshire, South and West Hertfordshire, Greenwich, North Hampshire and Rushcliffe via a contract with Circle Integrated Care (CIC).[4] The company claims that no changes to facilities or software are required. It can be accessed through healthcare professionals.

Pathway Through Arthritis is reported to be available to, but not used in the NHS.[5] The company claims that it requires no additional infrastructure, or facility changes within the NHS. It would be accessed through healthcare professionals.

Phio Engage is reported to be available to and used in the NHS via 10 different providers/Trusts, and the company claims that no system changes are required.[6] It can be accessed through healthcare professionals, or by self-referral.

It is unclear if Physio Wizard is available, as no information has been provided.

re.flex is not currently available in the NHS.[7] The company considers that there are no major obstacles to its adoption, and access would be through healthcare professionals.

Thrive is reported to have only recently been made available and therefore is not in active use by the NHS yet.[8] The company considers that some system changes would be required, including clinical pathway redesign, and integration with IT systems. It can be accessed through healthcare professionals, or by self-referral.

TrackActiveMe is reported to be available to, but not used in the NHS.[9] The company claims that it requires no additional infrastructure, or facility changes within the NHS. It would be accessed through self-referral.

9. Evidence gap analysis

9.1 Ongoing studies

The EAG knows of one ongoing RCT of Joint Academy versus placebo in knee OA (provided in comments on the EAG report),[10] and only two ongoing studies relevant to the scope, both of which relate to Phio Engage, which are both single arm studies in mild to moderate OA, due to be published in December 2025.[59] Joint Academy and getUBetter also stated in their comments on the EAG report that publications on the effect on EQ-5D and cost respectively are pending.

9.2 Evidence gap analysis

Tables 9-1, 9-2 and 9-3 show the evidence gap analyses for clinical effectiveness and cost effectiveness. Note that Table 9-1 includes both the prioritised (see Table 6-1) and deprioritised (see Appendix C) studies.

Table 9-1: Evidence gap analysis for clinical effectiveness

Outcome type	ESCAPE-Pain	getUBetter	Good Boost	Hinge Health	Joint Academy	Pathway Through Arthritis	Phio Engage	Physio Wizard	re.flex	Thrive	TrackActive Me
PROMS											
HRQoL	1 single arm UK, hip + knee, NR severity RED	No studies RED	No studies RED	No studies RED	1 RCT: UK, knee, NR severity AMBER	No studies RED	1 single arm: UK, hip + knee, NR severity RED	No studies RED	1 RCT: Germany, knee, moderate + severe OA AMBER RED	1 single arm: USA, hip OA, NR severity RED	No studies RED
Pain and stiffness	2 single arm UK, hip + knee, NR severity RED	1 single arm UK, knee + other, NR OA/severity RED	2 single arm: UK, hip + knee + other RED	1 RCT: USA, knee, OA + other, NR severity	1 RCT: UK, knee, NR severity AMBER	No studies RED	1 single arm: UK, hip + knee, mild + moderate RED	No studies RED	1 RCT: Germany, knee, moderate + severe OA AMBER	1 single arm: USA, hip OA, NR severity	1 single arm: RED
Physical function	3 single arm UK, hip +	1 single arm UK, knee +	2 single arm: UK, hip	1 RCT: USA, knee, OA	1 RCT: UK, knee, NR severity	No studies RED	1 single arm: UK, hip	No studies RED	1 RCT: Germany, knee,	1 single arm: USA,	No studies RED

Outcome type	ESCAPE-Pain	getUBetter	Good Boost	Hinge Health	Joint Academy	Pathway Through Arthritis	Phio Engage	Physio Wizard	re.flex	Thrive	TrackActive Me
	knee, NR severity	other, NR OA/severity	+ knee +other	+other, NR severity	AMBER		+ knee, mild + moderate		moderate + severe OA AMBER	hip OA, NR severity	
Self-efficacy	4 single arm UK, hip + knee, NR severity	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED
Psychological outcomes	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	1 single arm: USA, hip OA, NR severity RED	No studies RED
User satisfaction and acceptability	No studies RED	No studies RED	No studies RED	1 single arm: USA, knee, NR OA/severity RED	No studies RED	No studies RED	No studies RED	No studies RED	1 RCT: Germany, knee, moderate + severe OA AMBER	No studies RED	No studies RED

Outcome type	ESCAPE-Pain	getUBetter	Good Boost	Hinge Health	Joint Academy	Pathway Through Arthritis	Phio Engage	Physio Wizard	re.flex	Thrive	TrackActive Me
Activity impairment	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED
Clinical outcomes											
Referrals for injections	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED
Medicine use and appointments	No studies RED	1 single arm UK, knee + other, NR OA/severity RED	No studies RED	No studies RED	1 single arm: Sweden, hip + knee, NR OA/severity RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED
Secondary care referrals	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED
Referrals for surgery	No studies RED	No studies RED	No studies RED	No studies RED	1 single arm: Sweden, hip + knee, NR OA/severity RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED

Outcome type	ESCAPE-Pain	getUBetter	Good Boost	Hinge Health	Joint Academy	Pathway Through Arthritis	Phio Engage	Physio Wizard	re.flex	Thrive	TrackActive Me
Intermediate outcomes											
Intervention adherence, rates of attrition and completion	1 single arm UK, hip + knee, NR severity RED	No studies RED	single arm: UK, hip + knee + other RED	1 RCT: USA, knee, OA + other, NR severity AMBER	1 RCT: UK, knee, NR severity AMBER	No studies RED	No studies RED	No studies RED	1 RCT: Germany, knee, moderate + severe OA AMBER	No studies RED	No studies RED
Intervention related adverse events	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	1 RCT: Germany, knee, moderate + severe OA AMBER	1 single arm: USA, hip OA, NR severity RED	No studies RED
Work productivity /return to full activity	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	1 single arm: USA, hip OA, NR severity RED	No studies RED

Outcome type	ESCAPE-Pain	getUBetter	Good Boost	Hinge Health	Joint Academy	Pathway Through Arthritis	Phio Engage	Physio Wizard	re.flex	Thrive	TrackActive Me
Healthcare professional satisfaction	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED	No studies RED

HRQoL = health-related quality of life; NR = not reported; OA = osteoarthritis; RCT = randomised controlled trial; UK = United Kingdom; USA = United States of America

Table 9-2: Evidence gap analysis for key economic outcomes

Outcomes	Gap in current evidence
Subgroups: impact that different affected OA body parts OA (hip or knee) have on the cost-effectiveness of digital technologies	The difference of using digital technologies for hip or knee OA on resource use, costs, effectiveness and QoL estimates is currently unknown. Current studies capture some potential impact of digital technologies but either do not stratify to account for different types of MSK conditions at baseline or report on only one body part (see Table 9-1 for details on studies per technology for outcome types: intervention adherence, rates of attrition and completion, referrals for injections, medicine use and appointments, secondary care referrals, referrals for surgery, HRQoL). One clinical expert thought that digital technologies might be more impactful for knee OA compared to hip OA. RED
Effectiveness: engagement and adherence	It is not clear how many patients on average are eligible and willing to engage with digital technologies. It is also not clear what the drop-out or discontinuation rates are. Future studies should follow-up patients long-term and record uptake and treatment discontinuation over time. RED

Effectiveness evidence: long-term outcomes	It is not clear if there are any long-term impacts from using digital technologies for mild-to-moderate hip/knee OA, or if the benefits stop after use of the technology is discontinued. Long-term benefits could include sustained improvement in HRQoL, reduction in resource use, and slowed down disease progression. Long-term follow-up is therefore needed, and outcomes should include time to disease progression to severe OA, e.g. based on physical functioning. RED
Effectiveness evidence: effect of variations in digital technology provisions for mild-to-moderate hip/knee OA	Many providers offer a range of services. This includes features such as technology integration, exercise components, educational and behavioural elements, support systems and personalisation. There is little evidence that allows assessing the impact of different functionality of digital technologies on clinical or economic outcomes. Effectiveness evidence therefore should be produced per individual digital technology. RED
HRQoL: most appropriate measure	Currently, clinical studies use a range of different PROMs to capture the potential impact a digital technology may have on HRQoL. Clinical opinion should be sought on the most appropriate and robust HRQoL measure to collect in studies. AMBER
HRQoL studies	There is currently limited evidence of the impact digital technologies may have on HRQoL, measured through EQ-5D (in line with the NICE reference case). The only studies that used EQ-5D were a single-arm study and retrospective cohort study, which suffer from selection bias or confounding (see Table 9-1). RED
Digital technology costs	There is variation in the costs provided by the different providers. Further detail is necessary to be able to estimate the cost per person of individual technologies. AMBER
Resource use: wider healthcare resource use impact of digital technologies for self-management of mild-to-moderate hip/knee OA.	No evidence relevant to the scope of this EVA was available to inform the potential impact of digital technologies on resource use, such as medication use, or reduction in healthcare appointments. Data used in the economic model was based one expert opinion or provided by company's studies in wider MSK populations and included no full text reports. Randomised studies should be conducted in the mild-to-moderate hip/knee OA population. RED

EQ-5D = EuroQol-5 dimensions; EVA = early value assessment; HRQoL = health-related quality of life; MSK = musculoskeletal; NICE = National Institute for Health and Care Excellence; OA = osteoarthritis; PROMs = patient-reported outcome measures; QoL = quality of life

Table 9-3: Evidence gap analysis for digital technology costs

Outcome type	ESCAPE-Pain	getUBetter	Good Boost	Hinge Health	Joint Academy	Pathway Through Arthritis	Phio Engage	Physio Wizard	re.flex	Thrive	TrackActiveMe
Cost of the digital technologies	No answer	Company evidence request document	Company evidence request document	Company evidence request document	Company evidence request document	No answer	Company evidence request document	No answer	Company evidence request document	Company evidence request document	Company response to additional evidence request
Cost related to supporting the digital technologies	No answer	Company response to additional evidence request	No answer	No answer	Company response to additional evidence request	No answer	Company response to additional evidence request	No answer	Company response to additional evidence request	Company response to additional evidence request	Company response to additional evidence request

9.3 Key areas for evidence generation

Further RCTs are required for all interventions, implemented in a way and compared to treatment that are both as similar to actual clinical practice as possible, noting the role of healthcare professionals in addition to the digital technology. They should also ideally be set in the UK NHS.

These should have adequate follow-up, ideally for long enough to observe any effect on disease progression, including the rate of joint replacement, as well as referrals for secondary care and changes in pain and function.

Resource consumption and QoL using EQ-5D should also be measured.

In addition, any future evaluation might also consider accessibility and digital safety/privacy.[10]

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11. Appendix A Search strategies

Searches were conducted to identify studies of digital technologies for managing OA of the hip and knee, as recommended in the Centre for Reviews and Dissemination (CRD) guidance for undertaking reviews in health care. A single set of searches was conducted to identify both clinical and economic evidence, with additional pragmatic searches undertaken for the identification of HRQoL/utility and cost/resource use studies to inform the economic model.

The searches were conducted in a range of resources including research published in the journal literature, conference abstracts and ongoing research. Search strategies combined relevant search terms comprising indexed keywords (e.g. Medical Subject Headings (MeSH)) and free text terms appearing in the titles and/or abstracts of bibliographic database records. Search terms were identified through discussion between the review team, by scanning background literature and key articles already known to the project team, and by browsing database thesauri. The search strategies were developed specifically for each database and the keywords adapted according to the configuration of each database.

Search strategies combined OA terms (not limited to hip and knee OA) with generic terms for digital technologies, and separate searches for the specific named technologies of interest.

Search results were limited to those records published in English, but not limited by study design, or publication status (unpublished or published). Only studies in humans were sought. A publication date range of 2013-present date was applied to the searches to reflect digital technologies currently in use.

The following databases were searched on 24-25 March 2025, from inception to the most recent date available (publication date limits were applied within each strategy):

- MEDLINE and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions (Ovid): 1946 to March 24, 2025
- Embase (Ovid): 1974 to 2025 March 24
- Cochrane Database of Systematic Reviews (CDSR): Issue 3 of 12, March 2025 (https://www.cochranelibrary.com/)
- Cochrane Central Register of Controlled Trials (CENTRAL): Issue 2 of 12, February 2025 (https://www.cochranelibrary.com/)
- NHS Economic Evaluation Database (NHS EED): 2013 - March 2015 [database no longer updated] (https://www.crd.york.ac.uk/CRDWeb/)
- KSR Evidence: to 25.3.25 (https://ksrevidence.com/)

Completed and ongoing trials were identified by searches of the following resources:

- ClinicalTrials.gov: 2013-25.3.25 (https://clinicaltrials.gov/)
- World Health Organization International Clinical Trials Registry Platform (WHO ICTRP): 2013-25.3.25 (https://www.who.int/clinical-trials-registry-platform)

To identify conference proceedings, searches in Embase were not restricted to exclude conference abstracts. A search was also undertaken of the following conference proceedings resource:

- Northern Light Life Sciences Conference Abstracts (Ovid): 2010 - 2025 Week 11

An additional search of the medRxiv preprint server was undertaken. All results retrieved from this resource were treated with due caution as these are preliminary reports of work that have not been certified by peer review.

- medRxiv: 2013-25.3.25 (https://www.medrxiv.org)

Full search strategies are presented below:

Resource	Host	Date range	Date searched	Records found	Records found after deduplication
MEDLINE + In Process	Ovid	1946-24.03.25	25.03.25	1,525	1,475
Embase	Ovid	1974-24.03.25	25.03.25	2,004	939
Northern Light	Ovid	2010-Wk 11 2025	25.03.25	120	53
CDSR	Cochrane Library	Issue 3 of 12, March 2025	25.03.25	3	3
CENTRAL	Cochrane Library	Issue 2 of 12, February 2025	25.03.25	524	21
NHS EED	https://www.crd.york.ac.uk/CRDWeb/	2013-2015	25.03.25	31	31
KSR Evidence	https://ksrevidence.com/	to 25.03.25	25.03.25	91	15
ClinicalTrials.gov	https://clinicaltrials.gov/	2013 - 25.03.25	25.03.25	520	520
WHO ICTRP	https://trialsearch.who.int/	2013 - 25.03.25	25.03.25	413	413
MedRxiv	https://www.medrxiv.org/	2013 - 26.03.25	25.03.25	4	1
HRQoL					
KSR Evidence	https://ksrevidence.com/	to 24.03.25	24.03.25	34	32
TOTAL				**5,269**	**3,261**

MEDLINE and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions (Ovid): 1946 to 24 March 2025
Date searched: 25.03.25
Records found: 1,525

1 exp Osteoarthritis/ 84290
2 ((degenerative or noninflammatory) adj2 arthritis).ti,ab. 1705
3 (osteoarthr$ or osteo-arthr$).ti,ab. 105031
4 arthrosis.ti,ab. 5835
5 (coxartherosis or coxartheroses or coxarthrosis or coxarthroses).ti,ab. 1732
6 malum coxae senilis.ti,ab. 7
7 (gonarthrosis or gonarthroses).ti,ab. 1215
8 osteoarthropathy.ti,ab. 2296
9 or/1-8 133779
10 Mobile Applications/ 14487
11 exp Internet/ 105580
12 exp Cell Phone/ 25504
13 Computers, Handheld/ 4211
14 Therapy, Computer-Assisted/ 7042
15 self care/ and exp software/ 1074

16 Fitness Trackers/ 1270
17 Wearable Electronic Devices/ 11043
18 exp Telemedicine/ 51801
19 Self-Help Devices/ 6168
20 Remote Sensing Technology/ 4677
21 Digital Technology/ 1404
22 (online or web or internet or digital$ or app or apps).ti. 176202
23 ((online or web or internet or digital$ or app or apps) adj3 (based or application$ or intervention$ or program$ or therap$ or technolog$)).ab. 113547
24 ((computer or tech or technolog$ or wearable or cyber) adj3 (based or application$ or intervention$ or consult$ or therap$ or program$)).ti,ab. 116720
25 (phone$ or telephone$ or smartphone$ or cellphone$ or smartwatch$ or text messag$ or SMS or Iphone or Android).ti. 34546
26 ((phone$ or telephone$ or smartphone$ or cellphone$ or smartwatch$ or text messag$ or SMS or Iphone or Android) adj3 (based or application$ or intervention$ or program$ or therap$)).ab. 23468
27 (mobile health or mhealth or m-health or ehealth or e-health).ti. 10099
28 ((mobile health or mhealth or m-health or ehealth or e-health) adj3 (based or application$ or intervention$ or program$ or therap$)).ab. 7247
29 (digital tech$ or digital health$).ti,ab. 15626
30 (telemedicine or tele-medicine or telehealth or tele-health or telemanagement or tele-management or telenursing or tele-nursing or telecare or tele-care or tele-consult$ or teleconsult$ or tele-rehab$ or telerehab$ or tele-physi$ or telephysi$ or teletherap$ or tele-therap$ or tele-psyc$ or telepsyc$ or tele-exercis$ or teleexercis$).ti,ab. 41638
31 ((remote$ or online or digital$ or virtual or mobile or cyber or distance) adj3 (consult$ or deliver$ or program$ or schedul$ or advisor$ or group$ or participat$ or tracker$ or application$ or intervention$ or device$ or technolog$ or care)).ti,ab. 106457
32 ((selfmanag$ or self-manag$ or wearable) adj3 (digital$ or computer$ or software or tech or technolog$)).ti,ab. 4673
33 "re.flex".ti,ab. 78379
34 or/10-33 660401
35 9 and 34 1953
36 ("ESCAPE-pain" or "Orthopaedic Research UK" or Salaso).af. 60
37 (getUBetter or "Get U Better").af. 2
38 ("Good Boost" or Good Boost).af. 7
39 "Hinge Health".af. 29
40 "Joint Academy".af. and 9 27
41 ("Phio Engage" or "Phio Access" or "Phio Collect").af. 0
42 Physio Wizard.af. 0
43 "Re Flex".af. 5
44 (TrackActiveMe or "TrackActive Me" or "Active Health Tech").af. 1
45 "Pathway Through Arthritis".af. 0
46 (Thrive adj3 "Sword Health").af. 0

47 or/36-46 131
48 35 or 47 2063
49 exp animals/ not (exp animals/ and humans/) 5320597
50 48 not 49 2013
51 limit 50 to english language 1900
52 limit 51 to yr="2013 -Current" 1525

Embase (Ovid): 1974 to 24 March 2025
Date searched: 25.03.25
Records found: 2004

1 exp *osteoarthritis/ 97438
2 ((degenerative or noninflammatory) adj2 arthritis).ti,ab. 2079
3 (osteoarthr$ or osteo-arthr$).ti,ab. 144756
4 arthrosis.ti,ab. 6859
5 (coxartherosis or coxartheroses or coxarthrosis or coxarthroses).ti,ab. 1695
6 malum coxae senilis.ti,ab. 4
7 (gonarthrosis or gonarthroses).ti,ab. 1703
8 osteoarthropathy.ti,ab. 2412
9 or/1-8 172256
10 exp *mobile application/ 15752
11 *internet/ 39124
12 exp *mobile phone/ 19819
13 *text messaging/ 3692
14 *personal digital assistant/ 671
15 *computer assisted therapy/ 2778
16 *healthcare software/ 203
17 exp *self-care software/ 3199
18 exp *activity tracker/ 1426
19 *wearable computer/ 2037
20 exp *telemedicine/ 41558
21 assistive technology/ or wearable technology/ or digital technology/ 10815
22 *remote sensing/ 7057
23 *personal monitor/ 226
24 (online or web or internet or digital$ or app or apps).ti. 198722
25 ((online or web or internet or digital$ or app or apps) adj3 (based or application$ or intervention$ or program$ or therap$ or technolog$)).ab. 144892
26 ((computer or tech or technolog$ or wearable or cyber) adj3 (based or application$ or intervention$ or consult$ or therap$ or program$)).ti,ab. 138951
27 (phone$ or telephone$ or smartphone$ or cellphone$ or smartwatch$ or text messag$ or SMS or Iphone or Android).ti. 40649
28 ((phone$ or telephone$ or smartphone$ or cellphone$ or smartwatch$ or text messag$ or SMS or Iphone or Android) adj3 (based or application$ or intervention$ or program$ or therap$)).ab. 30253

29 (mobile health or mhealth or m-health or ehealth or e-health).ti. 10765
30 ((mobile health or mhealth or m-health or ehealth or e-health) adj3 (based or application$ or intervention$ or program$ or therap$)).ab. 7721
31 (digital tech$ or digital health$).ti,ab. 17089
32 (telemedicine or tele-medicine or telehealth or tele-health or telemanagement or tele-management or telenursing or tele-nursing or telecare or tele-care or tele-consult$ or teleconsult$ or tele-rehab$ or telerehab$ or tele-physi$ or telephysi$ or teletherap$ or tele-therap$ or tele-psyc$ or telepsyc$ or tele-exercis$ or teleexercis$).ti,ab. 54624
33 ((remote$ or online or digital$ or virtual or mobile or cyber or distance) adj3 (consult$ or deliver$ or program$ or schedul$ or advisor$ or group$ or participat$ or tracker$ or application$ or intervention$ or device$ or technolog$ or care)).ti,ab. 131819
34 ((selfmanag$ or self-manag$ or wearable) adj3 (digital$ or computer$ or software or tech or technolog$)).ti,ab. 5329
35 "re.flex".ti,ab. 93605
36 or/10-35 724390
37 9 and 36 2671
38 ("ESCAPE-pain" or "Orthopaedic Research UK" or Salaso).af. 55
39 (getUBetter or "Get U Better").af. 3
40 ("Good Boost" or Good Boost).af. 8
41 "Hinge Health".af. 19
42 "Joint Academy".af. and 9 36
43 ("Phio Engage" or "Phio Access" or "Phio Collect").af. 0
44 Physio Wizard.af. 0
45 "Re Flex".af. 22
46 (TrackActiveMe or "TrackActive Me" or "Active Health Tech").af. 1
47 "Pathway Through Arthritis".af. 0
48 (Thrive adj3 "Sword Health").af. 0
49 or/38-48 143
50 37 or 49 2771
51 animal/ 1694482
52 animal experiment/ 3292529
53 (rat or rats or mouse or mice or murine or rodent or rodents or hamster or hamsters or pig or pigs or porcine or rabbit or rabbits or animal or animals or dogs or dog or cats or cow or bovine or sheep or ovine or monkey or monkeys).ti,ab,ot,hw. 8094408
54 or/51-53 8094408
55 exp human/ 27715393
56 human experiment/ 686343
57 or/55-56 27718513
58 54 not (54 and 57) 5996249
59 50 not 58 2668
60 limit 59 to english language 2463
61 limit 60 to yr="2013 -Current" 2004

Northern Light Life Sciences Conference Abstracts (Ovid): 2010 - 2025 Week 11
Date searched: 25.03.25
Records found: 120

1	((degenerative or noninflammatory) adj2 arthritis).ti,ab.	57
2	(osteoarthr$ or osteo-arthr$).ti,ab.	12517
3	arthrosis.ti,ab.	133
4	(coxartherosis or coxartheroses or coxarthrosis or coxarthroses).ti,ab.	68
5	malum coxae senilis.ti,ab.	0
6	(gonarthrosis or gonarthroses).ti,ab.	78
7	osteoarthropathy.ti,ab.	105
8	or/1-7	12802
9	(online or web or internet or digital$ or app or apps).ti.	32743
10	((online or web or internet or digital$ or app or apps) adj3 (based or application$ or intervention$ or program$ or therap$ or technolog$)).ab.	8396
11	((computer or tech or technolog$ or wearable or cyber) adj3 (based or application$ or intervention$ or consult$ or therap$ or program$)).ti,ab.	7467
12	(phone$ or telephone$ or smartphone$ or cellphone$ or smartwatch$ or text messag$ or SMS or Iphone or Android).ti.	6476
13	((phone$ or telephone$ or smartphone$ or cellphone$ or smartwatch$ or text messag$ or SMS or Iphone or Android) adj3 (based or application$ or intervention$ or program$ or therap$)).ab.	1966
14	(mobile health or mhealth or m-health or ehealth or e-health).ti.	1813
15	((mobile health or mhealth or m-health or ehealth or e-health) adj3 (based or application$ or intervention$ or program$ or therap$)).ab.	621
16	(digital tech$ or digital health$).ti,ab.	1674
17	(telemedicine or tele-medicine or telehealth or tele-health or telemanagement or tele-management or telenursing or tele-nursing or telecare or tele-care or tele-consult$ or teleconsult$ or tele-rehab$ or telerehab$ or tele-physi$ or telephysi$ or teletherap$ or tele-therap$ or tele-psyc$ or telepsyc$ or tele-exercis$ or teleexercis$).ti,ab.	7771
18	((remote$ or online or digital$ or virtual or mobile or cyber or distance) adj3 (consult$ or deliver$ or program$ or schedul$ or advisor$ or group$ or participat$ or tracker$ or application$ or intervention$ or device$ or technolog$ or care)).ti,ab.	12679
19	((selfmanag$ or self-manag$ or wearable) adj3 (digital$ or computer$ or software or tech or technolog$)).ti,ab.	545
20	"re.flex".ti,ab.	4750
21	or/9-20	69854
22	8 and 21	138
23	("ESCAPE-pain" or "Orthopaedic Research UK" or Salaso).af.	6
24	(getUBetter or "Get U Better").af.	0

25 ("Good Boost" or Good Boost).af. 0
26 "Hinge Health".af. 6
27 "Joint Academy".af. and 8 2
28 ("Phio Engage" or "Phio Access" or "Phio Collect").af. 0
29 Physio Wizard.af. 0
30 "Re Flex".af. 2
31 (TrackActiveMe or "TrackActive Me" or "Active Health Tech").af. 0
32 "Pathway Through Arthritis".af. 0
33 (Thrive adj3 "Sword Health").af. 0
34 or/23-33 16
35 22 or 34 151
36 limit 35 to yr="2013 -Current" 120

The Cochrane Library
https://www.cochranelibrary.com/
CDSR: Issue 3 of 12, March 2025
Date searched: 25.03.25
Records found: 3

CENTRAL: Issue 2 of 12, February 2025
Date searched: 25.03.25
Records found: 524

#1 MeSH descriptor: [Osteoarthritis] explode all trees 11100
#2 ((degenerative or noninflammatory) NEAR/2 arthritis):ti,ab 164
#3 (osteoarthr* or (osteo NEXT arthr*)):ti,ab22235
#4 arthrosis:ti,ab 741
#5 (coxartherosis or coxartheroses or coxarthrosis or coxarthroses):ti,ab 247
#6 "malum coxae senilis":ti,ab 0
#7 (gonarthrosis or gonarthroses):ti,ab 587
#8 osteoarthropathy:ti,ab 49
#9 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 25208
#10 MeSH descriptor: [Mobile Applications] this term only 2267
#11 MeSH descriptor: [Internet] explode all trees 6700
#12 MeSH descriptor: [Cell Phone] explode all trees 3600
#13 MeSH descriptor: [Computers, Handheld] this term only 391
#14 MeSH descriptor: [Therapy, Computer-Assisted] this term only 1551
#15 MeSH descriptor: [Self Care] this term only 5222
#16 MeSH descriptor: [Software] explode all trees 6452
#17 #15 and #16 192
#18 MeSH descriptor: [Fitness Trackers] this term only 241
#19 MeSH descriptor: [Wearable Electronic Devices] this term only 344
#20 MeSH descriptor: [Telemedicine] explode all trees 5205
#21 MeSH descriptor: [Self-Help Devices] this term only 202
#22 MeSH descriptor: [Remote Sensing Technology] this term only 71

#23 MeSH descriptor: [Digital Technology] this term only 24
#24 (online or web or internet or digital* or app or apps):ti 24062
#25 ((online or web or internet or digital* or app or apps) NEAR/3 (based or application* or intervention* or program* or therap* or technolog*)):ab 27706
#26 ((computer or tech or technolog* or wearable or cyber) NEAR/3 (based or application* or intervention* or consult* or therap* or program*)):ti,ab 13304
#27 (phone* or telephone* or smartphone* or cellphone* or smartwatch* or (text NEXT messag*) or SMS or Iphone or Android):ti 9637
#28 ((phone* or telephone* or smartphone* or cellphone* or smartwatch* or (text NEXT messag*) or SMS or Iphone or Android) NEAR/3 (based or application* or intervention* or program* or therap*)):ab 12176
#29 ("mobile health" or mhealth or "m-health" or ehealth or "e-health"):ti 3013
#30 (("mobile health" or mhealth or "m-health" or ehealth or "e-health") NEAR/3 (based or application* or intervention* or program* or therap*)):ab 3028
#31 ((digital NEXT tech*) or (digital NEXT health*)):ti,ab 1754
#32 (telemedicine or "tele-medicine" or telehealth or "tele-health" or telemanagement or "tele-management" or telenursing or "tele-nursing" or telecare or "tele-care" or (tele NEXT consult*) or teleconsult* or (tele NEXT rehab*) or telerehab* or (tele NEXT physi*) or telephysi* or teletherap* or (tele NEXT therap*) or (tele NEXT psyc*) or telepsyc* or (tele NEXT exercis*) or teleexercis*):ti,ab 8048
#33 ((remote* or online or digital* or virtual or mobile or cyber or distance) NEAR/3 (consult* or deliver* or program* or schedul* or advisor* or group* or participat* or tracker* or application* or intervention* or device* or technolog* or care)):ti,ab 29037
#34 ((selfmanag* or (self NEXT manag*) or wearable) NEAR/3 (digital* or computer* or software or tech or technolog*)):ti,ab 629
#35 "re.flex":ti,ab 9
#36 #10 or #11 or #12 or #13 or #14 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 85929
#37 #9 and #36 1072
#38 "ESCAPE-pain" or "Orthopaedic Research UK" or Salaso 15
#39 getUBetter or "Get U Better" 0
#40 "Good Boost" or Good Boost 0
#41 "Hinge Health" 4
#42 "Joint Academy" 4
#43 "Phio Engage" or "Phio Access" or "Phio Collect" 0
#44 "Physio Wizard" 0
#45 "Re Flex" 10
#46 (TrackActiveMe or "TrackActive Me" or "Active Health Tech") 0
#47 "Pathway Through Arthritis" 0
#48 (Thrive NEAR/3 "Sword Health") 0
#49 #38 or #39 or #40 or #41 or #42 or #43 or #44 or #45 or #46 or #47 or #48 33

#50 #37 or #49 1092

#51 #50 with Cochrane Library publication date Between Jan 2013 and Mar 2025, in Cochrane Reviews 3

#52 #50 not (trial registry record or Clinical trial protocol):pt with Publication Year from 2013 to 2025, in Trials 524

NHS EED: 2013 - March 2015 [database no longer updated]
https://www.crd.york.ac.uk/CRDWeb/
Date searched: 25.03.25
Records found: 31

1 MeSH DESCRIPTOR Osteoarthritis EXPLODE ALL TREES 590
2 (osteoarthr* or osteo-arthr*) IN NHSEED FROM 2013 TO 2025 31
3 (degenerative arthritis) IN NHSEED FROM 2013 TO 2025 0
4 (noninflammatory arthritis) IN NHSEED FROM 2013 TO 2025 0
5 (arthrosis) IN NHSEED FROM 2013 TO 2025 0
6 (coxartherosis or coxartheroses or coxarthrosis or coxarthroses) IN NHSEED FROM 2013 TO 2025 0
7 (malum coxae senilis) IN NHSEED FROM 2013 TO 2025 0
8 (gonarthrosis or gonarthroses) IN NHSEED FROM 2013 TO 2025 0
9 (osteoarthropathy) IN NHSEED FROM 2013 TO 2025 0
10 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9) IN NHSEED FROM 2013 TO 2025 31

KSR Evidence: to 25.03.25
https://ksrevidence.com/
Date searched: 25.3.25
Records found: 91

1 osteoarthr* or "osteo-arthr*" in Title or Abstract 3413 results
2 (degenerative or noninflammatory) NEAR/2 arthritis in Title or Abstract 25 results
3 arthrosis in Title or Abstract 42 results
4 coxartherosis or coxartheroses or coxarthrosis or coxarthroses in Title or Abstract 2 results
5 "malum coxae senilis" in Title or Abstract 0 results
6 gonarthrosis or gonarthroses in Title or Abstract 4 results
7 osteoarthropathy in Title or Abstract 12 results
8 #1 or #2 or #3 or #4 or #5 or #6 or #7 in All text 3471 results
9 online or web or internet or digital* or app or apps in Title 2743 results
10 (online or web or internet or digital* or app or apps) adj3 (based or application* or intervention* or program* or therap* or technolog*) in Abstract 3731 results

11 (computer or tech or technolog* or wearable or cyber) adj3 (based or application* or intervention* or consult* or therap* or program*) in Title or Abstract 2620 results
12 phone* or telephone* or smartphone* or cellphone* or smartwatch* or "text messag*" or SMS or Iphone or Android in Title 649 results
13 (phone* or telephone* or smartphone* or cellphone* or smartwatch* or "text messag*" or SMS or Iphone or Android) adj3 (based or application* or intervention* or program* or therap*) in Abstract 1053 results
14 "mobile health" or mhealth or "m-health" or ehealth or "e-health" in Title 730 results
15 ("mobile health" or mhealth or "m-health" or ehealth or "e-health") adj3 (based or application* or intervention* or program* or therap*) in Abstract 787 results
16 "digital tech*" or "digital health*" in Title or Abstract 740 results
17 telemedicine or "tele-medicine" or telehealth or "tele-health" or telemanagement or "tele-management" or telenursing or "tele-nursing" or telecare or "tele-care" or "tele consult*" or teleconsult* or "tele rehab*" or telerehab* or "tele physi*" or telephysi* or teletherap* or "tele therap*" or "tele psyc*" or telepsyc* or "tele exercis*" or teleexercis* in Title or Abstract 1601 results
18 (remote* or online or digital* or virtual or mobile or cyber or distance) adj3 (consult* or deliver* or program* or schedul* or advisor* or group* or participat* or tracker* or application* or intervention* or device* or technolog* or care) in Title or Abstract 4113 results
19 (selfmanag* or "self manag*" or wearable) adj3 (digital* or computer* or software or tech or technolog*) in Title or Abstract 287 results
20 "Re Flex" in Title or Abstract 0 results
21 #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19 or #20 in All text 10652 results
22 #21 and #8 in All text 91 results
23 "ESCAPE-pain" or "Orthopaedic Research UK" or Salaso in All text 0 results
24 getUBetter or "Get U Better" in All text 0 results
25 "Good Boost" or Good Boost in All text 0 results
26 "Hinge Health" in All text 0 results
27 "Joint Academy" in All text 0 results
28 "Phio Engage" or "Phio Access" or "Phio Collect" in All text 0 results
29 "Physio Wizard" in All text 0 results
30 "Re Flex" in All text 0 results
31 TrackActiveMe or "TrackActive Me" or "Active Health Tech" in All text 0 results
32 "Pathway Through Arthritis" in All text 0 results
33 Thrive adj3 "Sword Health" in All text 0 results
34 #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 in All text 0 results
35 #22 or #34 in All text 91 results

ClinicalTrials.gov: 2013-25.03.25
https://clinicaltrials.gov/
Date searched: 25.03.25
Records found: 520

Limits: Searched disease term in “Condition/disease” field (synonyms automatically searched: Arthrosis ; Degenerative joint disease ; Osteoarthrosis ; arthritis osteoarthritis ; osteoarthritis arthritis) AND intervention terms as listed in “Intervention/treatment” field in basic search

Date range: 2013-current (study start date)

Search terms:

Search term	Records found
Osteoarthritis + Android OR cellphone OR Iphone	7
Osteoarthritis + app OR apps	53
Osteoarthritis + cyber OR digital OR internet OR online OR web	112
Osteoarthritis + distance OR remote OR virtual	102
Osteoarthritis + ehealth OR "e-health" OR mhealth OR "m-health"	26
Osteoarthritis + smartwatch OR wearable	35
Osteoarthritis + SMS OR "text message" OR "text messaging"	24
Osteoarthritis + tech OR technologies OR technology	72
Osteoarthritis + telecare OR "tele-care" OR "tele-consult" OR teleconsult	2
Osteoarthritis + "tele-exercise" OR teleexercise OR telehealth OR "tele-health"	26
Osteoarthritis + telemanagement OR "tele-management" OR telemedicine OR "tele-medicine"	20
Osteoarthritis + telenursing OR "tele-nursing" OR "tele-physiotherapy" OR telephysiotherapy	0
Osteoarthritis + "tele-psychiatry" OR telepsychiatry OR "tele-rehabilitation" OR telerehabilitation	29
Osteoarthritis + "ESCAPE-Pain" OR getUBetter OR "Get U Better" OR "Good Boost" OR Good Boost OR "Hinge Health" OR "Joint Academy"	0

Osteoarthritis + "Pathway Through Arthritis" OR "Phio Engage" OR "Phio Access" OR "Phio Collect" OR "Physio Wizard" OR "re.flex" OR Thrive OR TrackActiveMe	12
Total before deduplication	**520**
Total after deduplication	**339**

WHO ICTRP: 2013–25.03.25
https://trialsearch.who.int/
Date searched: 25.03.25
Records found: 413

Limits: Searched disease term in “Condition” field (with synonyms: Arthroses; Arthrosis; Degenerative Arthritides; Degenerative Arthritis; Osteoarthritides; osteoarthritis; Osteoarthroses; Osteoarthrosis; Osteoarthrosis Deformans) AND intervention terms as listed in “Intervention” field (without synonyms) in Advanced Search

Date range: 2013-current (date of registration)

Search terms:

Search term	Records found
Osteoarthritis + Android OR cellphone OR Iphone	3
Osteoarthritis + app OR apps	63
Osteoarthritis + cyber OR digital OR internet OR online OR web	141
Osteoarthritis + distance OR remote OR virtual	82
Osteoarthritis + ehealth OR “e-health” OR mhealth OR “m-health”	5
Osteoarthritis + smartwatch OR wearable	17
Osteoarthritis + SMS OR “text message” OR “text messaging”	13
Osteoarthritis + tech OR technologies OR technology	44
Osteoarthritis + telecare OR “tele-care” OR “tele-consult” OR teleconsult	0
Osteoarthritis + “tele-exercise” OR teleexercise OR telehealth OR “tele-health”	15
Osteoarthritis + telemanagement OR “tele-management” OR telemedicine OR “tele-medicine”	4
Osteoarthritis + telenursing OR “tele-nursing” OR “tele-physiotherapy” OR telephysiotherapy	0

Osteoarthritis + “tele-psychiatry” OR telepsychiatry OR “tele-rehabilitation” OR telerehabilitation	24
Osteoarthritis + “tele-psychology” OR telepsychology OR teletherapy OR “tele-therapy”	0
Osteoarthritis + “ESCAPE-Pain” OR getUBetter OR “Get U Better” OR “Good Boost” OR Good Boost OR “Hinge Health” OR “Joint Academy”	2
Osteoarthritis + “Pathway Through Arthritis” OR “Phio Engage” OR “Phio Access” OR “Phio Collect” OR “Physio Wizard” OR “re.flex” OR Thrive OR TrackActiveMe	0
Total before deduplication	**413**
Total after deduplication	**352**

medRxiv: 2013-25.03.25
https://www.medrxiv.org/
Date searched: 26.03.25
Records found: 4

Date range: 2013-current (date posted)

Searched Title field in Advanced Search

Search terms:

Search term	Records found
Osteoarthritis Android	0
Osteoarthritis cellphone	0
Osteoarthritis Iphone	0
Osteoarthritis app	0
Osteoarthritis apps	0
Osteoarthritis application	1
Osteoarthritis applications	0
Osteoarthritis cyber	0
Osteoarthritis digital	0
Osteoarthritis internet	0
Osteoarthritis online	0
Osteoarthritis web	0
Osteoarthritis distance	0
Osteoarthritis remote	0

Osteoarthritis virtual	0
Osteoarthritis ehealth	0
Osteoarthritis "e-health"	0
Osteoarthritis mhealth	0
Osteoarthritis "m-health"	0
Osteoarthritis mobile	1
Osteoarthritis smartwatch	0
Osteoarthritis wearable	1
Osteoarthritis SMS	0
Osteoarthritis text	0
Osteoarthritis texting	0
Osteoarthritis tech	0
Osteoarthritis technologies	0
Osteoarthritis technology	0
Osteoarthritis telecare	0
Osteoarthritis "tele-care"	0
Osteoarthritis "tele-consult"	0
Osteoarthritis teleconsult	0
Osteoarthritis "tele-exercise"	0
Osteoarthritis teleexercise	0
Osteoarthritis telehealth	1
Osteoarthritis "tele-health"	0
Osteoarthritis telemanagement	0
Osteoarthritis "tele-management"	0
Osteoarthritis telemedicine	0
Osteoarthritis "tele-medicine"	0
Osteoarthritis telenursing	0
Osteoarthritis "tele-nursing"	0
Osteoarthritis "tele-physiotherapy"	0
Osteoarthritis telephysiotherapy	0
Osteoarthritis "tele-psychiatry"	0
Osteoarthritis telepsychiatry	0
Osteoarthritis "tele-rehabilitation"	0
Osteoarthritis telerehabilitation	0
Osteoarthritis "tele-psychology"	0
Osteoarthritis telepsychology	0
Osteoarthritis teletherapy	0
Osteoarthritis "tele-therapy"	0

Osteoarthritis "ESCAPE-Pain"	0
Osteoarthritis getUBetter	0
Osteoarthritis "get U Better"	0
Osteoarthritis "Good Boost"	0
Osteoarthritis Good Boost	0
Osteoarthritis "Hinge Health"	0
Osteoarthritis "Joint Academy"	0
Osteoarthritis "Pathway Through Arthritis"	0
Osteoarthritis "Phio Engage"	0
Osteoarthritis "Phio Access"	0
Osteoarthritis "Phio Collect"	0
Osteoarthritis "Physio Wizard"	0
Osteoarthritis "re.flex"	0
Osteoarthritis Thrive	0
Osteoarthritis TrackActiveMe	0
Total before deduplication	**4**
Total after deduplication	**4**

Health Related Quality of Life

KSR Evidence: to 24.03.25
https://ksrevidence.com/
Date searched: 24.03.25
Records found: 34

1 osteoarthr* or "osteo-arthr*" in Title or Abstract 3413 results
2 (degenerative or noninflammatory) adj2 arthritis in Title or Abstract 25 results
3 arthrosis in Title or Abstract 42 results
4 coxartherosis or coxartheroses or coxarthrosis or coxarthroses in Title or Abstract 2 results
5 "malum coxae senilis" in Title or Abstract 0 results
6 gonarthrosis or gonarthroses in Title or Abstract 4 results
7 osteoarthropathy in Title or Abstract 12 results
8 #1 or #2 or #3 or #4 or #5 or #6 or #7 in All text 3471 results
9 "Quality adjusted life" or "quality of life index" in Title or Abstract 844 results
10 sf6D or "sf 6D" or "sf-6D" or "short form 6D" or "shortform 6D" or "sf six D" or "sfsixD" or "shortform six D" or "short form six D" in Title or Abstract 27 results
11 QALY* or DALY* or HALY* or YHL or HYES or YPLL or YHLL or qald* or qale* or qtime* or AQoL* in Title or Abstract 750 results

12 timetradeoff or "time tradeoff" or "time trade-off" or "Time trade off" or TTO or "Standard gamble*" or "willingness to pay" in Title or Abstract 372 results
13 HSUV* or "health state* value*" or "health state* preference*" or HSPV* in Title or Abstract 41 results
14 utilit* adj3 ("quality of life" or valu* or scor* or measur* or health or life or estimat* or elicit* or disease*) in Title or Abstract 692 results
15 utilities or disutili* in Title or Abstract 250 results
16 #9 or #10 or #11 or #12 or #13 or #14 or #15 in Title or Abstract 1937 results
17 #8 and #16 in Title or Abstract 34 results

12. Appendix B Excluded studies

Reason for exclusion	**Citation**
Intervention	Clohessy (2024)[78]
	Kloek (2018)[79]
	Murphy (2018)[80]
Outcomes	Berry (2022)[81]
	Burgess (2024)[54]
	Che Hasan (2020)[82]
	Hurley (2013)[83]
	Ryan (2025)[84]
	Truong (2024)[85]
	Wanless (2022)[86]
Unobtainable (conference abstract only)	Dahlberg (2017)[87]

13. Appendix C Deprioritised studies (included in Evidence gap analysis)

Study ID	Country	OA severity	Design	Joint	Sample size	Intervention adherence,	Medicine use and	Referrals for surgery	Health-related quality of life	Pain and stiffness	Physical function	Self-efficacy	User satisfaction
Wilson (2024)[37]	UK	NR OA/severity	Single arm trial	Hip + knee + lower back	34	yes	no	no	no	yes	yes	no	no
Smittenaar (2017)[88]	USA	NR OA/severity	Single arm trial	One knee	41	yes	no	no	no	yes	yes	no	yes
Dahlberg (2016)[89]	Sweden	NR	Single arm trial	Hip + knee	53	yes	no	no	no	yes	no	yes	no
Dahlberg (2017)[90]	USA	NR	Single arm observational	Hip + knee	101	no	no	no	no	yes	yes	no	no
Dahlberg (2020)[91]	Sweden	NR	Single arm observational	Hip + knee	920	yes	no	no	yes	yes	yes	no	no
Dahlberg (2023)[92]	UK	Severe (on joint replacement waiting list)	Single arm observational	Hip + knee	110	yes	no	no	no	yes	yes	no	no
Kiadaliri (2023)[93]	Sweden	NR	Single arm observational	Hip + knee	21688	no	no	no	yes	yes	yes	yes	no

Study ID	Country	OA severity	Design	Joint	Sample size	Intervention adherence,	Medicine use and	Referrals for surgery	Health-related quality of life	Pain and stiffness	Physical function	Self-efficacy	User satisfaction
Nero (2017)[43]	Sweden	NR	Single arm trial	Hip + knee	350	yes	yes	yes	yes	yes	yes	no	no
Nero 2018[94]	Sweden	NR	Single arm trial	Hip + knee	350	no	no	no	yes	yes	yes	yes	no

Note that none of the studies included the outcomes: work productivity, healthcare professional satisfaction, referrals for injections, secondary care referrals, psychological outcomes, or intervention related adverse events.

OA = osteoarthritis; NR = not reported; UK = United Kingdom; USA = United States of America

14. Appendix D Intervention details

Study name Intervention	Study ID	Intervention details
DRKS00030932 re.flex	Dieter (2025)[29]	The intervention group received re.flex© (2019, KINETO TECH REHAB SRL, Romania), a 3 month training programme with exercises guided by use of an app and two wearable motion sensors attached proximally and distally to the OA-affected knee joint. The primary focus of the intervention was to strengthen knee extensors, knee flexors, and hip abductors. Further exercises aimed for joint mobilisation, muscle stretching, and balance training. Different types (e.g., open and closed kinetic chain), exercise variations (e.g. short or long lever arms, elastic resistance bands), and poses (supine, sitting, and standing) were used to allow progression of training loads. Additionally, the user could choose one of two difficulty levels for strengthening exercises, of which the lower one was set as default. Details on the progressively designed programme with dosage principles and objectives are described in the Appendix p 3. All training sessions were conducted self-directed at home. At baseline, the patient was introduced into download, login into the free user account and usage of the app, sensors, and dosage principles by the study staff. The app provided the exercises with text descriptions and videos. Using biofeedback, the patient was asked to align his virtual limb to the target condition displayed with another avatar in order to control movement execution, pre-defined range of motion, movement velocity, and number of repetitions. Visual and auditive feedback were further provided by a movement bar, a real-time rating of movement quality, and auditive signal whenever reaching the end position of a movement. If an exercise was not performed correctly, verbal instructions were given. Further app features allowed to pause or skip exercises, rate pain and perceived exertion during exercise sessions, remind users of upcoming training sessions via push notification, monitor training progress with statistics, and allow to contact the app provider in case of technical issues via an app messenger service. A recommendation to pause training and to contact the physician in charge was given if the maximum pain level was entered. In the context of the study, medical issues (AEs) were reported to the study personal via email or phone call. Additionally, patients did receive information on how to deal with

Study name Intervention	Study ID	Intervention details
		increasing pain during or after exercising, if applicable. All information given at baseline were provided orally and written on a fact sheet and an instruction manual. Details and screenshots of the app features are displayed in Figure 1 and the Appendix 5-11.
		Participants in the control group did not receive any study intervention, but, in correspondence to the intervention group, were allowed to utilise usual care. Furthermore, participants were given the opportunity to use re.flex after study completion.
iBEAT-OA Joint Academy	Gohir (2021)[30]	6-week digitally delivered programme accessed via an iOS (Apple) or Google Play (Alphabet) app. It provided the intervention group with daily exercises and informative texts. The open- and closed-chain exercise instructions focused on neuromuscular leg strengthening and core stability and performance, as well as balance enhancement, as exemplified by doing sit-to-stand and stair-climbing exercises. These exercises were adjusted by the programme in regard to degrees of complexity, load, and difficulty in relation to each participant's response after doing the exercise, classified as too easy, good, or too difficult. The educational sessions covered the basics of OA, its treatment, self-managing symptoms, the benefits of behavioural change and maintaining a healthy lifestyle. Each educational session was followed by a quiz to ensure that participants had understood the key messages. Adherence was encouraged by daily emails or smartphone notifications, or by the physiotherapist via asynchronous chat or telephone during the study period.
		The usual care group was advised to continue with management of knee OA as recommended by their GP prior to trial recruitment. This involves use of core and adjunctive treatments, per NICE guidelines, and a self-management plan was developed, with patients able to initiate further consultations with GPs and therapists and referred to hospital specialists as required. Participants in the usual care group could continue to seek health care input for their knee pain as required during the duration of their study participation. Additionally, some participants in the usual care group were given a patient information leaflet on knee OA developed by Versus Arthritis by their GP or therapist.

Study name Intervention	Study ID	Intervention details
ISRCTN 13307390 Hinge Health	Mecklenburg (2018)[31]	Participants received a tablet computer with the Hinge Health application installed, and two custom Bluetooth sensors with straps to be used on the upper and lower leg during the in-app exercise therapy. Participants were assigned a personal coach that provided support and accountability throughout the programme and were placed in a team to provide peer support through a discussion feed within the app. Participation was completed entirely remotely through the app, at times and places chosen by the participant. Reminders were provided by text message and email if the participant was not engaging at the recommended intensity with the programme. On a weekly basis, participants in the DCP were set the goal of completing 3 sessions of sensor-guided exercise therapy, reading one to two education articles, logging their symptoms at least twice, performing CBT (subset of weeks only), working at weight loss (if overweight), and tracking at least three 30-minute sessions of aerobic activities. Details of each of these components of the DCP are described elsewhere. Each participant also maintained access to TAU.
		The control group received three pieces of education, presented digitally, that is also part of the Hinge Health DCP. These articles discussed the importance of self-care, how to deal with setbacks in knee pain, and how to manage communication and relationships when living with CKP. The control group maintained access to TAU and were informed that they would be reconsidered for the programme when new places became available following the 12-week study.
NR ESCAPE-Pain	Hurley (2016)[32]	The programme (described in detail at http://www.escape-pain.org/) was supervised by two physiotherapists in three inner London leisure centres. Briefly, participants attended 12 sessions (two sessions per week for 6 weeks) each comprised of a 25-minute education component and 45-minute exercise component. The education is a supervisor-guided theme discussions giving information, self-management and coping advice and incorporates behavioural change techniques. The exercise is an individualised, progressive regimen circuit that helps participants come to appreciate exercise is a safe, effective self-management strategy that reduces the impact of OA.
NR	Waller (2024)[33]	[redacted]

Study name Intervention	Study ID	Intervention details
Good Boost		[redacted]
	Wilson (2024)[37]	The exercise component consisted of a 40-minute personalised AI generated programme, based on information entered by participants in the Good Boost exercise app (HUB v1.22, Good Boost Wellness, UK), including the level of water confidence, MSK symptoms, functional limitations, and energy level. Participants were supported, as required, by NHS professionals in attendance at the pool and facilitators trained in the use of the application, to register on the app and log-in at each visit. Exercise programmes were delivered on individual waterproof tablet computers poolside provided by Good Boost Wellbeing and funded by the project grant. Participants exercised in a group of up to eight and were supported by NHS rehabilitation professionals in the water, and poolside by a trained volunteer. Aqua rehabilitation equipment was available for use during exercise sessions. On completion of an exercise session, participants could rate their perceived effort and like/dislike of each exercise on the app to inform subsequent exercise prescription. Post-session complimentary tea and coffee was provided in the leisure centre atrium to encourage connectivity between participants and peer to peer support. Participants could attend beyond six sessions if they wished.
NR	Thacker (2025)[35]	[redacted]
Phio Engage	Thacker (2025)[34]	[redacted]

Study name Intervention	Study ID	Intervention details
		[redacted]
NR Thrive	Janela (2022)[36]	A home-based DI comprised of exercise, education, and CBT, under the monitoring of a dedicated PT. Sword's digital therapist is an FDA-listed, class II medical device, which is composed of three interconnected components: (1) a motion capture system composed of proprietary wearable motion-tracking sensors (inertial motion units capable of 9-axis movement capture), (2) a mobile App that comes pre-installed on an Android-based tablet, which guides the patient in each exercise session, and (3) a Web-based portal that allows the PT to define and edit the programme (add/remove/edit exercises, difficulty levels, and goals) and gathers all the information from every session enabling remote monitoring (through analysis of patient performance, including correct and incorrect movements as well as the range of motion). Exercise sessions were performed using sensors placed over the explanation of that exercise. An execution interface was subsequently shown, with real-time audio and video feedback based on data captured by the motion trackers. For each correct repetition, the patient earned from 1 to 5 stars, depending on the range of motion of that specific movement in comparison to the target. The recommended exercise frequency was at least 3 sessions per week during a 12-weeks intervention (although early discharge was possible depending on the condition and PT assessment).
NR getUBetter	Walker	getUBetter was installed into every GP practice across Wandsworth CCG in 2018/2019.
NR TrackActiveMe	Active Health Tech Ltd[39]	NR

AEs = adverse events; AI = artificial intelligence; CCG = Clinical Commissioning Group; FDA = Food and Drug Administration; GP = General Practitioner; MSK = musculoskeletal; NHS = National Health Service; NICE = National Institute for Health and Care Excellence; NR = not reported; OA = osteoarthritis; PT = physical therapist; TAU = treatment as usual

15. Appendix E Risk of bias of RCTs

Study ID	Domain 1 - risk of bias arising from the randomisation process	Domain 2 - risk of bias due to deviations from the intended interventions	Domain 3 - missing outcome data	Domain 4 - risk of bias in measurement of the outcome	Domain 5 - risk of bias in selection of the reported result	Overall risk of bias
Gohir (2021)[30]	Low	Low	Some concerns	Low	Some concerns	Some concerns
Mecklenburg 2018)[31]	Low	Some concerns	Some concerns	Some concerns	Some concerns	Some concerns
Dieter (2025[29]	Low	Low	Low	Some concerns	Low	Some concerns

16. Appendix F Implementation of the computational model

The computational model was implemented in the statistical software R, using a modular structure with several custom-built functions:

- f_input: This function generates a structured data frame containing all input parameters required for the PA. It incorporates a variety of probability distributions (e.g., beta, gamma, log-normal) as well as fixed values to capture uncertainty in model parameters such as transition probabilities, utilities, and costs.

- f_model: This function simulates the state-transition model using a Markov framework. It calculates expected costs, QALYs, and LYs for two treatment strategies over a defined time horizon.

- f_wrapper: This function serves as a wrapper to conduct sensitivity analyses using the dampack package. It executes the health economic model, structures outputs for use with dampack::run_owsa_det(), and supports the analysis of intermediate results (e.g., costs and QALYs over time). It also provides the underlying Markov traces.

To replicate the main results, the script ‘Main.R’ can be executed. Uncertainty analyses, including the generation of the incremental cost-effectiveness plane, CEACs, and tornado diagrams, can be run via ‘Sensitivity analyses.R’. Intermediate outcomes such as disaggregated costs, QALYs by cycle, and state occupancy over time can be explored through the script ‘Intermediate results.R’.

17. Appendix G Clinical experts consultation

Expert 1

EQ-5D-5L utility scores in this group tend to range between 0.60 and 0.70, reflecting the impact of pain, reduced mobility, and activity limitations. Digital technologies can offer a meaningful HRQoL boost (approximately +0.05–0.08 EQ-5D) for patients with mild-to-moderate OA, with the potential to sustain improvements for at least 6 months, especially when used in conjunction with primary care support.

In standard care for mild-to-moderate hip or knee OA, common resource use items include: GP consultations, Physiotherapy referrals, Analgesics and anti-inflammatory medications and, Secondary care referrals if symptoms persist or worsen.

Digital self-management technologies can potentially reduce the need for: GP visits (by supporting symptom tracking and education), In-person physiotherapy (by offering guided home-based exercises) and, Medication use (due to improved physical function and pain management). Studies like Allen et al. (2022, *JMIR mHealth*) and Bennell et al. (2017, *Ann Intern Med*) show reductions in face-to-face care and improved self-efficacy. For example, a digital intervention trial reported a 15–30% reduction in physiotherapy visits and GP consultations over 3–6 months.

From a primary care perspective, I estimate that 60–70% of eligible patients with mild-to-moderate OA would initially be willing to try digital self-management technologies. Of those who start, 40–50% are likely to engage appropriately (i.e. regular log-ins, completion of exercises or modules) over the first 3–6 months. Engagement is likely to be encouraged by presence of links to their existing care plan, ease of use of the technology and what is perceived to be personalised feedback to the patient following their use.

Attrition is to be expected over time unfortunately. By 12 months, around 25–35% may continue to use the technology regularly. Drop-off may result from symptom improvement and non-improvement, technical challenges, or loss of motivation.

Expert 2

I do not have data on EQ-5D for this patient group. MSK-HQ scores at baseline for mild low risk (StarT MSK risk stratification) patients accessing our digital tool are around 33 (MSK-HQ 0-56 low to high functioning). I would expect patients as a minimum to meet the MCID for the MSK-HQ of a 6-point change (see Price et al. (2019)), in our service currently patients are making an average 8-point change but this has high variability and low numbers at present. I would anticipate improvement for 6 months and potentially longer depending on compliance/continuation with treatment plan/approaches.

It is likely that there will be more impact on resource use when used earlier in the pathway with appropriate screening/risk stratification (Burgess et al. 2024).

Expert 3

My gut suggests these apps may not better the MCID for most HRQoL measures. I have concerns that the potential benefit of these apps as adjuncts to treatment may be lost if used as stand-alone treatment alternatives.

Potentially, if it improved self-efficacy it may reduce the number of follow-ups required during a course of physiotherapy for example. If the app supports patients with flare up management, then that has potential to reduce contacts with GPs and the Emergency Department (ED). Providing alternatives to medication should in theory offer possibilities to reduce medication usage.

In services I have worked in we had an average of 50% uptake. Adherence is the challenge and means it is important to have opportunities to meet with a clinician once the app is given

Expert 4

Digital solutions can reduce healthcare costs by reducing unnecessary clinic visits, from follow-up to first time physiotherapy appointments and GP visits. There may be some cost-effectiveness associated with this (getUBetter have some data around this).

Expected improvement according to the 5 point likert scale: very likely, unlikely, neutral, likely, very likely

Dimension	Expected improvement	Why
Mobility	Likely to very likely	Apps will give guided and structured exercises and or gait training, improving strength and mobility
Self-care	Neutral to likely	If a patient is empowered to self-manage their OA, it will reduce dependence
Usual activities	Neutral to likely	When pain reduces and function improves, it allows patients to return to work, hobbies and social valued activities
Pain	Likely to very likely	As the joint gets stronger, patients regain confidence to move and return to valued activities, resulting in reduced pain
Anxiety / Depression	Neutral to likely	Having a digital coach in your pocket, that gives you right education, information and support will reduce anxiety and depression

Furthermore, there could be an increase in self-care and usual activities if value based activities are taken up again. This improvement could last quite long as a behavioural change occurred. However, should this not happen, then I suspect I would have to review this patient in 6 months to a year.

I do not have any references that prove that the use of these technologies will increase or decrease resource usage.

Digital technologies could expect to see a reduction in GP visits due to: Better self-management, Access to screening questionnaires which monitor

symptoms and triage according to local pathways, Remote consultation and, Self-referral to physiotherapy, bypassing primary care.

Digital technologies could reduce medication use due to: improved pain control through exercises, CBT, meditation.

Digital technologies could potentially reduce face-to-face physio appointments.

However, in certain scenario's may lead to increase in resource usage, especially during the early adoptions phase. Initial setup and engagement costs: time to embed algorithm in the app on local pathways and on boarding of primary and community care. Lack of patient engagement and awareness will need a comms strategy. Issues around health literacy and digital confidence resulting in higher cost as patient use the digital technology and local MSK services.

My assumption is that a cohort of patients will use digital technologies (about 20-25%). There is a 35% drop out from registering to using these technologies and adherence drops to about 50% over 3 weeks.

Category	**Knee OA**	**Hip OA**
HRQoL impact	Moderate-to-high improvement especially in mobility and pain	Improvement is slower and may be more limited for pain reduction
Symptom response	Good fast response to exercise based digital rehab	May need longer programmes, more tailored mobility support
Initial uptake	Potentially more younger (70) cohort therefore higher uptake	Potentially more older (80) cohort with less digital literacy and more barriers
Adherence	Suspect more adherence due to faster response to pain and mobility	Suspect more drop out due to more limited perceived benefit (akin escape pain classes)
Long term use	No long-term data available	No long-term data available
GP visits	Likely more reduction compared to hip OA	Likely less reduction compared to knee OA
Medication use	Likely similar usage	Likely similar usage

Physiotherapy use	Digital use could be higher for knee OA and could reduce demand on physiotherapy services	Likely less successful therefore hybrid approach more appropriate and thus more demand and more cost
Surgery avoidance	Not seen any data on this	Not seen any data on this
GP = General Practitioner; HRQoL = health-related quality of life; OA = osteoarthritis		

Expert 4 (response to EAG email)

GP and FCP activity: for mild-to-moderate OA likely to be more than one appointment per year. Perhaps two or three. And some patients get injections - could be every 6 months, every 4 months. With digital technologies I would expect to see a 30% reduction in GP/FCP use

Medication prescriptions: Could be more as already 100/170 opioid prescriptions (https://pmc.ncbi.nlm.nih.gov/articles/PMC7449800/) but difficult to guess - perhaps 300? per 1,000 (analgesic and NSAIDs and opioids). Not sure digital technologies will reduce prescription use, maybe 10% reduction.

Physiotherapy activity: This depends on if you include class activities. Three-four per patient per physio is correct, however you need to add another six-eight appointments as most do exercise classes. Digital technologies should reduce physiotherapy activity by 30%.

Secondary care: You would only refer to secondary care for severe OA, mild-to-moderate is managed within primary/community care. So, I wouldn't expect this to change.

Medication list: Agree with the list but add nefopam hydrochloride and perhaps 10% reduction.

Health Tech Programme

HTE10057 - Digital technologies for managing mild-to-moderate hip or knee osteoarthritis

External Assessment Report - Comments collated table:

Any confidential sections of the information provided should be underlined and highlighted. Please underline all confidential information, and separately highlight information that is 'commercial in confidence' in blue and all that is 'academic in confidence' in yellow

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
1	Simon Head	12	3	There is no discussion on (or evidence of) the accessibility of these technologies to the general public. Similarly, digital safety/privacy and inherent system biases are not explored. A description of the technology behind these products (i.e. decision tree system, linear training program, deep neural network, generative AI et cetera) would be useful in this regard.	Accessibility and digital safety/privacy are not included in the scope.
2	Simon Head	117	9.3	If evidence of the above is lacking, then a call for accessibility, digital safety/privacy and system bias data would be appropriate	Added some text.
3	EQL	14	Table 3.1 (intervention)	Reference is made to Phio Access, Phio Collect and Phio Engage. We had clarified with NICE that the scope of the evaluation was limited to Phio Engage and therefore only Phio Engage should be listed as being evaluated (otherwise it will render other information in the table incorrect also).	Corrected.
4	EQL	14	Table 3.1(Healthcare professional involvement)	"(either internal EQL specialist or NHS clinician, depending on configuration)." This comment is not fully accurate, therefore "(either internal specialist (EQL clinical services) or trained clinicians from an external health provider organisation e.g. NHS clinical team, depending on service configuration)" would better reflect the entire picture.	Amended.

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
5	EQL	27 30	6.4 Table 6-3	The clinical effect size (Cohen's D = 0.57) was provided (Reference 1) alongside the mean change in score (-9.7) and relevant confidence intervals (95%: -7.74 t0 -11.65) in the evidence we provided for review that assessed the confirmed OA hip and knee patients; we believe that this data (medan change, effect size and confidence intervals) should both be presented to facilitate a more accurate and clinically relevant picture. Together mean change, effect size and confidence intervals offer fuller insights into both the practical significance and the reliability of results. Confidence intervals are included for the RCT data only. These are still relevant and statistically valid for the single arm studies.	The EAG would argue that the mean difference between the intervention and usual care and CIs around this are far more meaningful than estimates for the technology only.
6	EQL	46	7.1 Company evidence	"**four studies** were included to inform the EAG economic model (three for cost and resource inputs, and one study for utility inputs, see Table 7-1)" - Table 7-1 lists **five studies**.	The text is updated to clarify that Table 7-1 contains five studies: four from company evidence and one from literature review.
7	EQL	43	6.5 Adverse events	Substantial information about adverse events and clinical risk management was provided by EQL in the "Company Evidence request" document (section 1.3: Adverse events, pp12-13); this appears to have been omitted in the EAR as only the information provided by 2 other companies is referred to.	Addressed.
5	getUBetter	35	Self-efficacy	***"No studies reported this outcome".*** Almost all the getUBetter real world system data demonstrates reduction in healthcare utilisation across the entire care pathway from GP, physiotherapy, urgent care, secondary care an included medication and diagnostics reduction. This would, based on expert option in the document, be included as evidence of self-efficacy i.e., able to self-management and follow care pathways without the need to seek help.	No data has been presented on this outcome.
6	getUBetter	48	Comparative data for	Sussex MSK Health (2025) unpublished but peer reviewed evidence awating conference presentation be included?	Added to Section 9-1.

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
			economic model	UK Patient Stratification in Musculoskeletal Physiotherapy: Evaluation of an Automated Triage Tool for Digital Self-Management. It shows safety, self-efficacy and economic impact of getUBetter.	
7	getUBetter	79 + 91 (table 7-6	Resource use reduction	"Resource use reduction" is dependent upon both the technology under investigation but also how is it deployed into a complex health system. Therefore, the resource used associated with getUBetter is not applicable to other technology as indicated as the technology is different and the radpid deployment and adoption model in unique.	We appreciate that the grouping of all digital technology is not ideal. Due to data limitations, the model inputs are based on information on a few technologies (e.g., HrQoL estimates are also based only on JointAcademy and re.flex) and assumed the same for others, based on similar technology characteristics and assumptions. These assumptions had to be made due to lack of evidence that fits the inclusion criteria for individual technologies and as a result any model results are only exploratory. We therefore stated in the report in Section 7.2 Interventions: "While a base-case is presented in which all technologies are grouped together in one intervention arm, it should be noted that in reality these technologies may affect patients' HRQoL and resource use in different ways. Due to the limitations with the evidence, this evaluation cannot capture these effects for each individual technology. However, the model can be used to explore the potential impact or value of digital technologies for mild-to-moderate hip/knee OA, given the current limitations of the evidence and the variation in the technologies." And in Section 7.3: "Due to the heterogeneity across the digital technologies and limited evidence to populate the economic model, the base-case is designed to represent an indicative average, rather than a definitive

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
					representation of every digital technology for mild-to-moderate hip/knee OA. The base-case therefore gives an indication of what the cost effectiveness of digital technologies may be under the base-case assumptions." And in Section 7.4: "While the base-case results do not aim to represent every digital technology provider precisely, they offer an indication of the potential impact these technologies might have if implemented."
8	getUBetter	106	Integration into the NHS	***Quote in text about getUBetter*** *"getUBetter is reported to be available and used in 17 Integrated Care* *Systems, and the company claims that no major changes to facilities or* *infrastructure are needed to adopt the technology, aside from updating* *websites to include access links.1 It can be accessed through healthcare* *professionals, non-clinicians, or by self-referral".* **Description is inaccurate and would benefit from being updated.** getUBetter is available across 17 integrated care systems and is made available across the entire MSK care pathway. It can be accesses from GP practices (3000+), MSK service providers (>50) and at other touch points such as in the community, at pharmacy (30% of people are not registered with their GP), from urgent care, via single point of access or in secondary care. Patients follow a MSK condition recovery and prevention pathway that is defined by the local NHS region / area but based on NICE guidelines and patients are navigated to local treatments and service if needed.	The EAG consider that their summary of the information submitted by the company is accurate, and so no changes are required to the EAR.

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
				The company claims that no major changes to facilities or infrastructure are needed to adopt the technology, but they have developed a very clear rapid deployment methodology to enable deployment across complex health systems at speed. There needs to be updating of websites, text messaging systems e.g., acurex and the provision of assets to enable access e.g., posters, videos. It can be accessed via self-referral, from non-clinicians or during a consultation (face to face or online) with a health care professional.	
9	Active Health Tech	14	Table 3-1	"One-way - patient to professional communication, limited to where red flags are triggered during app-use" is inaccurate. Please can we amend this text to say: "One-way - patients can manually request contact with a healthcare professional via email through the program interface or be automatically directed for health professional input if triggering flags that deem the person unsuitable for self-management."	Amended.
10	Active Health Tech	21	Table 6-1	Sample size currently says "15". We think this is a typo and please can we change sample size to 25 (aligned to the information we submitted)	Corrected.
11	Active Health Tech	27	6.4	Please can we remove confidentiality for our data on this page. We marked this as confidential initially however we would like to now unhide and show this specific data. Any reference to our pain and stiffness data in the report can be shown and without confidentiality.	Confidential marking removed.
12	Active Health Tech	30	Table 6-3	Please can we remove confidentiality for our data. We initially marked this as confidential however we would like to now unhide and show this specific data in the table. Any reference to our pain and stiffness data in the report can be shown and without confidentiality.	Confidential marking removed.

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
13	Active Health Tech	43	6.5	Please can we remove the confidentiality on this text. We would now like to unhide and show this text in the report.	
14	Active Health Tech	68	Table 7-4	You have revealed cost information for TrackActive when this is confidential information and our cost information should be either blacked out or removed as per original confidentiality on cost information. Please can you remove our cost information [redacted] from the table. You have hidden our cost information on other sections which is correct, and so this may have just been a mistake to show the [redacted] text on page 68	The EAG apologises and can confirm that the costs were not included in the calculation of the average costs for scenario 2 nor visible in the economic model. The EAG comment in Table 7-4 was left in there by mistake and has now been removed.
15	Joint Academy	13	Table 3-1: Included technologies: key features - self referral	***Comment:*** We have a self-referral option, patients can download the application via the google play store/ apple store and sign-up to make a self-referral. **Action:** **The self-referral section says No. Please change to YES.**	Amended.
16	Joint Academy	13	Table 3-1: Included technologies: key features - Health care professional involvement	***Comment:*** In the “Health care professional involvement” it is not clear that an initial physiotherapist call also takes place in JA and that the patient also can click to schedule a time point for the meeting. **Action:** **Please change to: Two- way - The patient books an initial assessment call (via video or phone, depending on their preference) with a Joint Academy physiotherapist to evaluate suitability for digital treatment. Appointment times are selected through a digital calendar. Weekly check-ins are conducted via chat, with a follow-up video consultation at six weeks and a final discharge call. Additional calls or chats are available if needed.**	Amended.
17	Joint Acadmey	18	6.2 included	***Comment:***	Added.

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
			and excluded studies	Educational and Behavioural Elements: Incorporation of educational sessions, quizzes, cognitive Behavioural therapy (CBT), and self -management strategies (e.g., ESCAPE-Pain, Hinge Health) **Action:** **Please add Joint Academy here as we also have this element. Joint Academy provides education and quizzes on a weekly basis.**	
18	Joint Academy	19	6.2 included and excluded studies	***Comment:*** Personalisation: Tailored exercise programs based on user input, pain levels, and functional limitations (e.g., Good Boost, Phio Engage). **Action:** **Please add Joint Academy here as we also have this element. Joint Academy has programs that are activated for patients, and patients complete the exercises on a daily basis. At the end of each exercise completion, patients are asked how they found the exercise, if it was easy, just right or too challenging which can prompt an alteration in the exercise depending on their response. Patients also have the option to chat with the physiotherapist to amend the program to suit their needs.**	Added.
19	Joint Academy	17 & 18	6. Clinical Evidence review	***Comment:*** We are thankful for the thorough work from the evaluation committee in choosing and evaluating digital means to treat osteoarthritis of the knee and hip. The choice of including RCT studies, if available, is fully understandable and the recognized method for this type of evaluation. At the same time, significant outcomes from caregivers that have RCT studies but also high-quality cohort studies could add information. Choosing to present the one RCT	Thank you for providing this information. The RCT in knee OA has been added to Section 9.1. The second one is of patients who are outside of the scope.

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
				out of the many large cohort studies Joint Academy has published will not fully represent Joint Academy's effectiveness in outcomes that were not specifically evaluated in the specific RCT. We therefore add recent publications and data in the below comments that may contribute to the evaluation. ***Comments to Clinical Evidence review:*** We expect that before the end of 2025 two more RCTs performed in the UK will be published, summarized below. The data is presently unpublished and therefore provided in confidence. This preliminary data was recently provided to us (personal communication Professor Ana Valdes, Faculty of Medicine & Health Sciences, Nottingham University, Ana.Valdes@nottingham.ac.uk) and therefore was not added to the initial evidence base (we can provide draft manuscripts in confidence if requested as soon they are submitted). ○ [redacted]	

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
				[redacted]	

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
				[redacted]	
20	Joint Academy	35	Clinical outcomes Self-efficacy	***Comment on Self efficacy "No studies reported this outcome"*** Integrated into the Joint Academy app is also a self-efficacy question on '*how ready are you to continue to do exercises on a daily basis?*' and we are happy to provide data for this, should you so wish.	Thank you – unfortunately these cannot be included at this stage.
21	Joint Academy	36	Table 6-5 Treatment satisfaction	***Comment on Treatment and user satisfaction:*** Questions are sent after discharge to patients. Our NPS score, around 70, is not published in a scientific journal but available from other sources. Also to note: Examples of a study that include user satisfaction: Regarding patients' Experiences and satisfaction this Qualitative Study gives information: Anna Cronström, Leif E Dahlberg, Håkan Nero, Jennifer Ericson, Catharina Sjödahl Hammarlund. "I would never have done it if it hadn't been digital" — A qualitative study on patients' experiences of a digital management programme for hip and knee osteoarthritis in Sweden. BMJ Open 2019;9:e028388. doi:10.1136/bmjopen-2018-028388	Thank you – unfortunately, this qualitative data study was not prioritised.
22	Joint*Academy	37-38	Psychological outcomes	***Comment on "Psychological outcomes":*** EQ-5D is integrated into the Joint Academy app which includes anxiety and depression questions related to psychological outcomes.	Mentioned in Section 9.1.

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
			Table 6-6: Psychological outcomes	Presently an EQ-5D MS is drafted.	
23	Joint Academy	39	Work productivity	***Comment on "work productivity":*** Joint Academy have an available study for this: This study includes WPAI: Kiadaliri, A., Lohmander, L.S., Ignjatovic, M.M. et al. Digital self-management of hip and knee osteoarthritis and trajectories of work and activity impairments. BMC Musculoskelet Disord 24, 207 (2023). https://doi.org/10.1186/s12891-023-06322-z Conclusion While participation in a digital self-management program for OA was, on average, associated with improvements in work and activity impairments, there were substantial variations among the participants. Baseline pain may provide useful insights to predict trajectories of work and activity impairments.	Thank you – unfortunately this cannot be included at this stage.
24	Joint Academy	39	Clinical outcomes	We report monthly on a range of clinical outcomes regarding UK NHS patients to our NHS provider, in line with NHS England data reporting requirements. These metrics include: 1. Patient safety incidents	Thank you – unfortunately this cannot be included at this stage.

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
				2. Waiting times 3. Patient satisfaction: a. Percentage of service users who rated their satisfaction with the service as "Good" or "Excellent" b. Percentage of service users who felt they were well informed about their care c. Percentage of service users who felt they were supported during their care 4. Onward referral (escalations) to other clinical services 5. Did Not Attend rates We can provide further data regarding this if it is of interest.	
25	Joint Academy	43	Adverse events	***Comment on "Adverse events":*** Joint Academy asks for and monitors adverse events, such as patients having a fall during their treatment duration and if it was a result of exercise. This was not studied in the RCT and therefore not reported.	Thank you for this information.
26	Joint Academy	Page 89	Model analysis Base-case analysis	Regarding ICER for JA, a calculation was included in this study https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0236342 "Incremental cost-effectiveness ratio"	Table 7-1 only presents key evidence used in the model. As the resource use and cost estimates from this study were specific to the Swedish setting and data were available for the UK, this study was not used to inform cost and resource use estimates in the model. Similarly, for HRQoL other studies were prioritized for use in the model as they reported HRQoL rather than pain scores.

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
			Table 7-1: Key economic and clinical evidence for EAG economic model	Based on the results of the costing analysis and on the results of one previous study [12] on the effects of the digital care model, the incremental cost-effectiveness ratio (ICER) was also calculated. For the given cost and effect differences, the ICER shows the cost per effect unit of adopting the intervention compared with the existing treatment model [26].”	
27	Oluwatobi Akinwale	22	6.3	The randomized controlled trials utilized were limited, and all were rated as having some concerns, indicating acceptable but not perfect quality. Future studies should aim to enhance methodological rigor, conduct more RCTs, increase sample sizes, and conduct replication studies to confirm findings across diverse NHS settings and populations. Well-designed RCTs and cohort studies should reflect UK standard care	Thank you – the EAG agrees.
28	Oluwatobi Akinwale	12-14	Table 3-1	Some platforms offer messaging and check-in, while others support real-time engagement (video calls), which reflects different levels of clinical involvement. Technologies with clinician involvement will provide more tailored care. Technologies can be used as a supplement or alternative to part of usual care and not a total replacement. Some had options to send user reports to NHS professionals, which suggests intended use in the care pathway.	Thank you for this.
29	Oluwatobi Akinwale	44		Lack of Hip O.A data. None of the RCTs included Hip O.A. None of the RCTs were conducted specifically in the target population of mild to moderate O.A. of the knee as defined in the NICE scope. This undermines the applicability of the findings to the intended population.	The EAG agrees.

Comment no.	Stakeholder	Page no.	Section no.	Comment	EAG Response
30	Oluwatobi Akinwale	44		The chronic nature of O.A a longer follow up is essential to asses long term benefits. All 3 RCTs had relatively short follow-up durations (6-12 weeks).	The EAG agrees.
31	Oluwatobi Akinwale	9		Future evidence generation should focus on mild and moderate Hip and Knee O.A, Use of common and applicable outcome measures.	The EAG agrees.

Section B Economic model - Comments

Stakeholder	Comment	Description of problem	Description of proposed amendment	Result of amended model or expected impact on the result (if applicable)	EAG response
Simon Head	1	HRQoL from 'high cost' technology is assumed across each product, whereas the additional cost is likely to be providing additional benefit (through the addition of physiotherapy sessions, two-way communication and additional hardware, as per the product description table). Without this context, the results give the impression that lower-cost, reduced-feature products are more cost effective than higher-cost, increased-feature products, whereas in fact there is no HRQoL data for lower-cost products.	Either remove the 'low-cost' scenario (scenario 2) or make this limitation explicit, especially in the 'Scenario analysis results' section	N/A	We added the following to the interpretation of scenario 2 results in Section 7.3 Scenario analysis results: "The QALY gain per person is unchanged as compared to the base-case because there was no evidence of HRQoL impact in these lower cost technologies." And to Section 7.4: "This is, however, based on very limited evidence and crucially relying on the assumption that HRQoL benefits do not differ between these technologies, an assumption which was made in the absence of evidence on differential

					HRQoL benefits between technologies.”
EQL	2	Table 7.4 Page 64 Row 3 **The cost quoted confuses cost per capita (£0.30-£0.50 depending on population size) with the cost per treated patient.** Phio Engage pricing is based on a population health model and handles a wide range of MSK conditions, not just hip and knee OA. NHS Trusts pay £0.30-£0.50 **per capita** (depending on population size) which allows anyone in that population unlimited access to both EQL’s MSK triage product Phio Access (included in the per cap cost) AND, if assessed as suitable, the Phio Engage self management platform. (N.B It is currently not possible for customers to purchase standalone usage of Phio Engage without Phio Access) **Cost per treated patient is therefore the annual cost of Phio (Engage & Access) for the population served divided by the total number of patients who interact with Phio (Engage & Access) products.** **For the sake of clarity, this means that the higher the uptake and utilisation of Phio (Engage & Access) within a given population the lower the per treated patient cost will be.** The 316,350 treated OA hip and knee patients is an estimated figure based on potential	Over 2.2million people across 11 NHS trusts(of varying population size) have access to Phio (Engage & Access). Based on data from SWBH NHS Trust, which is the largest individual NHS trust served by Phio, cost per treated patient is estimated thus: SWBH NHS Trust population = 530,000 Phio (Engage & Access) cost per capita per annum = £0.40 Number of patients using Phio in 2024 = 4,682 **Cost per treated patient per annum = £45.28** (530,000 x £0.40) / 4682 = £45.28	Will reduce SD of model costs especially for the sub scenario of low cost fewer feature technology analysis.	The cost calculations for PhioEngage are revised in Table 7-4 and have been updated in the economic model.

		utilisation across all the Phio NHS trust contracts (Over 2.2 million patients). This figure does not include other patients who use Phio **(Engage & Access)** for other MSK conditions and therefore CANNOT be used in isolation to calculate cost per treated patient. Please see adjacent column for estimate of cost per treated patient using the SWBH Trust data as an example case.			
getUBetter	3	**The getUBetter digital technology one-off cost if £18.84 per person is incorrect.**	The value £18.84 is based on the total cost of deploying and licencing getUBetter for all common MSK injuries and conditions and not OA in isolation. The deployment costs and licence cost quoted is for getUBetter's total MSK package which includes the following condition self-management pathways; Back, Back and leg, Hip, Knee, Foot, Neck, Shoulder, Elbow, Wrist, Tendinopathies (upper limb and lower limb) and well as acute soft tissue injuries. **In summary** • Only 25% of all getUBetter users are for Knee (18%) and Hip (7%).	This evaluation will reduce the ICER making getUBetter more cost effective.	The cost calculation for getUBetter are not revised because it appeared that the new calculation included double counting for the OA population. getUBetter now stated that only 5% of total getUBetter users are likely to be for Mild to moderate OA, which should replace the original 1.51% estimate of the EAG. The EAG was therefore uncertain that the new costs were accurate. The deployment costs should have been removed, so thank you for that comment, but it was too late to incorporate it in the model. An additional disclaimer about the getUbetter costs being uncertain was added in the text (section 7-2) as well as in Table 7-4.

			• Because getUBetter manages acute, subacute and long-term MSK injuries and conditions – patients with mild to moderate OA symptoms as a primary cause of symptoms will be small e.g., 20% or 1 in 5. • This means that only 5% of total getUBetter users are likely to be for Mild to moderate OA (25%/5) Please see the remodelled deployment and licence fee in relation to proportion of OA patients **Deployment** 25% of £1,200 = £300 20% of £300 = **£60** for OA as a proportion of total getUBetter users **Licence**		

			25% of £1,500 = £375 20% of £375 = **£75 for OA as a proportion of the total getUBetter users** The deployment fee is a one off so should be discounted. The total annual cost per adult is consistent. **Reworking of the EAG calculation with the above calculation for OA users** 1. **Licence fee per affected adult** = 75 / (10,000*1.51%) = £0.50 2. **Deployment charge per affected adult** = 60 / (8,900*1.51%) = £0.45 **3. Total annual cost per affected adult** (including deployment cost for year one only) **£0.95** **4. Total annual cost per**		

			affected adult (excluding deployment costs for year one **= £0.45**		
getUBetter	4	Page 53	getUBetter supports self-management of new / recurrent and long-term conditions. 1. The model parameters of 2-9 months do not consider the following: 2. The impact of acute injury or flare up – getUBetter supports patients to have the knowledge confidence and skill to self-manage from day 1 up to 10 years + including flare ups (identified by NICE as an important element of OA management. 3. OA is a lifelong condition and a 9 month horizon is too short – especially with reengagement in	Unsure – should make more cost effectiveness but only for getUBetter	The health economic model considers potential effects of digital technologies on resource use, costs and health-related quality of life. Within the estimates used for both, most of the effects cited here are already captured, with some notable exceptions including the potential impact of digital technologies on disease progression and benefits outside the NICE reference case, such as the described safety netting. This was already noted as a limitation in Section 7.4: “This economic evaluation does not include some potential benefits because there was no evidence supporting these or because they are outside of the NICE reference case. First, some companies stated that their digital technology may shorten waiting lists as patients required fewer face-to-face appointments. The EAG found this difficult to quantify and found no evidence that would allow inclusion in the health economic modelling. A

			self-management. 4. No mention of the management of flare ups – getUBetter supports these. 5. No mention of the importance of minimising deterioration and promoting active waiting. 6. No mention of work-related impact on Society and Patient 7. Little reference to the importance of safety netting and navigation to see health professions when needed (getUBetter is not just about triage but dynamic safety netting that navigates patient into their routine local NHS, local services and support in accordance with NICE guidelines and local pathways.		reduction in absenteeism due to illness was also not modelled because productivity losses are outside the NICE reference case. There may be a reduction in surgery but there is limited evidence, and this is unlikely to be impactful in a model with a 1-year time horizon in the mild-to-moderate OA population.”

			There are other externalities and benefits that need to be considered • The model assumes patients have symptoms of OA and have been diagnosed. 30% will have radiological evidence but no or limited symptoms and therefore indirectly will benefit from self-management and early intervention. The model does not take into account the economic impact of early intervention to minimising the primary impact and consequence of new or recurrent injuries or condition. • The model does not take into account the		

			impact of deterioration whilst on waiting list which getUBetter supports • Because getUBetter can connect patients to local treatments and service either by patient choice or automation based on approved local care pathways - patients are accessing support recommended by the NICE guidelines for managing mild to moderate OA. For example, MSK self-management by getUBetter and access to weight management, general fitness, mental health, work support or pain management. The NICE guidelines recommend a		

			combination of these strategies and getUBetter makes local services available for patients to choose. • Patients with co-morbidities are 3 times more likely to have OA. The model needs to recognise that getUBetter provides access to self-management support for more than on clinical area and therefore impacts not just monoarthritic problems modelled but polyarthritis as well other conditions co-morbidities relevant to individuals. Self-management of co-morbidities or other factors that influence an		

			individual's ability to be active and exercise is important. getUBetter can also support alongside OA wrap around support for women's pelvic health, pain-management, orthopaedic peri-op support (knee / Hip and back) as well as comorbidities (heart health and lung health). The economic benefit to patients, the NHS and society will be amplified. An example of this is Frimley (RW-11) where patients using getUBetter comparted with the match cohort (n=70,000) demonstrated reductions in 111 calls, ambulance and inpatient admissions alongside other		

			MSK pathway reductions. • It does not consider the societal impact of the interventions regarding work, family, travel and other indirect costs • It does not consider the value of decarbonising the care pathway		
getUBetter	5	Page 56	*"The model-based case thus assumes that digital technologies lead to reduce primary, community care and medication resource use reduction but do not replace standard Care in entirely"* This model is only applicable to getUBetter as it is the only solution that is embedded across the entire care pathway, is configured to local clinical pathways and can navigate patients in accordance with local	Not modelled but should improve cost effectiveness getUBetter but not other technology	The exact placement in the care pathway is not clear for every technology. This is a valid consideration and for this reason, we caveated the results of the economic analysis in Section 7.4: "While the base-case results do not aim to represent every digital technology provider precisely, they offer an indication of the potential impact these technologies might have if implemented. However, the findings should be interpreted with caution due to the limited and preliminary nature of the

			needs and national guidleines. Caution should be applied in attributing these benefits to other technology which do not perform the same function. These benefits are obtained through very clear deployment and integration methodology and configuration to local pathways rather than the technology in isolation. The ability to embed digital health technology into routine care across the entire care pathway and promote adoption and digital inclusion is vital to obtaining the above economic benefits to the entire system. getUBetter rapid deployment and clinical transformation model is vital to transformation and obtaining the impact across complex health systems. We want to highlight that caution should be applied to the assumption that these benefits can be obtained by other technologies.		available data. Some companies either lack evidence for their technologies or did not submit evidence for this evaluation, and the model relies on pragmatic use of the data that is available." And in the conclusion: "Further information is needed to determine the cost-effectiveness of individual digital technologies versus standard care. When evidence becomes available, the model developed for this assessment is flexible enough to include this evidence, extend the time horizon, add health states that are currently not included and produce analyses per digital technology." This also includes the ability of the model to take into account implementation costs per digital technology as well as the timing of impact on patients HRQoL.

getUBetter	6		The engagement model assumes one off adherence cycle. Adherence to self-efficacy / behavioural change tools polymodal and will often stop using but reengage when they have a reoccurrence of feel they need support. with getUBetter and reflects the recurrent episodic nature of mild to moderate knee pain. In a self-efficacy model demonstrated by behaviour change and reduced resource use - our aim is individuals to use the app less. For example, when Patient self-progressed their exercises and get the hardest one possible, we advise them to keep going and get back to as normal as possible– they are self-efficient. When their joint pain / problem reoccurs, we get reengagement in the app. This is a polymodal pattern. The model does not take into account recovery AND prevention. When	Not modelled but should improve cost effectiveness.	Our model does not allow for this granularity indeed, which is not common in health economic models in general, as the aim is to estimate the impact on costs and HRQoL over time for an average population. The described effect should be accounted for in utility estimates collected in RCTs – however, as described in the report, utility estimates were only available from few studies and few technologies.

			patients are back to "their normal" the app converts to a prevention tool. We provide a prevention / maintenance version of knee and hip pain. If their problem "flares up, getUBetter manage this reoccurrence again from day 1.		
getUBetter	7	Sussex MSK Health (2025) Peer reviewed and accepted for publication.	Sussex MSK Health (2025) unpublished but peer reviewed evidence awaiting conference presentation be included? Patient Stratification in Musculoskeletal Physiotherapy: Evaluation of an Automated Triage Tool for Digital Self-Management. It shows safety ability to self-manage (self-efficacy) and economic impact of getUBetter onto a MSK physiotherapy service including hours saved and cost model.	Not modelled but should improve cost effectiveness	Table 7-1 only presents key evidence used in the model. This pilot study was not included because the provided information in the Company Evidence Request document was limited. The abstract did provide some numbers on physiotherapy resource use reduction, but other getUBetter RW studies provided more information and were not marked AIC. The pilot study has been added to section 9 'Ongoing studies' now.
Oluwatobi Akinwale	8	The model does not clearly show how and where each digital technology fits within the NHS pathway, which significantly affects cost and outcomes.	Point of entry in the care pathway. Workflow integration Including a real-world NHS integration case study of how Joint Academy is used in	A model that reflects different care pathway placements enables better planning for integration, demonstrating that true pathway integration and	This is a valid consideration and for this reason, we caveated the results of the economic analysis in Section 7.4: "While the base-case results do not aim to represent every digital technology provider

			Bedfordshire MSK services, how getUbetter fits into the self-management pathway in an ICS. This provides practical context and shows feasibility.	helps better understanding of practical use plus it spots integration challenges early.	precisely, they offer an indication of the potential impact these technologies might have if implemented. However, the findings should be interpreted with caution due to the limited and preliminary nature of the available data. Some companies either lack evidence for their technologies or did not submit evidence for this evaluation, and the model relies on pragmatic use of the data that is available." And in the conclusion: "Further information is needed to determine the cost-effectiveness of individual digital technologies versus standard care. When evidence becomes available, the model developed for this assessment is flexible enough to include this evidence, extend the time horizon, add health states that are currently not included and produce analyses per digital technology." This also includes the ability of the model to take into account implementation costs per digital technology

					as well as the timing of impact on patients HRQoL.

Overview

Explanation

This page outlines the Early Value Assessment Team's comprehensive evaluation of whether a technology could be suitable for Early Value Assessment and if data collection is feasible. The assessment does not provide any guidance on whether a medicine technology is a cost-effective, or plausibly cost-effective, use of NHS resources . This document should be read in conjunction with other critical documents, particularly the company's evidence submission and External Assessment Group (EAG) report. Additional details for each consideration are available within the separate tabs.
While a rationale is provided, in general, the ratings for each area are:

- **Green** - No key issues identified
- **Amber** - Either outstanding issues that the Early Value Assessment team is working to resolve, and/or subjective judgments are required from the committee/stakeholders (see key questions)
- **Red** - The Early Value Assessment team does not consider this topic suitable for an early value recommendation.

Topic name: Digital technologies for managing mild-to-moderate hip or knee osteoarthritis; early value assessment for the National Institute for Health and Care Excellence

Topic ID: HTE10057

Technology name[s]: ESCAPE-Pain · getUBetter · Good Boost · Hinge Health · Joint Academy · Pathway Through Arthritis · Phio Engage · Physio Wizard · re.flex · Thrive · TrackActiveMe

Early Value Assessment Lead: Amy Barr, Aleix Rowlandson **Guidance team:** Bernice Dillon
EvGen Team: Vera Unwin, Thomas Lawrence
Date of assessment(s): 23rd June 2025

Is Early Value Assessment appropriate - Overall rating	Comments / Rationale
Data collection could potentially resolve evidence gaps depending on committee decision	Longer term outcomes (more than 18 months) for osteoarthritis may be difficult to capture, if these are essential it may not be feasible within context of EVA. If however more immediate outcomes are sufficient for future cost-efectiveness modelling, data should be relatively easy to collect within the evidence generation period.

Area	Rating (Responses for rating: Yes, No, Unclear, Not applicable)	Comments / Rationale
Are any technologies in the topic currently being used in the NHS?	Yes	Include use case and population if yes: Various depending on technology
Is it feasible to collect data that could sufficiently resolve the key evidence gaps outlined in the EAG report?	Unclear	Yes, if more immediate outcomes are sufficient for future modelling
Can data collection be completed without undue resource burden on patients or the NHS?	Unclear	Additional survey, and service and user input required
Are there any other substantive issues that are barriers to EVA?	Unclear	Dependant on committee decisions around follow-up periods

Key questions for committee if Early Value Assessment is considered	
1. Which evidence gaps does the committee consider to be essential?	
2. What follow-up period is most appropriate to collect data for these outcomes?	