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Primary care-based models of care for osteoarthritis; a scoping review

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ABSTRACT

Objective: To identify and describe the extent, nature, characteristics, and impact of primary care-based models of care (MoCs) for osteoarthritis (OA) that have been developed and/or evaluated.
Design: Six electronic databases were searched from 2010 to May 2022. Relevant data were extracted and collated for narrative synthesis.
Results: Sixty-three studies pertaining to 37 discrete MoCs from 13 countries were included, of which 23 (62%) could be classified as OA management programmes (OAMPs) comprising a self-management intervention to be delivered as a discrete package. Four models (11%) focussed on enhancing the initial consultation between a patient presenting with OA at the first point of contact into a local health system and the clinician. Emphasis was placed on educational training for general practitioners (GPs) and allied healthcare professionals delivering this initial consultation. The remaining 10 MoCs (27%) detailed integrated care pathways of onward referral to specialist secondary orthopaedic and rheumatology care within local healthcare systems. The majority (35/37; 95%) were developed in high-income countries and 32/37 (87%) targeted hip/and or knee OA. Frequently identified model components included GP-led care, referral to primary care services and multidisciplinary care. The models were predominantly 'one-size fits all' and lacked individualised care approaches. A minority of MoCs, 5/37 (14%) were developed using underlying frameworks, three (8%) of which incorporated behaviour change theories, while 13/37 (35%) incorporated provider training. Thirty-four of the 37 models (92%) were evaluated. Outcome domains most frequently reported included clinical outcomes, followed by system- and provider-level outcomes. While there was evidence of improved quality of OA care associated with the models, effects on clinical outcomes were mixed.
Conclusion: There are emerging efforts internationally to develop evidence-based models focused on non-surgical primary care OA management. Notwithstanding variations in healthcare systems and resources, future research should focus on model development alignment with implementation science frameworks and theories, key stakeholder involvement including patient and public representation, provision of training and education for providers, treatment individualisation, integration and coordination of services across the care continuum and incorporation of behaviour change strategies to foster long-term adherence and self-management.

Introduction

Osteoarthritis (OA) affects 7% of the population worldwide [1]. It is one of the fastest growing and most burdensome chronic conditions, representing an increasing global health concern [2]. OA has a substantial individual and socioeconomic impact, ranked as the 15th

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Table 1
Eligibility criteria of study selection.

Inclusion Criteria	Exclusion Criteria
Quantitative studies: experimental (e.g., randomised trials, non- randomised trials) and observational (e.g., cohort, cross-sectional) study designs	Stand-alone qualitative research, case series (<10 participants), individual case reports, opinion/narrative/ discussion/ editorial or review papers
Mixed-methods studies	
People with OA ≥ 50% of the study sample	Research published only as an abstract or protocol
Full-text peer reviewed articles (no language restriction)	Research published prior to 2010
Full-text non-peer-reviewed articles (English language only)	Clinical guidelines with no implementation element
Research published from Jan 2010 onwards to align with publication dates of recent guidelines	MoCs focused solely on adjunct therapies that did not include self-management, education, exercise and/or dietary intervention
MoCs including at least one of the core recommended treatments (self-management, education, exercise and/or dietary intervention) as per international evidence- based guidelines for OA	

highest cause of years lived with disability globally [3] and estimated to represent between 1% and 2.5% of the gross domestic product in westernised countries, considering both direct and indirect costs [4]. There are numerous international guidelines which endorse education, access to information on self-management, exercise therapy, and where appropriate, advice on weight management as first line OA treatments to be offered in primary care [5–8]. Implementation of these recommendations remains suboptimal and substantial gaps remain in the quality of OA management and delivery and uptake of these treatments [3]. Health systems, policy, socio-economic, delivery system, infrastructure, and volume factors may all be relevant as well as health care professionals training and consumer participation and engagement [9]. Early and effective conservative management of OA within primary healthcare systems could improve patient outcomes and reduce healthcare system burden. OA is increasingly being recognized as a heterogeneous disease with multiple clinical phenotypes [10]. There is a need for the management of OA to reflect this variability in terms of disease onset, symptomology, progression and treatment response. Efforts to provide access to cost-effective, evidence-based treatments have led to the development of primary-care based Models of Care (MoCs) for the management of OA internationally.

The term MoC is used to describe clinical service delivery initiatives to consumers, and is being increasingly applied to musculoskeletal conditions to close evidence-practice gaps and support delivery of high-value care to people [11]. A MoC can be defined as an 'evidence-informed strategy, framework or pathway that outlines the optimal manner in which condition specific care should be delivered to consumers within a local health system' [12]. Broadly, it defines the way 'health services are delivered. It outlines best practice care and services for a person, population group or patient cohort as they progress through the stages of a condition, injury or event' [13]. The aim of a MoC is to explicitly operationalise evidence-based guidelines and therefore support implementation by clinical teams in their local health systems [11]. Therefore, MoCs should be 'grounded in best evidence' taking into account 'appropriate contextual consideration', such as the 'fiscal environment, existing health policy and health governance, local clinical expertise and the lived experience of local communities' within the jurisdiction where it is to be applied [14]. This adaption and operationalisation of a MoC from a framework to a local model is sometimes referred to as a 'Model of Service Delivery' (MoSD) [15]. Despite the growing number of MoCs for OA, they have yet to be formally reviewed. Therefore, this scoping review aimed to synthesise this body of evidence by describing the extent, nature, characteristics, and impact of MoCs for OA management that have been developed and/or evaluated in primary care.

Specific objectives were to:

1 Outline how MoCs were developed and defined (including underlying frameworks, service user involvement, research designs and methods employed).
2 Describe the MoCs (including MoC content and commonalities and differences between MoCs).
3 Identify what outcome measures are reported and/or recommended in studies of MoCs.
4 Report findings in studies which evaluated MoCs.

Methods

Protocol/Registration

A scoping review was conducted to address our research aims. Arksey and O'Malley's methodological framework [16], along with the Joanna Briggs Institute (JBI) guidance on scoping reviews, were used to guide the conduct of this review. Reporting was guided by the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist [17]. Further information can be found in the published protocol [18].

Eligibility criteria

The Population-Concept-Context (PCC) framework was used to identify key concepts and address the primary aim of the review [19] i.e., to synthesise the available evidence regarding the extent, nature and characteristics of MoCs (concept) for OA management (population) that have been developed and/or evaluated in primary care (context). Inclusion and exclusion criteria are summarised in Table 1.

Population

MoCs were required to be designed for community dwelling adults (≥18 years) with OA. Diagnosis of OA was determined by the original research articles and could include radiographic, clinical or combination criteria [20]. In studies including populations with other forms of arthritis or chronic diseases, individuals with OA must have represented at least 50% or more of the study sample. Inclusion was not restricted to specific joints.

Concept

Given the disparity in the nomenclature used to indicate a MoC and to maintain the broad nature of this scoping review, the explicit use of the term 'MoC' was not required for inclusion in this review, but rather was based on meeting our definition of a MoC. Given that by definition, a MoC must be grounded in best evidence, models were required to have included at least one of the core recommended treatments for OA in line with international evidence-based guidelines developed by expert consensus [5–8], namely self-management, education, exercise and/ or dietary weight management.

Context

Information sources including original research, which describe the process of development or evaluation of MoCs for OA in primary care settings were considered. The setting for initiation and delivery of the MoC was required to be at the primary care level involving general practitioners (GPs)/primary care physicians, nurse practitioners and/or other primary healthcare professionals. MoCs which included referral pathways to secondary care were permissible. Models which were initiated and delivered in secondary care or other ambulatory speciality

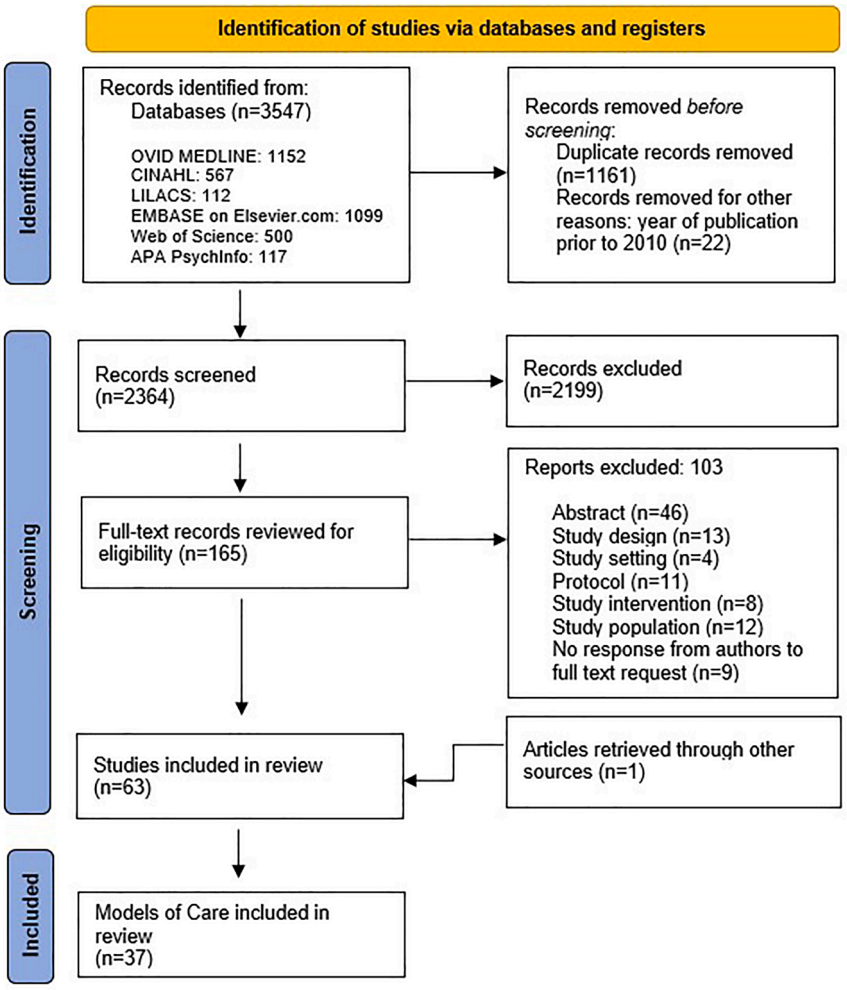

Fig. 1. PRISMA 2020 flow diagram.

settings were excluded.

Information sources, search, selection

Search strategy

The search strategy included terms relating to OA, MoCs and primary care using medical subject heading terms and keywords derived from those domains [Appendix 1]. In conjunction with a medical librarian (PM), six electronic databases were searched: Ovid MEDLINE, EMBASE, and CINAHL (via EBSCOhost), PsychINFO, Web of Science and LILACs. Given that a MoC should be evidence based, databases were searched from January 2010 to May 2022 to ensure MoCs were in line with recent clinical guidelines for OA [5,6,21,22]. Where full-texts were not available, authors were contacted to retrieve the full-texts and any other relevant studies.

Study screening and selection

Titles and abstracts were assessed by two independent review authors (JC, HPF) and relevant articles progressed to full-text screening by the same two reviewers. Any disagreements were resolved in consultation with a third reviewer (FD).

Data characterisation and charting

Data detailing the characteristics of included articles were charted using a standardised form developed from the JBI data extraction tool [19]. Data were independently charted by one author (JC) and cross-checked against original articles by a second author (HPF).

Critical appraisal

Although critical appraisal of studies is not consistently performed in scoping reviews [16], we used the JBI Critical Appraisal tools to appraise the evidence from studies that evaluated MoCs [23]. Two authors (JC, HPF) independently appraised each study using the appropriate tool for the study design. Any disagreements were resolved in consultation with a third review author (JMR).

Data synthesis

Data that were charted were narratively synthesised according to the aims and objectives of the review.

Results

Description of included models

Sixty-three articles describing 37 discrete models were included [Fig. 1], 33 (52%) of which were published between 2018 and 2022. Of the 37 models, 23 (62%) could be classified as OAMPs, comprising a self-management intervention. These programs can be described as discrete packages of care that could form part of MoCs or MoSDs. These were identified across 11 countries including Australia, Canada, Denmark,

Table 2
Identified Models of Care ($n = 37$).

Country	Abbrev. /In Text Model Name	Full Model Name (link to website/model summary for further information where applicable)
i) MoCs with Integrated Care Pathways ($n = 10$)		
Australia	KAHAS	Tweed Knee and Hip Arthritis Service https://aci.health.nsw.gov.au//networks/musculoskeletal/resources/service-directory/tweed-oaccp
	OACCP	Australian Osteoarthritis Chronic Care Program Model of Care www.*aci*.health.nsw.gov.au/models-of-care/musculoskeletal/osteoarthritis-chronic-care-program
	PARTNER	Primary care service delivery for managing pain and function in patients with knee osteoarthritis
	Victorian MoC	Victorian MoC for OA of the hip and knee MoC_Final-report.pdf (msk.org.au)
China	Three-colour ladder management model	Three-colour ladder management model for knee osteoarthritis in the community
Netherlands	BART	Beating osteoarthritis
	Better exercise in OA	Better exercise in osteoarthritis
Norway	SAMBA	Improved management of patients with hip and knee osteoarthritis in primary healthcare (SAMhandling for Bedre Artrosebehandling i kommunehelsetjenesten)
	START	The STavanger osteoARThritis Study
Spain	ARTROACAS	Unnamed Model
ii) Model Consultations ($n = 4$)		
UK	JIGSAW	Joint Implementation of Osteoarthritis guidelines in the West Midlands, UK (Based on MOSAICS study)
	JP Advisor	Joint Pain Advisor
	MOSAICS	Managing OSteoArthritis In ConsultationS OA e template www.keele.ac.uk/pchs/disseminatingourresearch/researchtools/oae-template/ OA guidebook www.keele.ac.uk/media/keeleuniversity/ri/primarycare/pdfs/OA_Guidebook.pdf
Other; Europe (5 countries including; UK, Netherlands, Norway, Denmark, Portugal)	JIGSAW-E	Joint Implementation of Osteoarthritis Guidelines Across Western-Europe https://jigsaw-e.com/
iii) Osteoarthritis Management Programmes ($n = 23$)		
Australia	FORT	Foot ORthoses for big Toe joint osteoarthritis
	TELCKO	Telephone Coaching for Knee Osteoarthritis
Canada	PhIT-OA	Pharmacist-initiated Intervention Trial
Denmark	GLA:D	Good Life with osteoArthritis in Denmark www.glaid.dk
Finland	Unnamed Model 1	Unnamed Model 1
Netherlands	OCTOPuS	Model of stratified exercise therapy
	STERK	Cost-effectiveness of exercise therapy added to general practitioner care for osteoarthritis of the hip
	Towards a regional approach of OA	Towards a regional approach of osteoarthritis (OA): Development, feasibility, and preliminary effects of an OA self-management course for patients
Mexico	Model of care first to the third level	Model of care for the treatment of patients with osteoarthritis of the first to the third level
Norway	AktivA	The Active with OsteoArthritis Physiotherapy Implementation Model
	START	The STavanger osteoARThritis Study
UK	BEEP	Benefits of Effective Exercise for knee Pain
	FASA	Facilitating Activity and Self-management in Arthritic Pain
	ibeat-OA	Internet-Based Exercise programme Aimed at Treating knee Osteoarthritis
	Peer Mentorship Model	Peer mentorship to improve self-management of hip and knee osteoarthritis
USA	LIFE	Learning to Improve Fitness and Function in Elders
	OA-PCP	Osteoarthritis physical activity care pathway
	PRIMO	Patient and Provider Interventions for Managing Osteoarthritis in Primary Care
	SeMOA	Self-Management of Osteoarthritis
South Korea	IMCHB	Interaction Model of Client Health behaviour
	SHP	Self-help Health Promotion Program
Sweden	BOA	Better management of OsteoArthritis www.boaregistret.se Digitalized version/e health: www.jojntacademy.com
	PEPOA	Patient education programme for osteoarthritis

Finland, the Netherlands, Mexico, Norway, UK, USA, South Korea and Sweden. Four model OA consultations (MOACs) were identified, including the Management of OsteoArthritis In Consultations (MOSAICs), originally developed and implemented within the UK, but since adapted to four European countries including; the Netherlands, Norway, Denmark and Portugal. These models focused on enhancing the initial consultation between a patient presenting with OA at the first point of contact into the health system and the clinician. The remaining 10 MoCs were identified across five countries; Australia, China, the Netherlands, Norway and Sweden and detailed a pathway outlining optimal OA care within local health systems, including onward referral to secondary care specialities including rheumatology and orthopaedics (Table 2). Details of the model components, including component parts, healthcare professionals involved and referral pathways are presented in Table 3.

Of the 37 models, 12 described the development process to varying extents [24–35] (Fig. 2). Commonalities between the development processes included alignment with up-to-date national or international evidence-based clinical guidelines, relevant policies and frameworks and position statements [24-26,28-31,34,36], stakeholder consultation [24,25,28-31,34,36], and use of knowledge translation and behaviour change theories [24,25,28,34,37]. Six models detailed underlying frameworks used in the development process [24,26,29,30,34]. Ten models included service user involvement as part of the development process [24-26,28,30,31,33,36,38,39]. Thirteen models (34%) included a provider intervention [24,25,30,31,33,38-45]. Training varied, with the majority requiring model providers to attend training courses/-workshops/educational meetings. Content of these interventions also varied across the models, from theoretical knowledge about OA, assessment and diagnosis of OA, information on the MoC itself, updated

Table 3
Components of Identified Models ($n = 37$).

MoC Abbrev. Associated references *Target Joint (s)*	MoC Provider Training	MoC Delivery method	Initial Consultation *Healthcare Professional(s) involved*	Referral *Healthcare Professional(s) involved*	Follow-up	Referral to secondary care
Osteoarthritis Management Programmes ($n = 23$)						
ARTROACAS [32] *Knee*	–	In person	Baseline visit: OA diagnosis, management including pharmacological treatment and patients split into mild or moderate OA *(GP)*	Education and exercise programme including knee OA disease information, recommendations on self-management, and a home exercise programme *(Physiotherapist)*	If improved, patients get a 12-month review	Treatment scheme for severe OA-referral to specialists (rheumatologist, orthopaedic referral).
BART [35,36, 69-72,78] *Hip*	–	In person	Step 1: medical history and physical examination, education, lifestyle advice. Acetaminophen *(GP)*	Step 2: radiology, pain coping and psychosocial factors, (Topical) NSAIDs or tramadol. Physical therapy/dietary therapy *(Physiotherapist, dietician)*	Baseline and evaluation at baseline and after 3–6 months.	Step 3: Consultation specialist. Optional: Multidisciplinary care
Better exercise in osteoarthritis [39] *Knee and/or hip*	GP and physiotherapist voluntary educational meetings on diagnosis of OA, guidelines and the pathway.	In person	Diagnosis of OA, provision of information about OA and advice about lifestyle, analgesics where necessary *(GP)*	More tailored information about OA and an exercise program focussing on guiding patients to a more active lifestyle. Psychologist/ occupational therapist/ dietitian when necessary *(Psychologist, occupational therapist. dietician, physiotherapist)*	GP evaluation of conservative treatment preferably after 6 months.	Referral to specialised medical care (mostly a referral to an orthopaedic surgeon).
KAHAS [29] *Knee and/or hip*	–	In person	An initial assessment, development of a detailed plan based on lifestyle interventions and physical activity. Patients given education, a self-management program, including exercise. *(Musculoskeletal physiotherapist)*	Referrals to support the lifestyle changes to improve joint health and function *(Multidisciplinary team)*	Ongoing assessment and management at 1, 3 and 6 months after the initial assessment to sustain and develop OA self-management strategies.	Referral to orthopaedics
OACCP [34] *Knee and/ or hip*	–	In person	GP prescribes analgesics and refers for conservative management *(GP)*	Active multidisciplinary non-operative management including assessment, goal setting and care plan development. Enhanced self-management support and discharge back to referring source or continue to joint replacement assessment *(Multidisciplinary team)*	–	Orthopaedic surgeon assessment for joint replacement surgery
PARTNER [24] *Knee*	A multimodal GP behavioural change intervention	In person/ remotely delivered	An effective consultation; diagnosis and education *(GP)*	CST for follow-up and ongoing care provided remotely *(Physiotherapist, CST: allied health care professionals)*	–	Referral to orthopaedics
SAMBA [38,52, 59] *Knee and/or hip*	A multidisciplinary workshop for PTs and GPs included information on OA treatment recommendations, appropriate referral for surgical treatment and the SAMBA model.	In person	Explanation of OA diagnosis and treatment alternatives, provision of pharmacological treatment *(GP)*	3-hour patient OA education programme (ActiveA), optional healthy eating program if overweight/obese, 8–12-week exercise programme with twice weekly 1-hour supervised group sessions *(Physiotherapist, dietician)*	GP review consultation post programme, with options of self-manage or new physiotherapy referral.	If indicated, referral for surgery.
START [45] *Knee and/or hip*	A physiotherapist and MDT workshop including OA update and delivery of ActiveA management program.	In person	Model consultation for diagnostic follow-up consultations, an OA guidebook *(GP)*	OA patient education (regular 3-hour group-based patient OA education programmes) and exercise program (a 6-week exercise programme with twice weekly 1-hour supervised group sessions) *(Physiotherapist)*	–	Referral to orthopaedic surgeon, core treatment

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Table 3 (*continued*)

MoC Abbrev. Associated references *Target Joint (s)*	MoC Provider Training	MoC Delivery method	Initial Consultation *Healthcare Professional(s) involved*	Referral *Healthcare Professional(s) involved*	Follow-up	Referral to secondary care
Osteoarthritis Management Programmes ($n = 23$)						
Three-colour ladder management model for knee osteoarthritis in the community [46] *Knee*	–	–	Green card: non-pharmacological management. Yellow card: green card management and joint injection and analgesia. Red card: pharmacological and surgical treatment *(NR)*	Green and yellow card: medical services from primary health institutions *(NR)*	Green card: 3 times/ year Yellow card: 1 time/ quarter Red card: 1 time/ month	Yellow card/ red card: turn to a specialised hospital.
Victorian MoC for Osteoarthritis of the hip and knee [26] *Knee and/or hip*	–	–	Non-pharmacologic and non-surgical care *(GP)*	–	–	Pharmacologic care and TJR surgery.
Model Consultations ($n = 4$)						
JIGSAW [28] *Non-specific*	Training of practice clinicians	In person	A model OA consultation, recording of high-quality care within electronic health records using an e-template, and provision of patient information using the Keele Osteoarthritis Guidebook *(Physiotherapist)*	Up to four follow-up consultations with the physiotherapist to support self- management *(Physiotherapist)*	–	–
JIGSAW-E [25] *Knee and/or hip*	Education for health professionals, in line with the JIGSAW-E training.	In person	A model consultation, knee OA patient leaflet, functional tests *(GP, physiotherapist)*	–	–	–
JP Advisor [44] *Knee and/or hip*	A two-day course on supporting behavioural change in people with diabetes, which could then be used for OA.	In person	An initial assessment to assess clinical outcomes, physical activity and ability, symptoms and agree goal(s), including targeted advice and action plan *(Physiotherapist)*	–	A 2–3-week, 6–8-week review and final 6-month review	–
MOSAICS [28,30,37,56,79,84,102-104] *Non-specific*	Training and educational packages for GPs and practice nurses.	In person	Enhanced consultation, provision of an OA Guidebook to support OA self-management and advice on analgesia *(GP)*	Up to four follow-up consultations to guide patients in self-management for OA with advice on weight management if required, general exercise, and PA, with goal-setting as appropriate *(Practice nurse)*	–	–
Osteoarthritis Management Programmes ($n = 23$)						
AktivA [42] *Knee and/or hip*	One-day physiotherapist certification course; education, updated evidence on first-line OA treatment and information about the AktivA program.	In person	Patient education OA school (class instruction for 3 h) and exercise program (individually tailored and supervised exercise program lasting 6–12 weeks) *(Physiotherapist)*	–	Assessments at baseline, 3, 12 and 24 months.	–
BEEP [60] *Knee*	–	In person	ITE: 12-week exercise program in six to eight one-to-one treatment sessions. TEA: 12-week exercise program in four individual face-to-face treatments up to week 12 *(GP and physical therapist)*	–	4–6 follow-up contacts (face-to-face or over the telephone) from week 12 through to 6 months (a total of 8–10 treatment contacts).	–
BOA [48,73,81] Knee and/or hip	–	In person	Baseline assessment: individual visit *(Physiotherapist)*	3 OA education sessions, exercise programme supported osteoarthritis self-management program sessions *(Physiotherapist)*	Baseline, 3- and 12-month assessments.	–
FASA [67] *Knee and/or hip*	–	In person	6-week group exercise and self-management intervention programme (twice weekly) including	–	Baseline and 6 month follow up	–

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Table 3 (*continued*)

MoC Abbrev. Associated references *Target Joint (s)*	MoC Provider Training	MoC Delivery method	Initial Consultation *Healthcare Professional(s) involved*	Referral *Healthcare Professional(s) involved*	Follow-up	Referral to secondary care
Osteoarthritis Management Programmes ($n = 23$)						
			20–25 min of physiotherapist-facilitated group discussion and 30–35 min of exercise *(Physiotherapist)*			
FORT [27] *First MTP*	–	In person	At least 3 visits with study podiatrist-provision of insoles *(Podiatrist)*	–	Baseline and 3-month assessment.	–
GLA:D [40] Knee and/or hip	Two-day course evidence-based treatment of OA, introduction to GLA:D	In person	Two patient education sessions and 12 supervised neuromuscular exercise sessions (Physiotherapist)	–	Baseline, immediately after treatment (approx. 3 months) and 12-month assessments.	–
ibeat-OA [53] Knee	–	Digital: online	6-week digitally delivered exercise program and informative texts (including the basics of OA, its treatment, self-managing symptoms, the benefits of behavioural change and maintaining a healthy lifestyle).	–	Baseline and 6-week assessments.	–
IMCHB [33] Knee and/or hip	Two CHNPs in each of the experimental groups were provided with 16 h of education and training using the patient care manual developed by the research team	In person	Multifaceted programme including: 8 sessions of health education and counselling combined with exercise classes based on the IMCHB (CHNPs (nurse practitioners))	–	Baseline and 8-week assessments (pre and post).	–
LIFE [51] *Non-specific*	–	Combination of in person and over the telephone	Baseline in-person counselling session, a workbook with targeted reading materials and exercise resources, 3 biweekly telephone calls within the first 6 weeks and then monthly telephone calls for the remainder of the trial (*PA counsellor)*	–	Baseline, 3-, 6- and 12-months assessments	–
Model of care for the treatment of patients with osteoarthritis of the first to the third level [41] *Knee and/or hip*	Integration and training of the specialized MDT	In person	Integrative model; nutritional, physiotherapeutic, social and psychological evaluation from the first level *(Nutritionist, physiotherapist, psychologist, social worker)*	–	–	–
OCTOPuS [85] *Knee*	–	In person	4-month exercise programme; 4 subgroups-high muscle strength subgroup, depression subgroup, obesity subgroup or low muscle strength subgroup *(Physical therapist)*	–	Baseline and 4-months follow-up.	–
OA-PCP [83] *Knee and/ or hip*	–	Telephone delivered	3 PA coaching calls (focused on goal setting), three check-in emails and linkage with community based or online resources to support PA *(Trained PA coaches)*	–	–	–
Peer mentorship Model [31] *Knee and/or hip*	–	In person	Usual care consisting of information resources and a handout about local services/support groups/ activities) *(NR)*	Up to eight 1-hour self-management support sessions *(Peer Mentors)*	–	–
PEPOA [66] *Knee and/or hip and/or hand*	–	In person	Multi-disciplinary self-efficacy programme, comprising 5 group sessions, 3 h for each	–	Baseline and after 6-month assessments.	–

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Table 3 (*continued*)

MoC Abbrev. Associated references *Target Joint (s)*	MoC Provider Training	MoC Delivery method	Initial Consultation *Healthcare Professional(s) involved*	Referral *Healthcare Professional(s) involved*	Follow-up	Referral to secondary care
Osteoarthritis Management Programmes ($n = 23$)						
			session, once per week for 5 weeks *(MDT (GP, orthopaedic specialist, physiotherapist or occupational therapist))*			
PhIT-OA [49,61] *Knee*	–	In person	A validated knee OA screening questionnaire *(Pharmacist)*	Exercise program, 1-hour physiotherapy assessment and exercise class twice per week for 6 weeks *(Rehabilitation assistant, physiotherapist)*	Baseline, 3 and 6-month assessments.	–
PRIMO [54,58,80,82] *Knee and/or hip*	–	Telephone delivered	12-month intervention focusing on PA, weight management, and cognitive behavioural strategies for managing pain. Telephone calls twice per month for the first 6 months, then monthly for the last 6 months *(Physician, counsellor with training in OA)*	–	Baseline, 6- and 12-month assessments.	–
SeMOA [64] *Knee and/or hip*	–	Telephone delivered	Educational materials and 12 monthly telephone calls to support individualized goals and action plans. The health education intervention involves non-OA educational materials and 12 monthly telephone calls related to general health screening topics *(Health educator (a counsellor))*	–	–	–
SHP [43] *Non-specific*	Two-day training program for CHPs included arthritis assessment, education strategies, the contents of the SCP.	In person	Self-care program implemented for 6 weeks, 2 h per week, at community health posts: overview of OA, everyday exercise for OA, pain control by medication *(CHPs (registered nurses)*	–	–	–
STERK [57,62] *Hip*	–	In person	Usual GP care and brochure with information about hip OA *(GP)*	A booklet of home exercises. 12 treatment sessions during the first 3 months; advice on lifestyle adaptations, possible walking aids, appropriate postural loading of joints and pain behaviour *(Physiotherapist)*	After completion of the initial treatment sessions 3 booster sessions in the fifth, seventh and ninth month.	–
TELCKO [65] *Knee*	–	Telephone-delivered	Consultation for self-management advice: 1 or more calls from telephone service *(Nurse)*	5–10 consultations of a telephone-delivered exercise program *(Physiotherapist)*	Baseline, 6-week and 6-month assessments.	–
Towards a regional approach of osteoarthritis [47] *Knee and/or hip*	–	In person	OA educational group-based program consisting of 2 meetings of 1.5 h MDT *(GP, physiotherapist, specialized nurse, orthopaedic surgeon)*	–	Baseline and 3 months follow-up.	–
Unnamed Model 1 [63] *Hip*	–	In person	An instructional hour-long session concerning the basic principles of non-operative treatment of hip OA *(GP)*	Exercise programme consisting of 12 supervised (once per week) exercise sessions *(Physiotherapist)*	4 additional booster exercise sessions one year later.	–
Unnamed Model 2 [74] *Knee*	–	In person	3-month education and exercise programme *(Occupational therapist)*	–	Baseline (before the start of the intervention), at 3 months (after the end of the group	–

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Table 3 (*continued*)

MoC Abbrev. Associated references *Target Joint (s)*	MoC Provider Training	MoC Delivery method	Initial Consultation *Healthcare Professional(s) involved*	Referral *Healthcare Professional(s) involved*	Follow-up	Referral to secondary care
Osteoarthritis Management Programmes ($n = 23$)						
					intervention), and at 12 months (long-term follow-up) for assessments.	

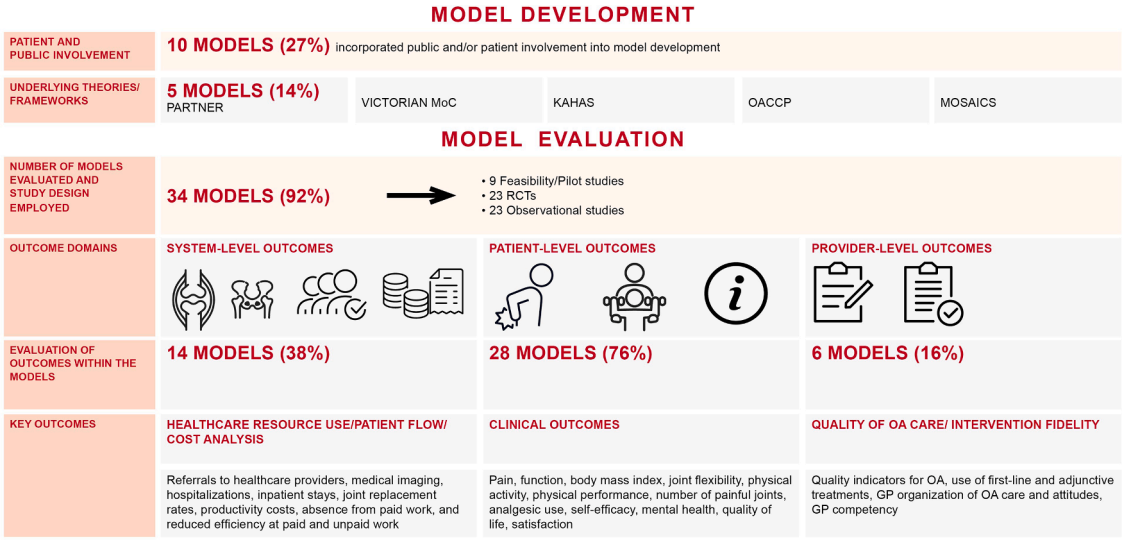

Fig. 2. Model Development and Evaluation.

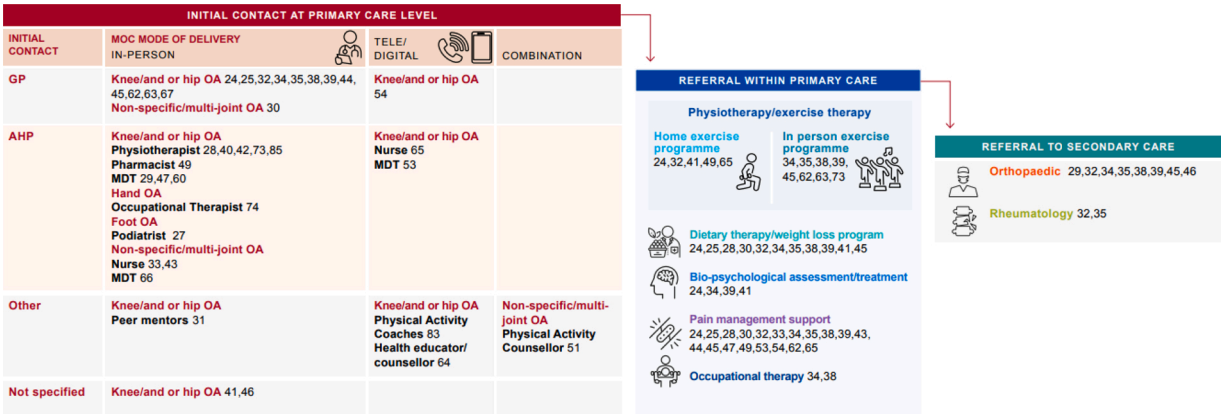

Fig. 3. Description of components of Models of Care ($n = 37$).

clinical guidelines, the content of the model, the role of different professionals within the model and the application of the model in practice, including access to online materials/resources, such as digital education and decision support tools and patient information sources. Delivery of the models varied from being delivered in-person, via telephone and digitally with GP-led models most common. Eight models employed a stepped care approach [32,34,36,38,39,45-47]. The exercise component of the MoCs varied, while most MoCs incorporated generic exercise programmes, a minority were individualised or tailored [34,38,48,49]. A stratified approach was adopted in the OCTOPuS study [50], where patients were categorised into subgroups depending on muscle strength and presence of co-morbidities such as obesity and depression. Provision of dietary/weight management, psychological support, adjuncts, such foot orthotics and walking aids medication advice/prescription varied

across the models (Fig. 3).

Evaluation of models

The 63 studies included 23 randomised controlled trials (RCTs) [30,33,38,43,49-67], 23 observational studies [25,29,36,39,40,42,44,47,48,68-81] and nine feasibility/pilot trials [27,28,31,32,41,82-85] evaluating the MoCs. Further detail is provided in Appendix 2.

Outcome domains

Patient-level outcomes

Twenty eight of the 37 models (76%) were evaluated for clinical outcomes through 17 RCTs, 10 observational studies and six pilot/feasibility studies. Pain and function were the most frequently evaluated clinical outcomes. Other outcomes included joint flexibility, physical activity, body mass index, use of analgesics, self-efficacy, mental health, quality of life (QoL) and satisfaction. Overall clinical effects were mixed. Seventeen RCTs evaluated clinical outcomes in 14 models; significant improvements for the MoC group compared to the usual care group was observed in nine RCTs [33,43,49,51,58,63,64,66,67], with two further RCTs only showing short-term improvements [62,65]. Six RCTs found no clinical effect associated with the MoC [30,50,53,54,56,57] amongst nine models that were evaluated via 10 observational studies [29,36,40,42,44,47,73,74,77,81], seven reported improvements associated with the MoCs [29,40,42,44,74,77,81]. Six models were evaluated for clinical outcomes via feasibility/pilot studies [27,32,41,50,82,83], largely showing promise of improvements in OA symptoms.

System-level outcomes

Fourteen of the 37 models (38%) were evaluated for system-level outcomes through five RCTs, 13 observational studies and one feasibility trial. System-level outcomes included cost analyses, referrals to healthcare providers, medical imaging, hospitalisations, inpatient stays, joint replacement rates, productivity costs, absence from paid work and reduced efficiency at paid and unpaid work. While the overall economic evaluations largely did not favour the models, emerging findings relating to health care use and referrals is positive. Four studies found significant positive-system level outcomes associated with four models, including reduced monthly medical visits and expenses [77], reduction in diagnostic imaging [39], higher proportions of patients being referred to physiotherapy and lower proportions being referred orthopaedic surgeons; [38] and reduction in use of health care resources (e.g. primary care physicians, specialists and emergency room visits) [32] post intervention. An RCT evaluation of the SeMOA model found no difference in health care use between groups [64] and an observational study evaluating the JIGSAW-E reported only a transient drop in the referral rate to orthopaedics in the first six months [86]. Five RCTs evaluated five models for cost effectiveness [56,60-63]. Only one RCT [57] reported reduced medical costs associated with the model, compared to usual care. Two RCTs demonstrated lower costs associated with usual care [60,61]. Although a reduced demand for orthopaedic surgery was found in the MOSAICS evaluation, overall, it was not shown to be cost-effective [56]. Similarly, one further RCT found no statistically significant differences in the total health care system costs associated with the MoC versus usual care [63]. Two further models were evaluated through two observational studies. A registry-based pre–post economic evaluation of the GLA:D found it to be cost-effective at one year in patients with knee or hip OA [87]. A digital version of the BOA model was also shown to be an economical alternative, costing around 25% of the existing face-to-face MoC [48].

Provider outcomes

Seven of the 37 models (19%), were evaluated in this outcome domain through seven RCTs [28,30,45,49,55,59,84] and two observational studies [25,36], with overall mixed results. However, there is emerging evidence of positive impacts of the models on quality of care. Outcomes included OA quality indicators, use of first-line and adjunctive treatments, GP organisation of OA care, attitudes, competency and treatment fidelity. Within the MOSAICS and JIGSAW-UK evaluations, improvements in OA education, provision of written OA information and uptake of core National Institute for Health and Care Excellence (NICE) recommendations (e.g. increased written advice on OA, exercise, and weight loss information) associated with the intervention were reported [28,30,55,84]. Similarly, evaluations of the PhIT-OA and SAMBA models also demonstrated improved care in the intervention group compared to usual care i.e. uptake of core treatments; exercise, patient education and referral to support for weight reduction [59] and OA quality indicators [49]. Positive effects on knee OA care found from the JIGSAW-E intervention were found to be transient only [25]. Findings from the START [45] and BART [36] did not demonstrate clear improvements in quality of OA care.

Critical appraisal

Methodological quality appraisal was conducted for RCTs ($n = 20$) and quasi-experimental studies ($n = 16$) according to the JBI Critical Appraisal Tools. Results are displayed in Supplemental material [Please see Appendix 3]. The main areas of bias included selection blinding resulting in the lack of treatment concealment in 35% of the RCTs, performance and detection bias (65% and 55% of studies respectively) due to lack of blinding of participants to the intervention and treatment deliverer to treatment assignment. Amongst the quasi-experimental studies, sources of bias included measurement bias due to the lack of control groups in the majority of studies (94%) and attrition bias due to incomplete follow-up in 25% of studies.

Discussion

This is the first scoping review to map the literature regarding MoCs for OA. For the purpose of this review we focused on models that were initiated and delivered at the primary care level, targeting individuals with OA entering or currently in the primary care system. We identified 37 models, highlighting the extensive international research conducted on this topic to date. Given the broad scope of the review and that the explicit use of the term MoC was not required, the models included in this review were varied. Twenty-three were best described as OAMPs in line with the Osteoarthritis Research Society International (OARSI) Joint Effort Initiative definition 'a model of evidence-based, non-surgical OA care that has been implemented in a real-world setting and includes the following four components: personalised OA care; delivered as a package of care with longitudinal reassessment and progression; comprising two or more elements of the core, guideline-recommended first line interventions (education, exercise and weight loss)' [88]. The models were identified across 13 countries (95% of which are classified as high-income economies) in diverse healthcare systems in terms of primary care delivery, public and private healthcare sectors, and health insurance models. While variation in care exists internationally, frequently identified model characteristics included; GP-led care, referral to primary care services and multidisciplinary care. It is recognised that complex intervention development should be theory driven, rigorous and structured in terms of methodological approach, and should involve relevant stakeholders to ensure the intervention is fit for purpose and that implementation is well-adopted [89]. However, most models lacked conceptual structure such as underlying development frameworks, patient and public involvement or representation from other key stakeholders.

OA is a multifaceted and varied disease [10]. Therefore, MoCs need to reflect this variability in terms of disease onset, symptomology, progression and treatment response. Lack of individualised care i.e.,

predominantly 'one-size fits all models' was evident. This may be explained by the absence of tailored care guidance in international recommendations. There is a need to develop and test MoCs that can flexibly optimise care for individual patients according to clinical phenotypes, severity of the disease and individual medical status, within varying social, cultural and economic contexts, in order to improve treatment response. Given the well-established overuse of unnecessary treatments and diagnostic tools in OA care, including imaging and arthroplasty [90], a stepped-care approach may reduce the clinical uncertainty and likelihood of patients receiving unnecessary treatment. By categorising individuals according to disease features and evolution, the ARTROACAS model facilitated an early targeted conservative management programme for individuals with mild OA.

Despite differences in the models, some positive findings emerged across the models such as increased use of quality indicators for OA care, uptake of evidence-based treatments [28,30,49,55,59,84] and reduced healthcare usage (e.g., diagnostic imaging, referrals, medical expenses) [32,38,39,77]. Clinical outcomes such as pain and function produced more conflicting results. Given the evidence for conservative management such as exercise on such outcomes [91], various factors may explain these findings such as lack of information on what constituted 'usual care' in the comparator group across studies. Given that pain and function can fluctuate on a daily basis, future evaluations may be better able to capture the gains from a multifaceted approach such as by measuring outcomes relating to more nuanced behaviour changes, patient activation or understanding, or sense of control over their condition. These outcomes may reap rewards in pain, function and QoL outcomes beyond the study period. Therefore, capturing wider health outcomes such as increased exercise uptake that can impact positively on co-morbidities is also important. It is likely that shifting clinician and patient mindsets towards consistent messaging about the benefit of non-surgical interventions will take time. Long-term treatment adherence remains challenging for OA management. As with any chronic condition, behaviour change is essential [92]. There is a need to incorporate effective strategies within models to foster long-term adherence to lifestyle modifications and to promote healthy behaviours throughout the disease course. Evidence from models incorporating home exercise was positive, indicating improvements in patient outcomes such as pain, function, QoL and self-efficacy [32,41,49,65]. The TELCKO [65] model demonstrated that telephone consultations could incorporate underutilised behavioural approaches in managing OA. Given the global Covid-19 pandemic shift towards remote care, it is likely that uptake in telephone and digitally-enabled care for OA will continue to increase. Digitally-delivered care may offer a solution to lack of services in regional and remote places. However, strategic implementation is warranted to avoid furthering inequity for those with low digital literacy or limited digital access. Although evaluation of the OCTOPuS study did not demonstrate significant clinical improvements associated with a stratified approach to exercise therapy over usual care [50], this approach appears logical and has been shown to be effective in low back pain populations [93]. Evaluations of a stepped-care approach from a small number of models showed promising results in clinical outcomes and quality of care, along with reducing healthcare system use [32,38,39,47,68,70,77].

Recommendations for future research and policy

The cultural and contextual adaptation of models such as MOSAICS through the Joint Implementation of Osteoarthritis Guidelines Across Western-Europe (JIGSAW-E) to other European countries [94], and potentially New Zealand, is promising [95]. Similarities between healthcare systems, for instance GP-based primary care and publicly funded secondary and tertiary care enhances the potential for established MoCs to be replicated across countries. However, variation in healthcare systems and resources may be a challenge, particularly in translating models to low- and middle-income countries (LMICs), which are poorly represented in this review. This review highlights opportunities for discrete packages of care identified, such as model consultations, education and training for healthcare providers and multi-component interventions to complement and form part of established MoCs or MoSDS. The prevalence of OA and other non-communicable diseases is increasing in LMICs, hence the urgent need for targeted public strategies [96]. There is a need to explore how existing models can be adapted and implemented, including in developing countries.

Future models would benefit from a more integrated approach addressing the entire biopsychosocial needs of individuals with OA and more widespread inclusion of dietary interventions, given the known negative influence of excess weight on activity levels, mobility, muscle strength and ultimately on disease progression [97,98]. A large proportion of the models focused on the hip and/or knee joint (32/37; 86%). In reality, multiple joints are commonly affected, and generalised OA may be a marker of more severe disease, increased progression and poorer outcomes [99]. Therefore, better insight into how to incorporate effective interventions into MoCs for this specific population are required. Furthermore, greater consideration of co-morbidities which may complicate treatments such as physical activity prescription is required, given the known association between OA and conditions such as cardiovascular disease, hypertension and diabetes [100]. To achieve change within health service delivery, the need for reorientation and education of the health workforce has been recognised [101]. Therefore, future development and assessment of training and education programs for health care professionals delivering evidence-based models for OA is required.

Strengths and limitations of this review

The scoping review methodology allowed us to map the broad literature regarding primary care based models of OA care and every effort was made to comprehensively search and include all relevant studies. To maintain a broad scope of this review, we did not require included studies to use the term 'Model of Care'. Rather, articles were screened based on the specified definition [12]. However, it is possible that we did not identify all eligible MoCs. While we identified a wide range of models, it was beyond the scope of this review to fully examine the overall effectiveness of the models and magnitude of the intervention effects. Further research is needed to ascertain which models are likely to be most clinically and cost-effective. Variation in healthcare systems and resources will likely dictate the 'best model' for a local health system. While it is necessary to consider the specific context of the models, it was beyond the scope of this review to explore the models in the context of their local health systems. Ultimately the success of a model depends on clinical and service-level integration. To optimise successful widespread implementation of a model, empirical investigation into cost analyses, and barriers and facilitators to engagement is vital in ascertaining acceptability and viability, along with exploration of strategies for large-scale and sustained model implementation.

Conclusion

There are emerging efforts across multiple countries to develop evidence-based models focussed on improving the nonsurgical management of OA in primary care and reducing the unnecessary burden on secondary care systems. We identified MoCs with integrated care pathways, model consultations and OAMPs. Although the models varied in content and design, key lessons included the importance of clear conceptual structure including underlying development frameworks and theories, stakeholder involvement including service user representation, a coherent trained workforce to deliver the model, integration across different levels of healthcare systems, processes to individualise treatment selection according to patient characteristics and individual medical status, and incorporation of behaviour change strategies to foster long-term adherence and self-management. While the MoCs provide some evidence for improved quality of care and patient-level outcomes, future research is required to systematically evaluate the outcomes and impact of these models over time to facilitate the spread of effective models and improve the care of this highly prevalent global condition.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Appendix I
Search strategies of electronic databases.

	OVID MEDLINE
	Ovid MEDLINE(R) and Epub Ahead of Print, In-Process, In-Data-Review & Other Non-Indexed Citations, Daily and Versions(R)
1	Osteoarthritis OR (Degenerative adj1 arthritis) OR (Degenerative adj1 joint adj1 disease) OR exp Osteoarthritis/ OR Osteoarthr$.mp. OR (degenerative adj2 arthritis) OR Arthrosis.mp. OR Gonarthrosis.mp. OR coxarthrosis.mp. OR Arthritis.mp. OR arthralgia.mp.
2	(Patient adj2 centred) OR (Client adj2 centred) OR (Collaborative adj1 model$) OR (Combined adj1 model$) OR (care adj2 model$) OR (New adj1 model$) OR (Individualized adj1 model$) OR (Structured adj1 model$) OR (Advanced adj1 model$) OR (Holistic adj1 model$) OR (Optimal adj1 model$) OR (Multidisciplinary adj1 model$) OR (Co-ordinated adj1 model$) OR (Complex adj1 model$) OR (Standardized adj1 model$) OR (Clinical adj1 model$) OR (Orthopaedic adj1 model$) OR (General adj2 practice adj2 model$) OR (Innovative adj1 model$) OR (Community adj2 based adj2 model$) OR (Continuum adj1 model$) OR (Implementation adj1 model$) OR (delivery adj1 model$) OR (Osteoarthritis adj1 model$) OR (Partnership adj1 model$) OR (medicine adj2 model$) OR (guideline$ adj2 model$) OR (practice adj1 model$) OR (Gold adj2 standard adj2 model$) OR (Consensus adj2 model$) OR (Management adj1 model$) OR (Quality adj2 model$)
3	(Clinical adj1 network$) OR (Quality adj1 improvement) OR (Management adj1 Programme) OR Intervention$.mp. OR Framework.mp. OR Policy.mp. OR Strategy.mp. OR Initiative.mp. OR Theory.mp. OR (Clinical adj1 Protocol) OR (Clinical adj1 pathway$) OR (care adj1 path*) OR (clinical adj1 path*) OR (Decision adj2 support adj2 system$) OR (decision adj1 tree) OR (pathway adj2 care) OR (continuity adj2 care) OR (patient adj 1 care) OR (system adj1 delivery) OR (service adj1 delivery) OR (care adj1 process) OR (care adj1 program*) OR (care adj1 map$) OR paradigm.mp. OR (process adj1 map*) OR (sequence adj2 care)
4	2 OR 3
5	(Care adj1 delivery) OR (Primary adj1 care) OR (primary adj1 health adj1 care) OR (primary adj1 health care) OR exp Primary Health Care/ OR exp General Practitioners/ OR (general adj1 practice) OR (allied adj1 healthcare) OR (care adj1 provider$) OR exp Community Health Services/ OR (community adj2 health) OR (Multidisciplinary adj1 care)
	1 AND 4 AND 5
	1 AND 6 AND 3
	EMBASE on Elsevier.com
1	'osteoarthritis'/exp OR Osteoarthritis:ti,ab,kw OR (Degenerative NEXT/1 arthritis) OR (Degenerative NEXT/1 joint NEXT/1 disease) OR Osteoarthr$:ti,ab,kw OR (degenerative adj2 arthritis) OR Arthrosis:ti,ab,kw OR Gonarthrosis:ti,ab,kw OR coxarthrosis:ti,ab,kw OR Arthritis:ti,ab,kw OR arthralgia:ti,ab,kw
2	(Patient NEXT/2 centred) OR (Client NEXT/2 centred) OR (Collaborative NEXT/1 model$) OR (Combined NEXT/1 model$) OR (care NEXT/2 model$) OR (New NEXT/1 model $) OR (Individualized NEXT/1 model$) OR (Structured NEXT/1 model$) OR (Advanced NEXT/1 model$) OR (Holistic NEXT/1 model$) OR (Optimal NEXT/1 model$) OR (Multidisciplinary NEXT/1 model$) OR (Co-ordinated NEXT/1 model$) OR (Complex NEXT/1 model$) OR (Standardized NEXT/1 model$) OR (Clinical NEXT/1 model$) OR (Orthopaedic NEXT/1 model$) OR (General adj2 practice adj2 model$) OR (Innovative NEXT/1 model$) OR (Community adj2 based adj2 model$) OR (Continuum NEXT/1 model$) OR (Implementation NEXT/1 model$) OR (delivery NEXT/1 model$) OR (Osteoarthritis NEXT/1 model$) OR (Partnership NEXT/1 model$) OR (medicine NEXT/1 model$) OR (guideline$ NEXT/2 model$) OR (practice NEXT/1 model$) OR (Gold NEXT/2 standard NEXT/2 model$) OR (Consensus NEXT/2 model$) OR (Management NEXT/1 model$) OR (Quality NEXT/2 model$)
3	(Clinical NEXT/1 network$) OR (clinical NEXT/1 quality) OR (Management NEXT/1 Programme) OR Intervention:ti,ab OR Framework:ti,ab OR Policy:ti,ab OR Strategy:ti,ab OR Initiative:ti,ab OR paradigm:ti,ab OR Theory:ti,ab OR (Clinical NEXT/1 Protocol) OR (Clinical NEXT/1 pathway$) OR (care NEXT/1 pathway$) OR (clinical NEXT/1 pathway$) OR (Decision NEXT/2 support NEXT/2 system$) OR (decision NEXT/1 tree) OR (continuity NEXT/2 care) OR (patient NEXT/1 care) OR (system NEXT/1 delivery) OR (service NEXT/1 delivery) OR (care NEXT/1 process) OR (care NEXT/1 program$) OR (care NEXT/1 map$) OR (process NEXT/1 map$) OR (sequence NEXT/2 care)
4	2 OR 3
5	(Care NEXT/1 delivery) OR (Primary NEXT/1 care) OR (primary NEXT/1 health NEXT/1 care) OR (primary NEXT/1 health care) OR 'Primary Health Care'/exp OR 'General Practitice'/exp OR (general NEXT/1 practice) OR (allied NEXT/1 healthcare) OR (care NEXT/1 provider$) OR (community NEXT/2 health NEXT/2 service$) OR (Multidisciplinary NEXT/1 care)
6	1 AND 4 AND 5
	Web of Science: Science and Social Science Citation Indexes
1	TS=((osteoarthritis OR Osteoarthritis OR (Degenerative NEAR/1 arthritis) OR (Degenerative NEAR/1 joint NEAR/1 disease) OR Osteoarthr$ OR (degenerative NEAR/2 arthritis) OR Arthrosis OR Gonarthrosis OR coxarthrosis OR Arthritis OR arthralgia))
2	TS=((Patient NEAR/1 centred) OR (Client NEAR/1 centred) OR (Collaborative NEAR/1 model$) OR (Combined NEAR/1 model$) OR (care NEAR/1 model$) OR (New NEAR/1 model$) OR (Individualized NEAR/1 model$) OR (Structured NEAR/1 model$) OR (Advanced NEAR/1 model$) OR (Holistic NEAR/1 model$) OR (Optimal NEAR/1 model$) OR (Multidisciplinary NEAR/1 model$) OR (Co-ordinated NEAR/1 model$) OR (Complex NEAR/1 model$) OR (Standardized NEAR/1 model$) OR (Clinical NEAR/1 model$) OR (Orthopaedic NEAR/1 model$) OR (General adj2 practice adj2 model$) OR (Innovative NEAR/1 model$) OR (Community adj2 based adj2 model$) OR (Continuum NEAR/1

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Appendix I (*continued*)

	model$) OR (Implementation NEAR/1 model$) OR (delivery NEAR/1 model$) OR (Osteoarthritis NEAR/1 model$) OR (Partnership NEAR/1 model$) OR (guideline$ NEAR/1 model$) OR (practice NEAR/1 model$) OR (Gold NEAR/1 standard NEAR/1 model$) OR (Consensus NEAR/1 model$) OR (Management NEAR/1 model$) OR (Quality NEAR/1 model$))
3	TS=((Clinical NEAR/1 network$) OR (clinical NEAR/1 quality) OR (Management NEAR/1 Programme) OR (Clinical NEAR/1 Protocol) OR (Clinical NEAR/1 pathway$) OR (care NEAR/1 pathway$) OR (clinical NEAR/1 pathway$) OR (Decision NEAR/1 support NEAR/1 system$) OR (decision NEAR/1 tree) OR (continuity NEAR/1 care) OR (patient NEAR/1 care) OR (system NEAR/1 delivery) OR (service NEAR/1 delivery) OR (care NEAR/1 process) OR (care NEAR/1 program$) OR (care NEAR/1 map$) OR (process NEAR/1 map$) OR (sequence NEAR/1 care))
4	2 OR 3
5	TS=((Care NEAR/1 delivery) OR (Primary NEAR/1 care) OR (primary NEAR/1 health NEAR/1 care) OR (primary NEAR/1 healthcare) OR (general NEAR/1 practice) OR (allied NEAR/1 healthcare) OR (care NEAR/1 provider$) OR (community NEAR/1 health NEAR/1 service$) OR (Multidisciplinary NEAR/1 care))
6	1 AND 4 AND 5
	APA PsychInfo
	On Ebscohost
1	(osteoarthritis OR Osteoarthritis OR (Degenerative N1 arthritis) OR (Degenerative N1 joint N1 disease) OR Osteoarthr$ OR (degenerative N2 arthritis) OR Arthrosis OR Gonarthrosis OR coxarthrosis OR Arthritis OR arthralgia)
2	((Patient N1 centred) OR (Client N1 centred) OR (Collaborative N1 model$) OR (Combined N1 model$) OR (care N1 model$) OR (New N1 model$) OR (Individualized N1 model$) OR (Structured N1 model$) OR (Advanced N1 model$) OR (Holistic N1 model$) OR (Optimal N1 model$) OR (Multidisciplinary N1 model$) OR (Co-ordinated N1 model$) OR (Complex N1 model$) OR (Standardized N1 model$) OR (Clinical N1 model$) OR (Orthopaedic N1 model$) OR (General adj2 practice adj2 model$) OR (Innovative N1 model$) OR (Community adj2 based adj2 model$) OR (Continuum N1 model$) OR (Implementation N1 model$) OR (delivery N1 model$) OR (Osteoarthritis N1 model$) OR (Partnership N1 model$) OR (guideline$ N1 model$) OR (practice N1 model$) OR (Gold N1 standard N1 model$) OR (Consensus N1 model$) OR (Management N1 model$) OR (Quality N1 model$))
3	((Clinical N1 network$) OR (clinical N1 quality) OR (Management N1 Programme) OR (Clinical N1 Protocol) OR (Clinical N1 pathway$) OR (care N1 pathway$) OR (clinical N1 pathway$) OR (Decision N1 support N1 system$) OR (decision N1 tree) OR (continuity N1 care) OR (patient N1 care) OR (system N1 delivery) OR (service N1 delivery) OR (care N1 process) OR (care N1 program$) OR (care N1 map$) OR (process N1 map$) OR (sequence N1 care))
4	2 OR 3
5	((Care N2 delivery) OR (Primary N1 care) OR (primary N2 health N2 care) OR (primary N1 healthcare) OR (general N1 practice) OR (general N1 practise) OR (allied N1 healthcare) OR (care N1 provider$) OR (community N2 health N2 service$) OR (Multidisciplinary N1 care))
6	1 AND 4 AND 5
	CINAHL
	On Ebscohost
1	(osteoarthritis OR Osteoarthritis OR (Degenerative N1 arthritis) OR (Degenerative N1 joint N1 disease) OR Osteoarthr$ OR (degenerative N2 arthritis) OR Arthrosis OR Gonarthrosis OR coxarthrosis OR Arthritis OR arthralgia)
2	((Patient N1 centred) OR (Client N1 centred) OR (Collaborative N1 model$) OR (Combined N1 model$) OR (care N1 model$) OR (New N1 model$) OR (Individualized N1 model$) OR (Structured N1 model$) OR (Advanced N1 model$) OR (Holistic N1 model$) OR (Optimal N1 model$) OR (Multidisciplinary N1 model$) OR (Co-ordinated N1 model$) OR (Complex N1 model$) OR (Standardized N1 model$) OR (Clinical N1 model$) OR (Orthopaedic N1 model$) OR (General adj2 practice adj2 model$) OR (Innovative N1 model$) OR (Community adj2 based adj2 model$) OR (Continuum N1 model$) OR (Implementation N1 model$) OR (delivery N1 model$) OR (Osteoarthritis N1 model$) OR (Partnership N1 model$) OR (guideline$ N1 model$) OR (practice N1 model$) OR (Gold N1 standard N1 model$) OR (Consensus N1 model$) OR (Management N1 model$) OR (Quality N1 model$))
3	((Clinical N1 network$) OR (clinical N1 quality) OR (Management N1 Programme) OR (Clinical N1 Protocol) OR (Clinical N1 pathway$) OR (care N1 pathway$) OR (clinical N1 pathway$) OR (Decision N1 support N1 system$) OR (decision N1 tree) OR (continuity N1 care) OR (patient N1 care) OR (system N1 delivery) OR (service N1 delivery) OR (care N1 process) OR (care N1 program$) OR (care N1 map$) OR (process N1 map$) OR (sequence N1 care))
4	2 OR 3
5	((Care N2 delivery) OR (Primary N1 care) OR (primary N2 health N2 care) OR (primary N1 healthcare) OR (general N1 practice) OR (general N1 practise) OR (allied N1 healthcare) OR (care N1 provider$) OR (community N2 health N2 service$) OR (Multidisciplinary N1 care))
6	1 AND 4 AND 5

Appendix 2
Description and evaluation of identified MoCs.

Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
Primary care service delivery for managing pain and function in patients with knee osteoarthritis *(PARTNER)* [24] Australia Joint Involved: Knee	Research design and methods: Stage 1; design of new model. Stage 2: development of BCI. Stage 3: 'CST' component of the service delivery model was operationalised. Underlying Framework: UK MRC guidance on complex intervention development. Service User involvement: Yes	Egerton et al. [24]	Descriptive study To describe the process of developing and operationalising a new model of service delivery to implement recommended care for people with knee OA in a primary care setting.	n/a	n/a	n/a	n/a
The Victorian MoC for OA of the hip and knee *(None)* [26] Australia Joint Involved: Knee and/or hip	Research design and methods: Four sequential phases i) continuous consultation; ii) continuous incorporation of best available evidence; and iii) alignment with existing and emerging relevant policy, frameworks or position statements. Underlying Framework: Best-practice framework developed as a global initiative through the Global Alliance for MSK Health of the Bone and Joint Decade. Service User involvement: Yes	Briggs et al. [26]	Descriptive study To describe the MoC development process and lessons learned.	n/a	n/a	n/a	n/a
Foot ORthoses for big Toe joint osteoarthritis *(FORT)* [27] Australia Joint Involved: First MTP	Research design and methods: Developed by an expert panel of podiatrists from Australia and NZ involving research on assessment and treatment for first MTP joint OA and a 1-hour teleconference meeting Underlying Framework: NR Service User involvement: NR	Paterson et al. [27]	Feasibility Trial To determine the feasibility of a clinical trial comparing a podiatry intervention to usual GP care for people with first MTP joint OA	Primary outcomes: Feasibility (recruitment, attendance, and retention;% prescribed exercise sessions completed; orthoses wear hours/day; treatment fidelity). Secondary outcomes: self-reported pain, function, satisfaction, adherence, adverse events, and dropouts	Usual care group $n = 15$, Intervention group $n = 15$	3 months	Improvements in pain and function that exceeded minimum clinically important differences in both groups at 12 weeks.
Australian Osteoarthritis Chronic Care Program Model of Care (OACCP) [34] Joint Involved: Knee and/or hip	Research design and methods: The NSW Model of Care for the OACCP was developed through a collaborative effort by consumer members of the ACI Musculoskeletal Network, Arthritis NSW, clinicians and managers and an Osteoarthritis Working Group. UnderlyingFramework: The National Chronic Disease Strategy, National Service Improvement Framework,	n/a	n/a	n/a	n/a	n/a	n/a

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Appendix 2 (*continued*)

Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
	National Arthritis and Musculoskeletal Conditions Advisory Group Service User involvement: Yes						
Tweed Knee and Hip Arthritis Service *(KAHAS)* [29] Australia Joint Involved: Knee and/or hip	Research design and methods: The methodology was composed of several key steps: [1] project initiation and start-up; [2] diagnostics; [3] solution design; [4] implementation planning; [5] implementation checkpoints; and [6] evaluation, sustainability and knowledge sharing. Underlying Framework: The clinical redesign framework based on the ACI Centre for Healthcare Redesign framework. Service User involvement: Yes	Campbell et al. [29]	Observational study To describe the processes of designing and implementing this conservative OA management service and report on key functional, mobility and pain outcomes for an initial cohort of patients referred to the newly established service	NRS pain score, FPW; s, 30-s chair stand, TUGT	Intervention group $n = 414$	6 months	An analysis of a foundational cohort of patients demonstrated improvements in a suite of validated and standardised measures for pain and function, with improvements seen as early as 1 month and sustained for 6 months.
Telephone Coaching for Knee Osteoarthritis *(TELCKO)* [65] Australia Joint Involved: Knee	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Hinman et al. [65]	RCT To evaluate a physiotherapist-led telephone delivered exercise advice and support intervention for people with knee OA.	NRS pain score, WOMAC function, cost-effectiveness	Usual care group=88, Intervention group=87	5 months	Greater improvement in function (mean difference 4.7 (95% CI 1.0 to 8.4)), but not overall pain (0.7, 0.0 to 1.4) at 6 months. By 12 months, most outcomes were similar between groups.
Pharmacist-initiated Intervention Trial *(PhIT-OA)* [49,61], Canada Joint involved: Knee	Research design and methods: NR Underlying Framework: NR Service User involvement: NR						
		Marra et al. [61]	Cost analysis included in RCT To determine if a pharmacist-initiated multidisciplinary strategy provides value for money compared to usual care in participants with previously undiagnosed knee OA.	Costs and QALYs, HUI3, PAT-5D	Control group $n = 66$, Intervention group $n = 73$	6 months	Average patient in the intervention group generated slightly higher costs compared with usual care. Similar findings obtained when using the societal perspective. The intervention resulted in ICERs of $232 ([95% CI 1530 to 2154) per QALY gained from the Ministry of Health perspective and $14,395 (95% CI 7826 to 23,132) per QALY gained from the societal

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
							perspective, compared with usual care.
		Marra, Cibere [49]	RCT To evaluate whether pharmacists could address the gaps in OA patient care as measured using quality of care indicators and health-related quality of life markers.	Primary outcome: Arthritis Foundation's quality indicators for OA. Secondary outcomes: WOMAC pain and function, LEFS, PAT-5D, HUI3	Control group $n = 66$, Intervention group $n = 73$	5 months	Overall quality indicator pass rate was significantly higher in the intervention compared to control arm (difference of 45.2%; 95% CI l 34.5% to 55.9%). Significant improvements in the intervention compared to control arm in WOMAC global, pain, and function scores at 3 and 6 months (all $p < 0.01$); PAT-5D daily activity scores at 3 and 6 months; the HUI3 single-attribute pain scores at 3 and 6 months and LEFS at 6 months (all $p < 0.05$), PAT-5D pain scores at 6 months; PAT-5D pain scores at 6 months (both $p = 0.05$).
Three-colour ladder management model for knee osteoarthritis in the community [46] China Joint Involved: Knee	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Peng, Yan [46]	Observational To explore the application effect of a three-colour ladder management system for knee OA in the community.	WOMAC pain, stiffness and function VAS, joint flexibility, health-related behaviour score, ESCA score, AIMS2-SF score, knee replacement rate, changes of patients' visits and treatment costs	Usual care group $n = 43$, Intervention group $n = 43$	12 months	After 12 months, the scores of WOMAC and VAS in the research group were significantly lower than those of the control group ($P<0.05$), while the scores of joint flexibility and extension, cognition, behaviour and condition of Omaha System health-related behaviours, ESCA and AIMS2-SF were significantly higher than those of the control group ($P<0.05$). After 12 months, the monthly visits and expenses of green cards, yellow cards and red cards in the research group were significantly lower than those before entering the group ($P<0.05$).
Joint Implementation of Osteoarthritis Guidelines Across Western-Europe JIGSAW-E [86] Denmark			Observational study To evaluate interventions to sustainably improve general practitioner delivered care	Usage of first-line and adjunctive treatment elements, functional tests, and the EMR phrase.	Participants $n = 199$	18 months	Approximately 50 knee OA cases participated in each of the four half-year periods. Primary interventions had only transient effects lasting

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
Joint Involved: Knee and/or hip			for patients with knee osteoarthritis.				<12 months on the knee OA care. Functional tests and EMR phrases were used predominantly during the first 6 months, where a transient drop in the referral rate to orthopedics was observed. Use of educational elements was moderate and without significant change during follow-up.
Good Life with osteoArthritis in Denmark *(GLA:D)* [40,87] Denmark Joint Involved: Knee and/or hip	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Johnsen, Roos [40]	Observational prospective cohort study To investigate the impact of educational level and employment status on change in pain intensity after treatment amongst patients with knee and hip OA.	VAS	Participants $n = 22,588$	6 weeks	On average, all patients improved in pain intensity. Average pain improvement did not differ by educational level, except for one group. Patients with long-term education had less pain improvement after treatment (2.0 mm, 95% CI 0.8 to 3.1) and at 12 months (2.0 mm, 95% CI 0.6 to 3.4) compared with primary school only. Patients on sick leave had the greatest pain improvement after treatment (−3.4, 95% CI −4.9 to −1.9) and at 12 months (−4.5, 95%CI −6.4 to −2.6) compared with retired patients.
		Grønne, Roos [87]	Observational registry-based cohort study To evaluate 1-year cost-effectiveness of an 8-week supervised education and exercise programme delivered in primary care to patients with symptomatic knee or hip OA.	Adjusted healthcare costs per QALY gained from baseline to 1 year (ratio of change in healthcare costs to change in EQ-5D)	Participants $n = 16\ 255$	1 year	Adjusted change in healthcare cost was 298€ (95% CI: 206 to 419) and 640€ (95% CI: 400 to 1009) and change in EQ-5D was 0.035 (95% CI: 0.033 to 0.037) and 0.028 (95% CI: 0.025 to 0.032) for knee and hip patients, respectively. Hence estimated adjusted healthcare costs per QALY gained was 8497€ (95% CI: 6242 to 11 324) for knee and 22 568€ (95% CI: 16 000 to 31 531) for hip patients. Healthcare costs per QALY were below

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
							conventional thresholds for willingness-to-pay at 22 804€ (20 000£) and 43 979€ (US$50 000), except the upper limit of the 95% CI for hip patients which was in between the two thresholds.
Unnamed Model 1 *(None)* [63] Finland Joint Involved: hip	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Juhakoski, Tenhonen [63]	RCT To evaluate the short- and long-term effectiveness of exercise training in pain, function and direct costs to health care systems attributable to hip OA.	WOMAC pain, function, SF-36, use and healthcare system costs of doctor visits and physiotherapy associated with hip OA, number of THRs, use of analgesic and NSAIDs, performance-based outcome scores and BMI.	Usual care group $n = 58$, Intervention group $n = 60$	12 weeks, 4 additional booster sessions one year later	No differences between the groups in WOMAC hip pain, SF-36 physical functioning score, performance-based outcome scores or BMI. The effect of the exercise intervention on WOMAC function was statistically significant at 6 months (mean −7.5; 95% CI) −13.9 to 1.0; $p = 0.02$) and 18 months (mean 7.9; 95% CI 15.3 to 0.4; $p = 0.04$). No significant differences in total health care system costs between the groups.
Model of care for the treatment of patients with osteoarthritis of the first to the third level *(none)* [41] Mexico Joint Involved: Hip Knee	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Rodríguez-Skewes, Quiñones-Díaz Terán [41]	Prospective, pilot, study				
Cost-effectiveness of exercise therapy added to general practitioner care for osteoarthritis of the hip *(STERK)* [57,62] Netherlands Joint Involved: Hip	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Teirlinck, Luijsterburg [62]	RCT To assess the effectiveness of exercise therapy added to GP care compared with GP care alone, in patients with hip OA during 12 months follow-up	Primary outcomes: HOOS, WOMAC. Secondary outcomes: HOOS at 6 weeks, and 3, 6, 9 and 12 months, NRS pain score, EQ-5D3L, TUG, ROM, compliance to assigned treatment and co-interventions (e.g. visits to healthcare providers), inpatient days at the hospital, rehabilitation centre, nursing home and residential home, medical imaging, laboratory services, medications, appliances and home care.	Usual care group $n = 102$, Intervention group $n = 101$	3 months 3 three booster sessions at 5, 7 and 9 months	At 3-months follow-up, pain and function scores differed in favour of patients allocated to the additional exercise therapy compared with GP care alone. No between-group difference in hip pain and function during the 12-month follow-up. Patients in the intervention group received a median of 8 treatments (IQR 7.0) in the first 3 months. In the following 9 months 48 (48%), 46 (46%) and 36 (36%) patients received booster sessions in the fifth, seventh and ninth month, respectively.

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
		Tan, Teirlinck [57]	Cost analysis included in RCT To determine the cost-effectiveness of exercise therapy compared to GP care only in patients with hip OA in primary care.	Direct medical costs (resource use of visits to healthcare providers, inpatient hospital days, rehabilitation centre, nursing home and residential home, medical imaging productivity costs, absence from paid work and reduced efficiency at paid and unpaid work). QoL: EQ-5D instrument.	Usual Care group $n = 102$, Intervention group $n = 101$	3 months and 3 booster sessions at 5-, 7- and 9-months	Annual direct medical costs per patient were significantly lower for the intervention group (€1233) compared to the control group (€1331). Average annual societal costs per patient were lower in the intervention group (€2634 vs €3241). Productivity costs were higher than direct medical costs. There was a very small adjusted difference in QoL of 0.006 in favour of the control group (95% CI: 0.04 to 0.02).
Beating osteoarthritis *(BART)* [35,36,69-72,78] Netherlands Joint Involved: Hip	Research design and methods: A national, multidisciplinary, steering group developed the strategy in three phases: [1] consensus amongst steering group members; [2] written consultation of 23 representatives of patient organizations and professional associations involved in OA care; [3] consensus of the final draft after discussion in two rounds during a conference with representatives from the different disciplines. Underlying Framework: NR Service User involvement: Yes	Smink, van den Ende [35]	Descriptive study To describes the development of an evidence-based, multidisciplinary, patient-centred, stepped care strategy.	n/a	n/a	n/a	n/a
		Smink, Van den Ende [36]	Observational prospective cohort study To assess the association between care that is in line with the SCS recommendations for hip or knee OA and health outcomes (pain, physical function, self-efficacy, and active pain coping) and healthcare use	WOMAC, Dutch General Self-Efficacy Scale, Pain Coping Inventory, healthcare use (treatment modalities based on the SCS)	Usual care group $n = 163$; Intervention group $n = 117$.	2 years	No significant differences in pain and physical function over a 2-year period between patients who received SCS-inconsistent care and patients who received SCS-consistent care. This was also the case after adjusting for possible confounders, that is, –4.3 (95% CI = –10.3 to 1.7) and –1.9 (95% CI = –7.0 to 3.1), respectively. No differences in changes over time between groups in self-efficacy and pain coping.

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
		Smink, Bierma-Zeinstra [69]	Observational prospective cohort study To measure the extent to which health care in general practice is consistent with the SCS after implementation of the SCS	Consistency between clinical practice and the strategy was examined regarding three aspects of care: (i) timing of radiological assessment, (ii) sequence of non-surgical treatment options and (iii) making follow-up appointments.	Participants $n = 313$	2 years	Of the 212 patients reported having an X-ray, 92 (44%) received it in line with the SCS. The sequence of treatment was inconsistent with the SCS in 58% of patients, which was mainly caused by the underuse of lifestyle advice and dietary therapy. In 57% of consultations, the patient reported to have been advised to make a follow-up appointment.
		Smink, Dekker [70]	Observational prospective cohort study To describe health care use of patients with hip or knee OA after implementation of the SCS and to identify factors related to this health care use at the level of the patient, GP, and general practice	GP organization of OA care and attitudes about OA management and the SCS (via questionnaire). Dutch AIMS, WOMAC, health care use was assessed by asking the patients at baseline and after each 6-month period which treatment modalities they had used in the preceding 6-month period related to their hip or knee symptoms, DGSS, Pain Coping Inventory	Participants $n = 313$	2 years	The most frequently used modalities were education, acetaminophen, lifestyle advice, and exercise therapy, which were used by 242 (82%), 250 (83%), 214 (73%), and 187 (63%) patients, respectively. 14% of overweight patients reported being treated by a dietician. Being female, having an active coping style, using the "Care for OA," booklet, and having limitations in functioning were recurrently identified as determinants of healthcare use.
		Barten, Smink [71]	Observational prospective cohort study To identify patient-related, GP–related, and general practice related factors associated with treatment limited to primary care (step 1 and step 2 SCS), continuation of nonsurgical secondary care within the subpopulation that was referred (step 3 SCS), and the application of a surgical procedure, including TJR.	1) Treatment limited to primary care (yes/no): step 1 and step 2 SCS; 2) Continuation of nonsurgical treatment after referral to secondary care (yes/no): step 3 SCS; Application of a surgical procedure, including TJR (yes/no).	Participants $n = 313$	2 years	Patients whose treatment had been limited to primary care tended to function physically better (Odds Ratio (OR) 1.03). They less often received exercise therapy (OR 0.46), intraarticular injections (OR 0.08), and radiologic assessments (OR 0.06). Continuation of nonsurgical care after referral was more likely in employed patients (OR 2.90) and patients who had no exercise therapy (OR 0.19) or NSAIDs (OR 0.35). Surgically treated patients

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
							more often received exercise therapy (OR 7.42). Referral and surgical treatment depended only to a limited extent on the GP/practice.
		Barten, Swinkels [72]	Observational registry-based cohort study 1) To describe the content of current GP care in patients with hip/knee OA, including compliance to the SCS. 2) To describe the content of care in physical therapy practice in GP-referred versus self-referred patients.	Medical record data: GPs' interventions, including (telephone) consults, home visits, prescriptions, and referrals. Prescriptions were registered according to the ATC classification system. Referrals to physical therapists, dieticians, and orthopaedic surgeons. Physical Therapy data: Per treatment episode due to hip/knee OA, the applied interventions at the end of a treatment episode, recurrence rate and type of access (referred by GP/ medical specialist/, direct access)	Participants $n = 12{,}118$	5 years	84% of the population was treated by at least one of the step-1 modalities, 21% was treated by any step-2 modality, and 18% received any step-3 intervention.
		Smink, Bierma-Zeinstra [78]	Cross-sectional study To describe GPs' attitudes regarding the effectiveness of the recommended non-surgical treatment modalities and their agreement with specific recommendations regarding the sequence for care.	Organization of OA management in general practice (involvement of GP, practice nurse, and practice assistant in the following care tasks: a) providing information, b) providing lifestyle advice, c) distributing patient information material from the Dutch College of GPs, d) distributing other types of information, e) referral to dietician, f) referral to physical or exercise therapist.	GPs $n = 456$	NR	Seven of the 11 recommended modalities (oral NSAIDs, physical therapy, glucocorticoid intra-articular injections, education, lifestyle advice, acetaminophen, and tramadol) were considered effective by most GPs (varying between 60 and 95%). The mean agreement score, based on a 5-point scale, with the recommendations regarding the sequence for care was 2.8 (SD = 0.5). Ten percent of the variance in GPs' agreement could be explained by the GPs' attitudes regarding the effectiveness of the recommended and non-recommended non-surgical treatment modalities and the type of practice.

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
Towards a regional approach of osteoarthritis (OA): Development, feasibility, and preliminary effects of an OA self-management course for patients *(None)* [47] Netherlands Joint Involved: Knee and/or hip	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Claassen, Schers [47]	Observational study To determine preliminary effects of this OA educational program on healthcare utilization and clinical outcomes	Healthcare utilization, pain medication use, pain and functioning in daily living, illness perceptions, patient activation, knowledge, physical activity and patient satisfaction with the course.	Participants $n = 143$	2 meetings of 1.5 h	Proportion of participants who had visited their GP in the 3 months after the program was lower than 3 months prior to the program (40% versus 25%). Decrease in proportion of patients who visited the physio and exercise therapist, (36.1% versus 25.0%). Both illness perceptions and knowledge on OA and treatment options changed positively (Δ −1.8, 95% CI: 0.4 to 3.4, and Δ 2.4, 95% CI: −3.0 to −1.6 respectively). No changes in BMI, pain, functioning and self-efficacy were found.
Model of stratified exercise therapy (OCTOPuS study) [73,96] Netherlands Joint Involved: Knee	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Knoop et al. [85]	Feasibility trial To evaluate i) the effect of the implementation of the pathway, on GP diagnostic imaging re quests and GP referrals to orthopaedic surgeons for hip and knee OA. ii) to what extent the pathway is applied in practice before patients are referred to orthopaedic care and iii) the effect of the pathway on the appropriateness of these referrals.	Primary outcomes: the Dutch translation of the KOOS ADL subscale and NRS for knee pain on average during walking in the past week.	High muscle strength subgroup $n = 17$, Depression subgroup $n = 4$, Obesity subgroup $n = 6$ or Low muscle strength subgroup $n = 23$	4 months	Clinically relevant improvements in physical functioning and knee pain ($p < 0.001$ for both) for the total group. In general, the model of stratified exercise therapy was considered to be easily applicable and of added value for daily practice.
		Knoop, Dekker [50]	Cluster RCT	NRS pain scores, KOOS	Control group $n = 182$, Intervention group $n = 153$	12 months	Negligible differences were found between the experimental and control groups in knee pain (mean adjusted difference 0.2, 95% CI −0.4 to 0.7) and physical function (−0.8, 95% CI −4.3 to 2.6) at 3 months. Similar effects between groups were also found for each subgroup separately, as well as at other time points and for nearly all secondary outcome measures.

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
Better exercise in osteoarthritis [39] Netherlands Joint Involved: Knee and/or hip	Research design and methods: The pathway originated from a regional collaboration of stakeholders consisting of a coordination centre for diagnostics; MCC Omnes Medical Centre, GP organisation, health insurance company and a patient representative organisation. It was designed using the Dutch College of GPs national guidelines for hip and knee OA, by members of an expert group, consisting of two GPs, a physical therapist, an orthopaedic surgeon, a rheumatologist, a radiologist, a physician assistant and a coordinator of MCC Omnes Medical Centre. Underlying Framework: NR Service User involvement: Yes	van den Bogaart, Kroese [39]	Observational study To evaluate the effect of the pathway on diagnostic and referral behaviour of GPs.	The number of hip- and knee-related diagnostic imaging procedures (X-rays and MRIs) requested by GPs and the number of GP referrals to orthopaedic care per 1000 insured persons	n/a	6 months	Number of diagnostic imaging decreased and the number of initial orthopaedic consultations increased during the post-implementation period. Significant interaction effects were found in knee-related diagnostics ($p \leq 0.001$) and diagnostics of other joints ($p = 0.039$). No significant interaction effects were found in hip-related diagnostics ($p = 0.060$) and in initial orthopaedic consultation claims of hip ($p = 0.979$), knee ($p = 0.281$), and other joints ($p = 0.464$). Being referred according to the pathway had no significant effect on the probability of undergoing arthroplasty.
The Active with OsteoArthritis Physiotherapy Implementation Model *(AktivA)* [42] Norway Joint Involved: Knee and/or hip	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Holm, Pripp [42]	Observational registry-based cohort study To evaluate the long-term effects of and adherence to the AktivA program for patients with mild to moderate knee or hip OA	Pain, QoL, physical activity, self-efficacy and satisfaction.	Participants $n = 6245$	6–12 weeks	After participating in the AktivA program, the patients reported decreased pain and increased health-related and disease-specific QoL at three months and the positive effect was maintained up to two years after inclusion. The proportion of patients reporting to be inactive or having a low physical activity level reduced from 43% to 22%. After two years, more than 80% of the participants reported to use what they have learned from the AktivA program at least once a week.
Improved management of patients with hip and knee osteoarthritis in primary healthcare (SAMhandling for Bedre Artrosebehandling i kommunehelsetjenesten) *(SAMBA)* [38,52,59],	Research design and methods: NR Underlying Framework: NR Service User involvement: Y	Moseng, Dagfinrud [52]	Secondary analysis of cluster RCT i) to evaluate a clinically important response to treatment through the OMERACT-OARSI responder criteria) after 3	NRS pain scores	Control group $n = 109$, Intervention group $n = 284$	8–12 weeks	In total 47% of the intervention and 35% of the control group participants were responders at 3 or 6 months combined; showing an uncertain between-group difference (OR adjusted

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
Norway Joint Involved: Hip and/or knee			and 6 months between patients receiving the structured OA care model vs. usual care. ii) to investigate if the proportion of responders in the intervention group was influenced by adherence to the exercise program inherent in the model.				1.38 (95% CI 0.41, 4.67). In the intervention group, 184 participants completed the exercise programme (exercised ≥2 times/week for ≥8 weeks) and 55% of these were classified as responders. In contrast, 28% of the 86 non-completers were classified as responders.
		Østerås, Moseng [38]	Cluster RCT To assess the effectiveness of the SAMBA model (a structured model for integrated OA care was developed based on international recommendations) in primary healthcare compared with usual care	Primary: patient-reported quality of OA care at T6 measured with the OA-QI v2. Secondary: GP referrals to physiotherapists, MRI, and orthopaedic surgeons self-reported as 'Yes' or 'No', Norwegian Health Economics Administration data on the total number of registered discharge reports, patients' satisfaction with OA care, physical activity frequency, duration and intensity, calculation of the proportion of patients 'fulfilling' versus 'below' recommendations, BMI	Control group $n = 109$, Intervention group $n = 284$	8–12 weeks	In the intervention group, a higher proportion was referred to physiotherapy (OR 2.5; 95% CI 1.08, 5.73; $p = 0.03$), a higher proportion fulfilled physical activity recommendations (OR 9.3; 95% CI 2.87, 30.37; $p < 0.001$), and a lower proportion was referred to an orthopaedic surgeon (OR 0.3; 95% CI 0.08, 0.80; $p = 0.02$), as compared to the control group. There were no significant group differences regarding referral to MRI (OR 0.6; 95% CI 0.13, 2.38; $p = 0.42$) and proportion of patients who were overweight or obese (OR 1.3; 95% CI 0.70, 2.51; $p = 0.34$)
		Moseng, Dagfinrud [59]	RCT i) to evaluate the implementation fidelity of a strategy and intervention used to implement OA treatment recommendations in primary care. ii) to evaluate uptake of core treatment amongst OA patients	Fidelity was evaluated using six components representing adherence to the content and dose instructions in the implementation strategy and assessed against a-priori criteria for high adherence	Participants with OA $n = 393$, GPs $n = 40$, 37 PTs $n = 37$	8–12 weeks	The patient-reported data showed statistically significant higher uptake for exercise, patient education and referral to support for weight reduction, amongst the intervention group compared to the control group ($P < 0.05$). Evaluation of fidelity showed high adherence to GP and PT workshop attendance and physiotherapy use, partly adherence to PT knowledge

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
							after workshops, and low adherence to exercise attendance, dose and progression instructions
The STavanger osteoARThritis Study *(START)* [45] Norway Joint Involved: Hip and/or knee	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Osteras, Blaker [45]	Observational quasi-experimental study To evaluate the impact of the intervention on: alignment of care with guideline recommendations, discharge reports, frequency of GP referral letters.	Primary outcome: change in patient-reported quality of OA care from pre- to post-implementation period (measured with the OA-QI v2). Secondary outcomes: number of PT discharge reports, information in GP referral letters, proportion of patients receiving core treatments, proportion of people assessed for MRI, but not x-ray.	The PT workshop had 30 attendees, and 31 PTs and 33 GPs attended the multidisciplinary workshop.	44 weeks	There was a statistically non-significant increase in mean total score for quality of OA care (mean change = 4.96, 95% CI −0.18 to, 10.12), which was mainly related to items on OA core treatment. Patients had higher odds of reporting receipt of information on treatment alternatives (OR 1.9, 95% CI 1.08 to 3.24) and on self-management (OR 2.4, 95% CI 1.33 to 4.32) in the post-implementation phase. There was a small, statistically non-significant, increase in the proportion of GP referral letters indicating prior use of core treatment modalities. There were negligible changes in the number of PT discharge reports, in the information included in the GP referral letters, and in the use of imaging for OA assessment.
Peer mentorship to improve self-management of hip and knee Osteoarthritis [31]	Research design and methods: Underlying Framework: Service User involvement:	Anderson, Lavender [31]	To determine the feasibility of conducting a RCT of a peer mentorship intervention to improve self-management of OA.	Participant and peer mentor recruitment and attrition, intervention completion and the sample size required for a definitive RCT. Patient-reported outcomes collected via questionnaires.	Control group $n = 25$, Intervention group $n = 25$	6 months	Allowing for 20% attrition, the sample size required for a definitive RCT was calculated as 170 participants. The intervention group showed improvements in self-management compared with the control group.
Managing OSteoArthritis In ConsultationS *(MOSAICS)* [30,37,56,79,84,102-104] UK Joint Involved: Non-specific	Research design and methods: Postal Delphi consensus exercise with two expert groups: i) 15 GPs with expertise in OA management and ii) 14 patients with experience of living with OA. An advisory group generated 61 possible	Porcheret, Grime [37]	Descriptive paper To develop the content of a model OA consultation for the assessment and treatment of older adults presenting in general practice with peripheral joint problems.	n/a	n/a	n/a	n/a

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
	consultation tasks for consideration in the consensus exercise. Expert groups were asked to consider which tasks should be included in the model OA consultation. Level of agreement for inclusion in the model was set at 90%. Underlying Framework: Calgary-Cambridge framework and NPT Service User involvement: Yes						
		Porcheret, Main [102]	To describe the systematic selection and use of theory to develop a behaviour change intervention to implement GP delivery of the enhanced consultation.	n/a	n/a	n/a	n/a
		Blackburn, Higginbottom [103]	Descriptive study To describe how a Research User Group (RUG) worked alongside researchers to co-produce a set of self-reported quality indicators for people with osteoarthritis when visiting their general practitioner or practice nurse (primary care).	n/a	n/a	n/a	n/a
		Dziedzic et al. [30]	Two-arm cluster RCT To determine the effectiveness of a model OA consultation, compared with usual care, on physical function and uptake of NICE OA recommendations, in adults 45 years consulting with peripheral joint pain in UK general practice	Primary outcomes SF-12 PCS. Uptake of NICE core recommendations measured by self-reported quality indicators of OA care. Questionnaires on self-management and patient enablement. Secondary outcomes measures of pain (peripheral joint pain intensity, OMERACT/OARSI responder criteria), Arthritis Self- Efficacy pain subscale, IPAQ, PASE and Global Assessment of Change, SF-12 MCS, PHQ8, GAD7.	Control group $n = 237$, Intervention group $n = 288$	Consultation	There were no statistically significant differences in SF-12 PCS: mean difference at the 6-month primary endpoint was 0.37 (95% CI 2.32, 1.57). Uptake of core NICE recommendations by 6 months was statistically significantly higher in the intervention arm compared with control: e.g., increased written exercise information, 20.5% (95% CI 7.9, 28.3).
		Oppong et al. [56]	Cost analysis included in RCT To estimate the cost-effectiveness of a model OA	QALY, EQ-5D questionnaire, SF-12 questionnaire, ICECAP-A questionnaire	Resource use over 12-months: Usual care group ($n = 155$), Model OA consultation	12 months	Differences in health outcomes between the model OA consultation and usual care arms were not

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
			consultation for OA to support self-management compared with usual care.		$n = 199$, Health outcomes over 12 months: Usual care group $n = 237$; Model OA consultation $n = 288$		statistically significant. On average, visits to the orthopaedic surgeon were lower in the model OA consultation arm by −0.28 (95% CI: −0.55 to −0.06). The cost-utility analysis indicated that the model OA consultation was associated with a non-significant incremental cost of £−13.11 (95% CI: −81.09 to 54.85) and an incremental quality adjusted life year (QALY) of −0.003 (95% CI: −0.03 to 0.02), with a 44% chance of being cost-effective at a threshold of £20 000 per QALY gained. The percentage of participants who took time off and associated productivity cost was lower in the model OA consultation arm.
		Jackson et al. [79]	Observational study To determine common patterns of recorded primary care for OA, and patient and provider characteristics associated with the quality of recorded care.	Achievement of seven quality indicators of care (pain/function assessment, information provision, exercise/weight advice, analgesics, physiotherapy), recorded through an electronic template or routinely recorded in the electronic healthcare records, was identified for patients aged ≥45 years consulting over a 6-month period with clinical OA.	Participants $n = 1724$	6-month period	Common patterns of recorded quality care were: cluster 1 (38%, High) received most quality indicators of care; cluster 2 (11%, Moderate) had pain and function assessment, and received or were considered for other indicators; cluster 3 (17%, Low) had pain and function assessment, and received or were considered for paracetamol or topical non-steroidal anti-inflammatory drugs; cluster 4 (35%, None) had no recorded quality indicators. Patients with higher levels of recorded care consulted a clinician who saw more patients with OA, consulted multiple times and had less morbidity. Those in the High cluster were more

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
							likely to have recorded diagnosed OA and have knee/hip OA.
		Porcheret et al. [84]	Feasibility trial To evaluate the behaviour change intervention (BCI) workshops on GP competency in undertaking 14 predetermined consultation tasks as part of the MOSAICS enhanced consultations.	1. GP competency score: the number of tasks assessed as present in each video. 2. Task delivery score: the number of videos at a given time-point in which the task was assessed as present	GPs $n = 15$	Videos were undertaken at three time-points	GP competency increased from a median of seven consultation tasks undertaken by each GP at baseline to 11 at both time-points after the workshops. Specific tasks which were undertaken more frequently after the workshops related to explaining that OA is treatable and not inevitably progressive, eliciting and addressing patient expectations of the consultation, and providing written OA information. However, the use of the word "osteoarthritis" in giving the diagnosis of OA was not enhanced by the workshops.
JIGSAW-UK [28]	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Quicke et al. [28]	Observational pilot study To evaluate the implementation of a clinical-academic physiotherapist OA clinic embedded into a general practice	Data regarding patient referrals, attendance, recorded achievement of NICE OA quality indicators, onward referrals and narrative service feedback from practice staff and patients were captured. Quality indicator data were compared with outcomes from the empirical MOSAICS intervention practices, MSK HQ	Participants $n = 181$	10 months	High achievement of provision of written information was recorded. Only 13% completed MSK-HQ at discharge consultation about: OA (73%); weight management (49%) and; exercise (69%). These proportions were higher than achieved with a GP-practice nurse model within the MOSAICS trial (53%, 30% and 44% respectively).
Internet-Based Exercise programme Aimed at Treating knee Osteoarthritis *(ibeat-OA)* [53] UK Joint Involved: Knee	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Gohir et al. [53]	RCT To compare the effect of an internet-based treatment for knee OA vs routine self-management (i.e., usual care).	Primary outcome: NRS pain scores during the last 7 days. Secondary outcomes: 2 physical functioning scores, hamstring and quadriceps muscle strength, WOMAC and quantitative sensory testing.	Usual care group $n = 57$, Intervention group $n = 48$	6 weeks	No significant difference was observed between participants groups in terms of use of analgesic medications before or after the intervention. In the intervention group, the mean (SD) adherence with the internet-based exercise program was 87.9%

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
							(14.3%) of sessions completed.
The Joint Pain Advisor *(JP Advisor)* [44] UK Joint Involved: Knee and/or hip	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Walker et al. [44]	Observational study To evaluate whether AHP-led primary care delivering person-centred, practical lifestyle coaching was a feasible, effective way to manage chronic knee and/or hip pain.	The KOOS or HOOS. PA levels: number of days of the week participants performed ≥20 min of moderate physical activity. Body weight, BMI, waist circumference 30-second sit-to-stand.	498 Participants	6 months	Between initial assessment and reviews, participants' pain, function, QoL, weight, waist circumference and physical activity improved ($p < 0.005$). Service user satisfaction was high; they reported easier access to advice and support tailored to their needs that translated into clinical benefits and a more efficient pathway reducing unnecessary consultations and investigations. 12% ($n = 60$) returned for a 6-month review as they considered they had received sufficient advice.
Facilitating Activity and Self-management in Arthritic Pain *(FASA)* [67] UK Joint Involved: Knee and/or hip	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Walsh et al. [67]	RCT To investigate the effectiveness of a generic exercise and self-management intervention for people over-50 with hip/knee OA and/or lower back pain compared to continued GP management.	Primary outcome measure: DI-SMFA. Secondary outcomes: Self-efficacy and exercise health beliefs questionnaire, HADS, Short Form McGill Pain questionnaire, AFPT	Control group $n = 179$, Intervention group $n = 170$	6-week	Intervention arm participants reported better function at 6 months compared with continued GP management alone (−3.01 difference in DI-SMFA [95% CI −5.25 to − 0.76]. Attrition rate was 13% at the 6 month primary endpoint.
Benefits of Effective Exercise for knee Pain *(BEEP)* [60] UK Joint Involved: Knee	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Kigozi et al. [60]	Cost analysis included in RCT To investigate the cost-effectiveness of two enhanced physical therapy interventions compared with usual physical therapy care (UC) for adults with knee OA.	EQ-5D 3 L questionnaire	Usual Care $n = 175$, Individually tailored exercise (ITE) ($n = 176$) and Targeted Exercise Adherence (TEA) ($n = 163$))	4 individual face-to-face treatments up to week 12, and a further 4–6 follow-up contacts, from week 12 through to 6 months	The UC group was associated with lower NHS costs [ITE-UC: £273.30, 95% CI: £ 62.10 to £562.60; TEA-UC: £141.80, 95% CI: £ 135.60 to £408.10)] and slightly higher QALY gains (ITE-UC: 0.015, 95% CI: 0.057 to 0.026; TEA-UC: 0.003, 95% CI: 0.045 to 0.038). In the base case, UC was the most likely cost-effective option (probability <40% of ITE or TEA cost-effective at £20 000/QALY). Differences in total costs were attributable to intervention costs, number

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Appendix 2 (*continued*)

Intervention Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
						of visits to NHS consultants and knee surgery, which were higher in both ITE and TEA groups.
Learning to Improve Fitness and Function in Elders *(LIFE)* Huffman et al. [51] USA Joint Involved: Non-specific	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Huffman et al. [51] RCT To explore whether persons with arthritis alone or those with both arthritis and diabetes could improve amounts of PA with a home-based counselling intervention.	PA per week, endurance training and strength training time	Persons with no arthritis ($n = 85$), arthritis ($n = 178$), and arthritis plus diabetes ($n = 84$)	12 weeks	Recipients of PA counselling increased minutes of PA per week independent of disease status (treatment arm by time interaction $P<0.05$ for both; endurance training time $P = 0.0006$ and strength training time $P<0.0001$). Although PA was lower at each wave amongst persons with arthritis, and even more so amongst persons with arthritis plus diabetes, the presence of these conditions did not significantly influence response to the intervention (Arthritis/Diabetes group X time interactions $P>0.05$ for both outcomes) as each group experienced a nearly two-fold or more increase in PA.
Patient and Provider Interventions for Managing Osteoarthritis in Primary Care *(PRIMO)* [54,58,80,82]. USA Joint Involved: Knee and/or hip	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Allen et al. [54] Cluster RCT To examine whether patient-based, provider-based, and patient-provider interventions improve OA outcomes.	Primary outcome: WOMAC. Secondary outcomes: objective physical function (Short Physical Performance Battery) and PHQ.	Participants $n = 537$	12 months	No difference was observed in WOMAC score changes from baseline to 12 months in the patient (–1.5 [95% CI, –5.1 to 2.0]; $P = 0.40$), provider (2.5 [CI, –0.9 to 5.9]; $P = 0.152$), or patient-provider (–0.7 [CI, –4.2 to 2.8]; $P = 0.69$) intervention groups compared with usual care. All groups had improvements in WOMAC scores at 12 months (range, –3.7 to –7.7). In addition, no differences were seen in objective physical function or depressive symptoms at 12 months in any of the intervention groups compared with usual care.
		Allen et al. [58] Cluster RCT To examine a combined patient and provider intervention for	Primary outcome: WOMAC total score. Secondary outcomes: WOMAC function subscale, WOMAC pain	30 PCPs, 300 patients	12 months	At 12-month follow-up, WOMAC scores were 4.1 points lower (indicating improvement) in the OA

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
			management of OA in primary care.	subscale, Short Physical Performance Battery and depressive symptoms (PHQ-9).			Intervention arm vs. usual care [95% confidence interval (CI) = −7.2, −1.1; $p = 0.009$]. The WOMAC function subscale was 3.3 points lower in the intervention arm [95% CI = −5.7, −1.0; $p = 0.005$]. There was no difference in WOMAC pain subscale scores between arms ($p = 0.126$). Physical performance and depressive symptoms did not differ between the two arms.
		Corsino et al. [82]	Feasibility trial To test a telephone delivered culturally appropriate Spanish behavioural intervention for management of OA in Hispanic/Latino adults.	The primary outcome: WOMAC. Secondary outcomes: Short Physical Performance Battery, PHQ	Participants ($n = 15$)	12 months	The mean improvement in WOMAC scores between baseline and 12 months, amongst 11 participants who completed the study, was − 13.27 [95% CI, − 25.09 to − 1.46].
		Allen et al. [80]	Descriptive study To describe heterogeneity in clinic and patient characteristics, as well as recruitment metrics, across PRIMO study clinics	[1] Practice Characteristics, including primary care speciality, numbers and specialties of providers, numbers of patients age 55+, urban/rural location and county poverty level; [2] Recruitment Metrics, including rates of eligibility, refusal and randomization; [3] Participants' Characteristics, including demographic and clinical data (general and OA-related); and [4] Participants' Self-Reported OA Treatment Use, including pharmacological and non-pharmacological therapies.	Participants $n = 537$	12 months	Study clinics varied considerably across all measures, with notable differences in numbers of patients age 55+ (1507–5400), urban/rural location (ranging from "rural" to "small city"), and proportion of county households below poverty level (12%−26%). amongst all medical records reviewed, 19% of patients were initially eligible (10%−31% across clinics), and amongst these, 17% were randomized into the study (13%−21% across clinics). There was considerable between-clinic variation, as measured by the ICC (>0.01), for the following patient characteristics and OA treatment use variables: age (means: 60.4–66.1 years),

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
							gender (66%–88% female), race (16%–61% non-white), low income status (5%–27%), presence of hip OA (26%–68%), presence both knee and hip OA (23%–61%), physical therapy for knee OA (24%–61%) and hip OA (0%–71%), and use of knee brace with metal supports (0%–18%).
Osteoarthritis physical activity care pathway *(OA-PCP)* [83] USA Joint Involved: Knee and or hip	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Allen et al. [83]	Feasibility trial To obtain information on feasibility and acceptability, as well as preliminary data on efficacy, of an OA Physical activity Care Pathway (OA-PCP).	Primary efficacy outcome: minutes of MVPA, assessed via accelerometer. Secondary outcomes: minutes of light intensity activity, sedentary minutes, step counts, and WOMAC pain and function subscales. Participants were also asked to rate the helpfulness of the OA-PCP intervention (0–10 scale).	Participants $n = 60$	3 months	Average daily minutes of MVPA was 8.0 at baseline (standard deviation (SD) = 9.9) and 8.9 at follow-up (SD = 12.1, $p = 0.515$). There were no statistically significant changes in light intensity activity, sedentary time or step counts. The mean WOMAC pain score improved from 8.1 (SD = 3.6) at baseline to 6.2 (SD = 3.8) at follow-up ($p < 0.001$); the mean WOMAC function score improved from 26.2 (SD = 13.2) to 20.2 (SD = 12.5; $p < 0.001$). The mean rating of helpfulness was 7.6 (SD = 2.5)
Self-Management of Osteoarthritis *(SeMOA)* [64] USA Joint Involved: Knee and/or hip	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Allen et al. [64]	RCT To examine the effectiveness of a telephone-based self-management intervention for hip or knee OA in a primary care setting	AIMS-2 pain subscale, VAS	OA Self-Management Intervention group ($n = 172$), Health Education Intervention group ($n = 172$), Usual Care ($n = 171$)	12 months	The mean AIMS-2 pain score in the OA self-management group was 0.4 point lower (95% CI, 0.8 to 0.1; p=0.105) than in the usual care group and 0.6 point lower (CI, 1.0 to 0.2; p=0.007) than in the health education group at 12 months. The mean VAS pain score in the OA self-management group was 1.1 points lower (CI, 1.6 to 0.6 ; p< 0.001) than in the usual care group and 1.0 point lower (CI, 1.5 to 0.5; p 0.001) than in the health

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
							education group. Health care use did not differ across the groups.
Self-help Health Promotion Program *(SHP)* [43] South Korea Joint Involved: Non-specific	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Lee and Cho [43]	RCT To evaluate a self-care program for elders with OA managed by primary health care workers, Community Health Practitioners (CHPs), in rural Korea.	The number of painful joints and level of arthritis management skill. The number of painful joints was measured by checking all painful joints using an image showing possible joints. The level of arthritis management skill was measured by a scale developed by the study team.	Control group $n = 140$, Intervention group $n = 150$	6 weeks	The intervention group showed a significant decrease in the number of painful joints ($p<0.001$) and a significant increase in self-care ability ($p<0.05$) compared to the control group.
Interaction Model of Client Health behaviour *(IMCHB)* (33) South Korea Joint Involved: Knee and/or hip	Research design and methods: The intervention was developed by the research team using the intervention mapping (IM) process in conjunction with an advisory committee comprising eight experts in community health ($n = 3$), nursing ($n = 4$), and medicine ($n = 1$). The IM process included a needs assessment (literature reviews, surveys, and interviews), goal setting, selection of theory-based interventions, production of program components, and development of an implementation and evaluation plan. Underlying Framework: NR Service User involvement: Yes	Ahn and Ham [33]	RCT To evaluate a multifaceted intervention for OA symptoms.	PAM, Korean version of the WOMAC, HAQDS, CES-D	Experimental group 1 (E1) $n = 20$, Experimental group 2 (E2) $n = 28$, Control group (C) $n = 30$	8 weeks	At post-test, the changes in the mean scores were significant for joint pain and stiffness, and physical functioning. E2 with walking exercise showed better improvements in joint pain and physical functioning than the other groups ($P < 0.01$).
Unnamed Model *(ARTROACAS)* [32] Spain Joint Involved: Knee	Research design and methods: A multidisciplinary expert panel established diagnosis and management recommendations for patients with knee OA. Following best practice suggestions and the best evidence available, rapid cycle processes and clinical care pathways were developed according to disease features and evolution. This included explicit indications regarding treatments to reduce clinical uncertainty and related to specialist consultations to	Loza et al. [32]	Feasibility trial To examine the feasibility and efficacy of a multidisciplinary health care programme (ARTROACAS) for patients with knee OA.	Primary outcome measures: OARSI responder criteria, WOMAC pain subscale. Secondary outcome measures: OMERACT-OARSI responder rate, WOMAC subscales and SF-36, VAS pain, changes in OA classification, rate of adherence to the education self-management programme, patients' and health professionals' satisfaction (assessed with structured questionnaires), and use of health care resources (visits to primary care physicians,	Participants $n = 226$	12 months	At the end of the study, 78% of patients achieved pain relief of ≥20 points in the WOMAC pain subscale, and 80% OMERACT-OARSI response criteria. Almost 90% of physicians followed the recommendations. WOMAC and SF-36 subscales/dimensions improved ($p<0.050$), 14% remained classified as moderate or severe disease, 85% of patients attended the exercise training course, and more than 80% of patients

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
	facilitate delivery and improve out-patient referral appropriateness. Underlying Framework: NR Service User involvement: NR			specialists, emergency room, blood analyses, images, drugs, hospitalisations, days of hospitalisation, and the use of analgesics, NSAIDs, SYSADOAs, steroids, hyaluronic acid injections, gastroprotective drugs).			and professionals were satisfied with the programme. Compared to usual care the programme seems to use fewer resources.
Better management of OsteoArthritis *(BOA)* [48,73,75,81] Sweden Joint Involved: Knee and/or hip	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Olsson et al. [73]	Observational study To describe the change in self-efficacy after a supported osteoarthritis self-management program.	Self-efficacy for pain and other Symptoms were assessed with the Arthritis Self-efficacy Scale	11'906 patients	Baseline, 3 and 12 months.	In total, 9440 (pain subscale) and 9361 (symptom subscale) patients reported self-efficacy scores at baseline and at least one follow-up. The lowest self-efficacy at baseline was reported by patients with low education, walking difficulties, comorbidity and low physical activity level. Overall, the self-efficacy scores improved at the 3-month follow-up and returned to baseline at the 12-month follow-up. Younger age (pain and symptom subscales) and exercise (pain subscale) were associated with a greater increase in self-efficacy. Obesity (pain subscale) and hip problems (pain and symptom subscales) were associated with lower self-efficacy at baseline and a greater decrease at follow-up.
		Ekman et al. [48]	Observational cost analysis To assess the cost of providing digital care and best practice face-to-face care, and to compare the two models to evaluate the differences in resource use.	Patients receiving care in the BOA model $n = 9465$, Patients receiving care in the digital model $n = 1421$	Data were collected from the providers of the care. Costs (provider training, rehab session, techanical support, follow-ups), patient costs; rehab session, introduction, joint academy contacts. Admin costs (transport to and from clinic, user fees, Co2 emissions	12 weeks	The total societal costs of providing the BOA model of care was approximately 117 million SEK. The cost of the digital model was 4.1 million SEK. The most common resource is time used for various care activities, including training/rehabilitation sessions, preparations and follow-up, and transportation. The results

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
							show that overall the digital model costs around 25% of the existing face-to-face model of care.
		Abbott et al. [75]	Observational registry based cohort study To investigate the proportion and type of dispensed analgesic prescriptions in Sweden received by patients during 3 years before commencing non-pharmacological primary care interventions for OA (2008–2016) compared with the general population. Furthermore, we analysed the proportion of analgesic prescriptions dispensed before (2008–2012) com-pared with after (2012–2016) guideline publication in terms of concordance with clinical guideline recommendations.	Swedish Prescribed Drug Register data	Participants $n = 72{,}069$	3 years	Since guideline publication, the proportion of the OA cohort having no dispensed prescription analgesics prior to non-pharmacological primary care intervention concordantly increased by 5.0% (95% CI 4.2–5.9). Furthermore, dispensed prescriptions concordantly decreased for non-selective NSAIDs –8.6% (CI –9.6 to –7.6), weak opioids –6.8% (CI –7.7 to –5.9), glucosamine –9.5% (CI –9.8 to –8.8). and hyaluronic acid –1.6% (CI –1.8 to –1.5) but discordantly increased for strong opioids 2.8% (CI 2.1–3.4) and glucocorticoid intra-articular injection for hip OA 2.1% (CI 1.0–3.1).
		Dell'Isola et al. [81]	Observational registry based cohort study To explore the joint-specific association of patients' demographics; health, disease, and psychological status; and previous OA care with the change in pain severity following a first-line intervention provided nation-wide in Swedish primary care.	NRS pain scores, VAS general health status, Pain frequency (5-point *l*=Likert scale), Intake of drugs for OA in last 3 months, Arthritis Self-Efficacy Scale	23,309 people from the BOA register.	6 weeks	The mean change in pain was −1.27 (SD = 2.14) and −0.98 (SD = 2.34) at 3 months and −0.93 (SD = 2.10) and −0.47 (SD = 2.32) at 12 months for people with knee and/or hip OA, respectively ($P < 0.001$, adjusted $R^2 = 0.25$). High levels of baseline pain were associated with decreased pain at 3 and 12 month follow-ups, whereas being older, overweight, or female had a weak or no association. At both follow-ups, bilateral OA was associated with increased pain only in people with knee OA, whereas comorbidities and the willingness to undergo surgery were associated

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Model Originating Country Associated Studies and Evaluations	Development Research design and methods Underlying Frameworks Service User involvement	Evaluation	Study Design Aim	Outcome Measures	Participants	Duration of intervention	Findings
							with increased pain regardless of the affected joint.
Patient education programme for osteoarthritis *(PEPOA)* Hansson et al. [66] Sweden Joint Involved: Knee and/or hip and/or hand	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Hansson et al. [66]	RCT To evaluate the effects of this education programme for patients with OA in primary health care in self-efficacy, function and self-perceived health	EuroQol-5D, Arthritis self-efficacy scale, Grip Ability Test	Control group $n = 53$, Intervention group $n = 61$	5 weeks	There were differences between the intervention group and the control group, comparing the results at baseline and after 6 months in EuroQol-5D ($p < 0.001$) and in standing one leg eyes closed ($p = 0.02$) in favour of the intervention group. No other differences between the groups were found.
Unnamed Model 2 *(None)* [74] Sweden Joint Involved: Knee	Research design and methods: NR Underlying Framework: NR Service User involvement: NR	Bjurehed et al. [74]	Observational study To evaluate the effects on hand function, activity limitations, and self-rated health of a primary care hand OA group intervention.	GAT, SOFI, dynamometry (grip force), hand pain at rest using a VAS, PSFS, the Quick-DASH, and the EuroQol VAS (EQ VAS).	64 individuals	6-week	Hand function, activity limitation, and self-rated health significantly improved from baseline to end of intervention, grip force (right hand: $P < 0.001$; left hand: $P = 0.008$), SOFI ($P = 0.011$), GAT ($P < 0.001$), hand pain at rest ($P < 0.001$), PSFS (1: $P = 0.008$, 2: $P < 0.001$, and 3: $P = 0.004$), Quick-DASH ($P = 0.001$), and EQ VAS ($P = 0.039$), and the effects were sustained after 1 year.

Legend.

AFPT: Aggregated Functional Performance Time, AIMS: Arthritis Impact Measurement Scales, AIMS2-SF: A short form of the Arthritis Impact Measurement Scales 2, ATC: Anatomical Therapeutic Chemical BMI: body mass index, CST: Care Support Team, CES-D: Centre for Epidemiologic Studies Depression Scale, EMR: Electronic medical records, ESCA: exercise of self-care agency scale, EQ-5D (5 L): EuroQoL 5-Dimensions (5-Level questionnaire), EQ-5D3L: EuroQoL 5-Dimensions (3-Level questionnaire), DI-SMFA: Dysfunction Index of the Short Musculoskeletal Functional Assessment, DGSS: Dutch Generalized Self-Efficacy Scale, FPW: 40-m fast-paced walk, GAD-7: General Anxiety Disorder-7, GAT: Grip Ability Test, HADS: Hospital Anxiety and Depression. Scale, HAQDS: Stanford Health Assessment Questionnaire Disability Scale, HOOS: Hip disability and Osteoarthritis Outcome Score, HUI3: Health Utilities Index Mark 3, ICECAP-A questionnaire: Aalborg University's Research Portal-A questionnaire, IPAQ: International Physical Activity Questionnaire, KOOS: Knee Injury and Osteoarthritis Outcome Score, LEFS: The lower extremity functional scale, MCS: mental component summary, MDT: multidisciplinary team, MRC: Medical Research Council, MSK: musculoskeletal, MSK HQ: Musculoskeletal Health Questionnaire, MRI: Magnetic Resonance Imaging, MTP: metatarsophalangeal joints, MVPA: minutes of moderate-to-vigorous physical activity, NICE: The National Institute for Health and Care Excellence, NRS: Numeric Rating Scale, NSAIDs: non-steroidal anti-inflammatory drugs, OARSI: Osteoarthritis Research Society International, OA-QI v2: OsteoArthritis Quality Indicator version 2, OMERACT: Outcome Measures in Rheumatology, PA: physical activity, PAM: Patient Activation Measure, PASE: Physical Activity Scale for the Elderly, PAT-5D (QOL): Paper-and-pencil semi-adaptive test for 5 domains (health-related quality of life), PCS: Physical component summary, PHQ(8/9): The (eight/nine-item) Patient Health Questionnaire depression scale, PSFS: the Patient-Specific Functional Scale, QALY: Quality-adjusted life years, QoL: quality of life, ROM: Range of Movement, SF-12: The 12-Item Short Form Survey, SF-36: The 36-Item Short Form Survey, SCS: Stepped Care Strategy, SOFI: The Signals of Functional Impairment, SYSADOAs: Symptomatic slow-acting drugs, TJR: Total Joint Replacement, TUG(T): Timed Up and Go (Test), WOMAC: The Western Ontario and McMaster Universities Arthritis Index, VAS: Visual Analogue Scale.

Appendix 3 (i)

Critical appraisal for randomised controlled trials ($n = 20$) (y: yes, n: no, u: unclear).

References	1. Was true randomization used for assignment of participants to treatment groups?	2. Was allocation to treatment groups concealed?	3. Were treatment groups similar at the baseline?	4. Were participants blind to treatment assignment?	5. Were those delivering treatment blind to treatment assignment?	6. Were outcomes assessors blind to treatment assignment?	7. Were treatment groups treated identically other than the intervention of interest?	8. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?	9. Were participants analysed in the groups to which they were randomized?	10. Were outcomes measured in the same way for treatment groups?	11. Were outcomes measured in a reliable way?	12. Was appropriate statistical analysis used?	13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?
Dziedzic et al. [30]	y	y	y	u	n	u	y	y	y	y	y	y	y
Gohir et al. [53]	y	y	y	n	n	n	y	y	y	y	y	y	y
Walsh et al. [67]	y	y	y	n	n	y	y	y	y	y	y	y	y
Huffman et al. [51]	u	u	u	u	u	u	u	y	n	y	y	y	y
Allen et al. [54]	y	y	y	u	u	y	y	y	y	y	y	y	y
Allen et al. [58]	y	y	y	n	u	y	y	y	y	y	y	y	y
Allen et al. [64]	y	y	y	u	u	u	y	y	y	y	y	y	y
Marra et al. [49]	y	u	y	n	n	y	y	y	y	y	y	y	y
Hinman et al. [65]	y	y	y	y	n	y	y	y	y	y	y	y	y
Lee and Cho [43]	u	u	n	u	u	u	u	u	u	y	u	y	u
Ahn and Ham [33]	u	n	u	n	n	u	y	u	y	y	y	y	y
Moseng et al. [52]	y	u	y	u	u	u	y	y	y	y	y	y	y
Osteras et al. [38]	y	n	y	n	n	u	y	y	y	y	y	y	y

(*continued on next page*)

Appendix 3 (i) (*continued*)

References	1. Was true randomization used for assignment of participants to treatment groups?	2. Was allocation to treatment groups concealed?	3. Were treatment groups similar at the baseline?	4. Were participants blind to treatment assignment?	5. Were those delivering treatment blind to treatment assignment?	6. Were outcomes assessors blind to treatment assignment?	7. Were treatment groups treated identically other than the intervention of interest?	8. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?	9. Were participants analysed in the groups to which they were randomized?	10. Were outcomes measured in the same way for treatment groups?	11. Were outcomes measured in a reliable way?	12. Was appropriate statistical analysis used?	13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?
Hansson et al. [66]	y	n	y	n	n	y	y	u	y	y	y	y	y
Teirlinck et al. [62]	y	n	y	n	n	y	y	n	y	y	y	y	y
Juhakoski et al. [63]	y	n	y	n	n	y	y	y	y	y	y	y	y
Anderson et al. [31]	y	n	y	n	n	u	y	y	y	y	y	y	y
Peng et al. [46]	u	u	y	u	u	u	u	u	u	u	u	u	u
Rodríguez-Skewes et al. [41]	n	n	u	n	n	n	u	n	y	u	u	u	y
Knoop et al. [50]	y	y	y	y	n	n	y	y	y	y	y	y	y

Appendix 3 (ii)

Critical appraisal for quasi-experimental studies ($n = 16$) (y: yes, n: no, u: unclear, n/a: not applicable).

References	1. Is it clear in the study what is the 'cause' and what is the 'effect' (I.e. there is no confusion about which variable comes first)?	2. Were the participants included in any comparisons similar?	3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	4. Was there a control group?	5. Were there multiple measurements of the outcome both pre and post the intervention/ exposure?	6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?	7. Were the outcomes of participants included in any comparisons measured in the same way?	8. Were outcomes measured in a reliable way?	9. Was appropriate statistical analysis used?
Olsson et al. [73]	y	y	y	n	y	n/a	y	y	y
van den bogart et al. [39]	y	u	y	n	y	u	y	y	y
Smink et al. [36]	y	n	n	n	y	y	y	y	y
Smink et al. [70]	y	y	y	n	y	y	y	y	y
Johnsen et al. [40]	y	n/a	n/a	n	y	y	y	y	y
Quicke et al. [28]	y	y	y	n	y	n/a	y	u	u
Bjurehed et al. [74]	y	y	y	n	y	y	y	y	y
Walker et al. [44]	u	n/a	n/a	n	y	n	y	y	u
Osteras et al. [45]	y	y	y	n	y	y	y	y	y
Claassen et al. [47]	y	y	y	n	y	n/a	y	y	y
Holm et al. [42]	y	y	y	n	y	n/a	y	y	y
Loza et al. [32]	y	y	y	y	y	y	y	y	y
Allen et al. [83]	y	y	y	n	y	n	y	y	y
Baumbach et al. [25]	y	y	y	n	n	u	y	u	y
Campbell et al. [29]	y	y	y	n	y	n	y	u	y
Grønne et al. [76]	y	y	y	n	y	n	y	u	y

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.semarthrit.2023.152221.

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