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REVIEW

Effectiveness of remote care interventions: a systematic review informing the 2022 EULAR Points to Consider for remote care in rheumatic and musculoskeletal diseases

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ABSTRACT

Objective To perform a systematic literature review (SLR) on different outcomes of remote care compared with face-to-face (F2F) care, its implementation into clinical practice and to identify drivers and barriers in order to inform a task force formulating the EULAR Points to Consider for remote care in rheumatic and musculoskeletal diseases (RMDs).

Methods A search strategy was developed and run in Medline (PubMed), Embase and Cochrane Library. Two reviewers independently performed standardised data extraction, synthesis and risk of bias (RoB) assessment.

Results A total of 2240 references were identified. Forty-seven of them fulfilled the inclusion criteria. Remote monitoring (n=35) was most frequently studied, with telephone/video calls being the most common mode of delivery (n=30). Of the 34 studies investigating outcomes of remote care, the majority addressed efficacy and user perception; 34% and 21% of them, respectively, reported a superiority of remote care as compared with F2F care. Time and cost savings were reported as major benefits, technical aspects as major drawback in the 13 studies that investigated drivers and barriers of remote care. No study addressed remote care implementation. The main limitation of the studies identified was the heterogeneity of outcomes and methods, as well as a substantial RoB (50% of studies with high RoB).

Conclusions Remote care leads to similar or better results compared with F2F treatment concerning efficacy, safety, adherence and user perception outcomes, with the limitation of heterogeneity and considerable RoB of the available studies.

Key messages

What is already known about this subject?

⇒ There is an increased interest in remote care of rheumatic and musculoskeletal diseases (RMDs) over the last decade with a boost since the COVID-19 pandemic has started.

⇒ Remote care and telehealth can improve healthcare, particularly when used to complement conventional clinical care.

⇒ In rheumatology, telehealth can be used for screening, diagnostic and monitoring purposes, as well as for patient education.

What does this study add?

⇒ Currently available studies in patients with RMDs report similar efficacy, safety, adherence and user perception of remote care as compared with face-to-face care, with the limitation of substantial risk of bias and heterogeneity of data.

How might this impact on clinical practice or further developments?

⇒ This systematic review has informed the task force formulating the 2022 EULAR Points to Consider for remote care in RMDs.

INTRODUCTION

Rheumatic and musculoskeletal diseases (RMDs) are among the most common chronic diseases worldwide,[1] and their optimal clinical care includes regular follow-up. Due to the growing number of patients but an inadequate increment of human resources, there is an increasing pressure on the healthcare system, and new forms of care are needed,[2] for example, telehealth-based follow-ups, or self-management interventions in the form of patient education.

Thanks to the sophistication of communication systems and technologies, remote care interventions have become more widespread

Box 1 Topics of the three research questions

⇒ Patients, Intervention, Comparator or Control, Outcome (PICO) 1: What is the efficacy (O1)/safety (O2)/cost-effectiveness (O3)/user perception (O4)/adherence (O5) of remote care method A (I1)/blended care (I2) as compared with remote care method B (C1)/standard care (C2) in people with rheumatic and musculoskeletal diseases (RMDs) (P)?

⇒ PICO 2: In people with RMDs (P), how is remote care (I) delivered/tailored to people (O1)/integrated into clinical practice (O2)?

⇒ Patients, Intervention, Outcome 3: In people with RMDs (P), what are the drivers and barriers for implementation in clinical practice (O) of remote care (I)?

over the past 20 years, with presumed benefits for diagnosis, treatment, rehabilitation and follow-up monitoring of patients.[3]

Use of telehealth interventions, including communication with patients/caregivers, disease screening or monitoring of different aspects of the disease (eg, disease activity, damage, quality of life, adherence, etc) is, however, still heterogeneous, and guidance is needed about when to use which telehealth interventions, and how to combine it best with conventional face-to-face (F2F) visits in order to optimise patients' care. A task force has developed EULAR Points to Consider for remote care in RMDs. This systematic literature review (SLR) informed this task force. Herein, we summarise available data on efficacy, safety, cost-effectiveness, satisfaction, adherence and the potential barriers and drivers of remote care for patients with RMDs.

METHODS

This SLR was conducted according to the Cochrane Handbook.[4] Reporting followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.[5]

The steering group of the task force developing the EULAR Points to Consider (AM, PB, AdT, YM, CM, CD, TAS, JWHB) drafted the SLR protocol (online supplemental material S1). The research questions, approved by the entire task force, are depicted in box 1. They were framed and structured according to the EULAR standardised operating procedures[6] using the 'Patients, Intervention, Comparator or Control, Outcome' (PICO) or PIO format, as applicable.

Search strategy and study selection

The search strategy (with a combined search for all key questions) was developed and run by an experienced librarian (LF) in Ovid Medline, Embase (Embase.com) and the Cochrane Library, from inception through 1 December 2020, followed by monthly updates until 28 February 2021. Studies published in English, French, Spanish, German and Portuguese language, with no restriction of the publication date, were considered for inclusion. Eligible studies were full research articles, short reports and research letters of prospective and retrospective studies, as well as qualitative studies. Congress abstracts of EULAR 2020 and the American College of Rheumatology 2020 were screened for relevant unpublished studies. Details of the complete search strategy are provided in the online supplemental material S2. Furthermore, EULAR national societies and PARE (People with Arthritis / Rheumatism across Europe) organisations were contacted via the EULAR secretary for available publications on remote care.

All identified citations were uploaded into Covidence (Veritas Health Innovation, Australia) software, and duplicates were removed. Titles and abstracts were screened by two independent reviewers (AM and PB) to assess eligibility. Subsequently, all potentially eligible articles were read in full text in order to decide whether or not they fulfilled the inclusion criteria. For further information on the inclusion and exclusion criteria, see the SLR protocol (online supplemental material S1). Any disagreement between reviewers was resolved through discussion. In case a consensus was not found, one of the conveners (AdT and CD) was involved as a tiebreaker. The three PICO were approached in parallel.

Assessment of risk of bias, data extraction and synthesis

The two reviewers (AM and PB) independently assessed the risk of bias (RoB) of the included studies according to study type. The Cochrane risk-of-bias tool for randomised trials version 2 (RoB 2)[7] was used for randomised controlled trial (RCT) studies, the risk-of-bias tool for non-randomised studies of interventions (ROBINS-I) for cohort studies,[8] the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross Sectional Studies for cross-sectional studies[9] and the JBI Critical Appraisal Checklist for qualitative research.[10]

To improve the readability of the RoB reports, we transformed the items 'serious concern' and 'some concern' used in the original version of the ROBINS-I tool into 'high' and 'moderate' RoB in the text, according to the RoB 2 classification.

Data were extracted from the selected publications by the two reviewers (AM and PB), and results were synthesised according to the PICO/PIO questions. Meta-analysis of data was not possible due to heterogeneity of the studies in terms of population, interventions and outcomes measured.

RESULTS

From a total of 2240 citations, 129 were selected for full-text review, and thereof 47 fulfilled the inclusion criteria. Included studies comprised 26 RCTs, 8 prospective cohort studies, 8 cross-sectional studies and 5 qualitative studies. None of the congress abstracts revealed any eligible, unpublished studies. The search results are depicted in figure 1.

Characteristics of included studies and interventions

The included studies were published in the past 20 years (time range 2001–2021) and were conducted in 16 different countries. Settings were both primary care and hospitals. The interventions were delivered by different healthcare professionals including rheumatologists, nurses, psychologists, nutritionists, physiotherapists, occupational therapists, social workers and dietitians.

Regarding remote care, the most frequently studied intervention was remote monitoring (ie, telehealth-based monitoring of disease activity or function) (n=35; 74%), followed by remote diagnostics (n=2; 4%). Remote care was mostly delivered using telephone/video calls (n=30; 64%), and in 10 studies, all of them RCTs, an individual e-device was used for data collection (21%).

The critical appraisal of results for each study is summarised in online supplemental material S3. The majority of RCTs (16/26; 61%) revealed a high degree of bias, only six studies had a low risk and four a moderate RoB. Regarding the cohort studies, most (n=5) had serious overall RoB and three had moderate RoB. The RoB tools applied for cross-sectional and qualitative studies did not allow overall grading, rather each item of the tools had to be assessed dichotomously (positive or negative).

We found 34 studies answering PICO 1 (value of remote care, see tables 1 and 2 for details) and 13 studies answering PIO 3 (drivers and barriers, see table 3). No study revealed data for more than one PICO, and no study directly addressed PICO 2 (remote care delivery/tailoring). For PICO 1, 20 papers investigated non-inflammatory RMDs (59%), 10 inflammatory (29%) and 4 both non-inflammatory and inflammatory RMDs (12%). For PIO 3, there were only three (23%) studies

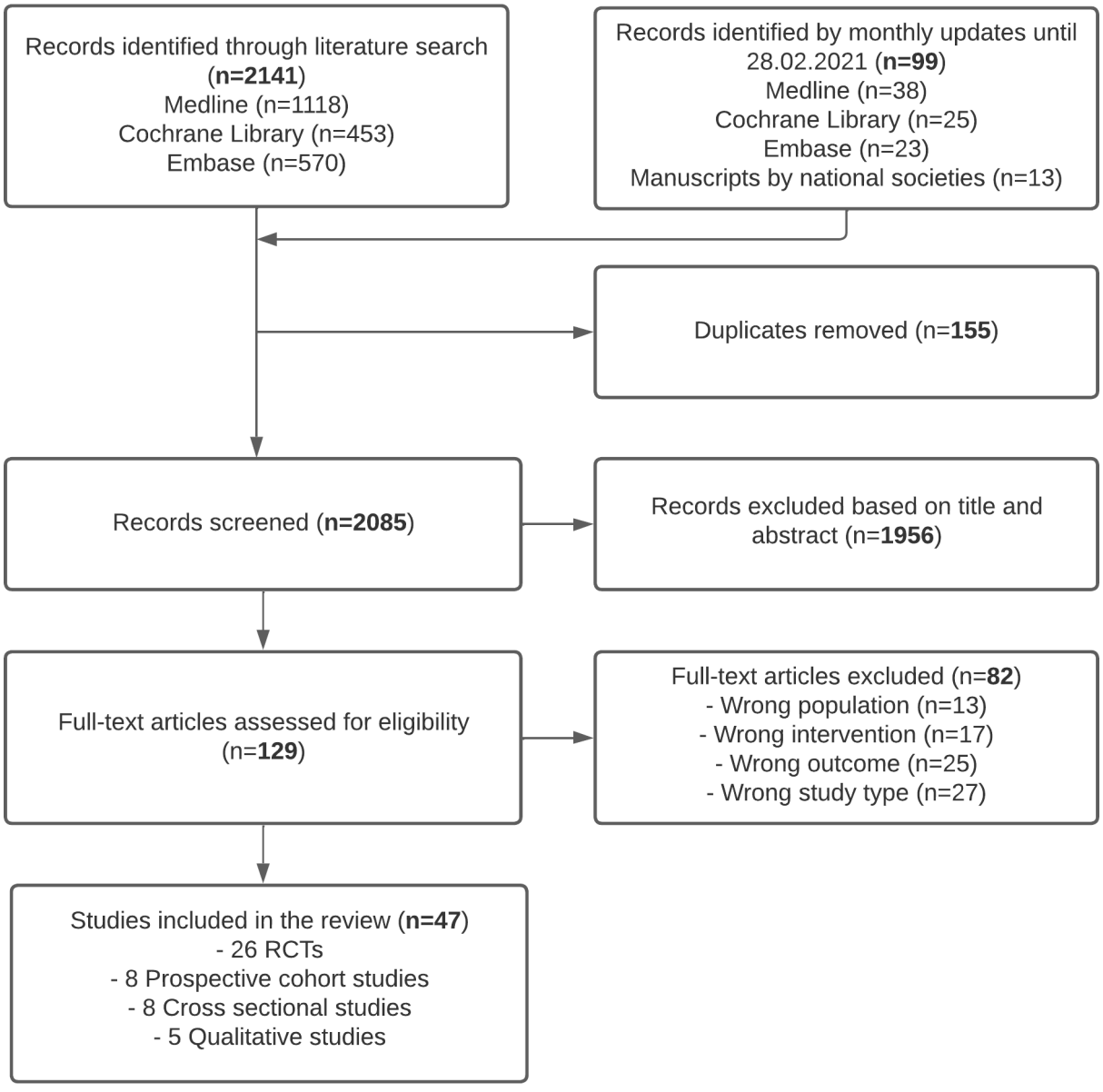

Figure 1 Flow chart of study selection. RCT, randomised controlled trial.

Table 1 Studies on the value of remote care in inflammatory RMDs (PICO 1)

Study	Study design	Disease	N°	Demographics*	Intervention	Control	Outcomes	Results†	RoB‡
Berdal *et al* [11]	RCT	RA, SpA, PsA, SLE, OA	389	Age: 58 y Female: 71% FU duration: 12 mo	Self-management booklet, goal setting interviews, telephone FU, additionally to traditional rehabilitation programme	Traditional rehabilitation programme	Efficacy (HRQoL/PGI)	Better HRQoL values at discharge; no differences in other outcomes at any timepoints	RoB 2: low
Gossec *et al*[24]	RCT	RA	320	Age: 57 y Female: 79% FU duration: 12 mo	E-health platform for health self-assessment and storing questions, additionally to rheumatology visits	Rheumatology visits	User perception	Better patient-physician interactions and patient perceived care	RoB 2: some concern
Khan *et al*[13]	RCT	SLE	50	Age: 43 y Female: 95% FU duration: 16 w	Smartphone/Web application for tracking lifestyle activities and disease triggers, telephone calls to discuss lifestyle modifications, additionally to usual care	Usual care as recommended by treating physician	Efficacy (FACIT-F; BPI-SF; QoL)	Less fatigue, pain and QoL outcomes	RoB 2: high
Pers *et al*[14]	RCT	RA in moderate/ high disease activity	94	Age: 18–75 y§ Female: 75% FU duration: 6 mo	Smartphone app notifying rheumatologist for the necessity of a visit	Standard care	Efficacy (N° of visits, DAS28; HAQ; RAPID-3; SF-12) Safety (adverse events) User perception	Lower n° of total visits, no differences in other outcomes	RoB 2: high
Salaffi *et al*[16]	RCT	Early RA	41	Age: 50 y Female: 75% FU duration: 12 mo	Web application for disease activity assessment and user perception, telephone calls in case of active disease	Conventional strategy	Efficacy (RAID; CDAI) User perception	Better according to the number of patients reaching remission and time to remission. Better for function radiological progression. Patient satisfaction was high with the application, but no comparisions were made	RoB 2: high
Song *et al*[15]	RCT	RA	92	Age: 55 y Female: 71% FU duration: 24 w	Telephone education (medication, side effects, exercise, psychological approaches), additionally to standard care	Standard care	Efficacy (DAS28) Adherence	Better for compliance and medication adherence, no difference in disease activity	RoB 2: high
Taylor-Gjevre *et al*[17]	RCT	Inflammatory arthritis	85	Age: 56 y Female: 20% FU duration: 9 mo	Remote diagnostic videoconference including physical exam by an on-site physical therapist	In person (F2F) rheumatology FU	Efficacy (DAS28; EQ-5D; RADAI) User perception	No differences	RoB 2: high

Continued

Table 1 Continued

Study	Study design	Disease	N°	Demographics*	Intervention	Control	Outcomes	Results†	RoB‡
de Thurah *et al*[12]	RCT	RA in low disease activity	294	Age: 61 y Female 69% FU duration: 52 w	Telehealth FU every 3–4 mo	Outpatient department every 3–4 mo	Efficacy (DAS28; HAQ; EQ-5D) Adherence	Non-inferiority between intervention and control	RoB 2: low
Ammerlaan *et al*[23]	Cohort study	Patients with RMDs	19	Age: 22 y Female: 84% FU duration: 6 w	Six-week long interactive online programme (chatting with peers and peer leaders, home exercises, discussion board)	Three-day F2F programme with similar content	User perception	No differences	ROBINS-I: serious
Kennedy *et al*[18]	Cohort study	Patients with RMDs (RA, PsA, SLE, IBD, arthritis, gout)	123	Age: 58 y Female: 90% FU duration: 6 mo	Teleconference for patient education (learning best practices, integration of self-management strategies)	F2F meeting with identical programme	Efficacy (self-efficacy)	No differences	ROBINS-I: serious
Leggett *et al*[19]	Cohort study	New rheumatology referrals	100	Age: 48 y Female: 75% FU duration: two visits (no info)	Diagnostic telephone and subsequent teleconference consultation between patients and rheumatologists in a general practitioner office	F2F meeting	Efficacy (diagnostic accuracy) User perception	Numerically better diagnostic accuracy, patient and general practitioner satisfaction in the teleconference group compared with telephone consultations alone, no difference between teleconference and F2F	ROBINS-I: moderate
Nguyen-Oghalai *et al*[20]	Cohort study	Veterans with suspected RMDs	38	Age: 57 y Female: 8% FU duration: 2–3 mo	Diagnostic videoconference between patient, nurse practitioner (same place) and rheumatologist	F2F visit with the same patients, 2–3 mo after videoconference	Efficacy (diagnostic accuracy) User perception	No statistical comparisions performed	ROBINS-I: moderate
Wood *et al*[22]	Cohort study	Veterans with inflammatory arthritis	85	Age: 64 y Female: 15% FU duration: not given	Telemedicine care (videoconference)	Usual care (F2F)	Efficacy (travel distance) User perception Cost-effectiveness	Costs and distance of driving decreased when switching from usual to telemedicine care. No difference in satisfaction with medical care	ROBINS-I: serious
Kessler *et al*[21]	Cross-sectional study	Paediatric patients with RMDs	338	No information reported	Telemedicine clinic for routine FU visits	In person visits in a rheumatology clinic	Efficacy (time schedule) Cost-effectiveness	Less distance travelled, less hours missed for work/school, less expenses for food/lodging, higher interest in telehealth	NA

*Age/Female ratio was calculated by the sum of age (mean or median) or female ratio (%) of intervention and control groups, respectively and divided by the number of groups, unless reported otherwise.
†Results are reported in respect to the comparison of the intervention with the control.
‡Overall RoB is reported according to the RoB 2 tool (low, some concern, high RoB) and the ROBINS-I tool (low, moderate, serious RoB). Cross-sectional and qualitative studies were assessed using the Joanna Briggs Institute Critical Appraisal checklists which do not determine an overall RoB (therefore reported as 'NA').
§Age was reported as the number of patients (%) in age categories: 18–39 years: 8 (9); 40–59 years 41 (46); 60–75 years: 40 (45).
BPI-SF, Brief Pain Inventory Short Form; CDAI, Clinical Disease Activity Index; DAS28, Disease Activity Score based on 28 joints; EQ-5D, European Quality of Life 5 Dimensions; FACIT-F, Functional Assessment of Chronic Illness Therapy-Fatigue; F2F, face-to-face; FU, follow-up; HAQ, Health Assessment Questionnaire; HRQoL, Health-Related Quality of Life; IBD, inflammatory bowel disease; mo, months; NA, not available; PGI, patient generated index; PsA, psoriatic arthritis; QoL, quality of life; RA, rheumatoid arthritis; RADAI, Rheumatoid Arthritis Disease Activity Index; RAID, Rheumatoid Arthritis Impact of Disease; RAPID-3, Routine Assessment of Patient Index Data 3; RCT, randomised controlled trial; RMDs, rheumatic musculoskeletal disease; RoB, risk of bias; ROBINS-I, risk-of-bias tool for non-randomised studies of interventions; SF-12, Short Form 12; SLE, systematic lupus erythematosus; SpA, spondyloarthritis; w, weeks; y, years.

Table 2 Studies on the value of remote care in non-inflammatory RMDs (PICO 1)

Study	Study design	Disease	N°	Demographics*	Intervention	Control	Outcomes	Results†	RoB‡
Amorim *et al*[27]	RCT	Chronic back pain	68	Age: 58 y Female: 50% FU duration: 6 mo	Physical activity plan, phone calls, activity Tracker, web application, additionally to information booklet	Information booklet	Efficacy (pain, physical activity)	No differences	RoB 2: some concern
Azma *et al*[28]	RCT	Knee OA	54	Age: 56 y Female: 60% FU duration: 6 mo	Pamphlet with physical exercises, logbook for physical activity, monitoring phone calls	Office-based physical therapy for 6 weeks	Efficacy (pain; WOMAC)	No differences	RoB 2: high
Bennell *et al*[29]	RCT	Knee OA	168	Age: 62 y Female: 16% FU duration: 12 mo	Six telephone coaching sessions (education, physical activity, exercises and adherence strategies)	Physiotherapy	Efficacy (pain; WOMAC; PASE) Adherence	Better adherence, function, pain and/or physical activity	RoB 2: some concern
Cuperus *et al*[30]	RCT	OA	147	Age: 60 y Female: 85% FU duration: 52 w	Two F2F meetings (patient education, pain management, physical activity), four telephone calls (goal setting, progress reporting)	Six F2F meetings	Efficacy (SF-36 pain; physical activity, GSES)	Worse pain, better physical activity. No difference in QoL and self-efficacy	RoB 2: low
Cuperus *et al*[41]	RCT	OA	147	Age: 60 y Female: 85% FU duration: 52 w	Two F2F meetings (patient education, pain management, physical activity), four telephone calls (goal setting, progress)	Six F2F meetings	Cost-effectiveness	Worse for quality-adjusted life years, lower total programme costs	RoB 2: high
Friesen *et al*[31]	RCT	FM	60	Age: 48 y Female: 95% FU duration: 8 w	Eight-week long online programme on pain management	Waiting list	Efficacy (FIQR; BPI; HADS) User perception	Better for symptoms, depression, pain, fear of pain, generalised anxiety and physical health outcomes. No difference in patient satisfaction	RoB 2: low
Geragthy el al[32]	RCT	Low back pain	87	Age: 58 y Female: 61% FU duration: 3 mo	Six-week web application use for self-management, phone calls for support and encouragement, additionally to usual care	Usual care (consultations and/or physiotherapy and/or pain clinics)	Efficacy (RMDQ; pain) Adherence	Only descriptive analysis, no comparisons performed	RoB 2: some concern
Hinman *et al*[33]	RCT	Knee OA	175	Age: 63 y Female: 55% FU duration: 12 mo	Telephone calls (physical activity), additionally to help line (OA education)	Help line (OA education: self-management, community resources, emotional support and treatment escalations)	Efficacy (pain; WOMAC) User perception	Better physical function, pain, physical activity and satisfaction outcomes	RoB 2: low
Kloek *et al*[40]	RCT	Knee and/or hip OA	208	Age: 63 y Female: 68% FU duration: 12 mo	Five F2F physical therapy sessions, web application (behavioural graded activities, exercises, disease education, progress reports)	Physical therapy	Efficacy (TUG; accelerometer) User perception	No difference in physical function. Slightly less sedentary behaviour. No difference in user perception	RoB 2: high

Continued

Table 2 Continued

Study	Study design	Disease	N°	Demographics*	Intervention	Control	Outcomes	Results†	RoB‡
Kloek *et al*[42]	RCT	Knee and/or hip OA	208	Age: 63 y Female: 68% FU duration: 12 mo	Five F2F physical therapy sessions, web application (behavioural graded activities, exercises, disease education, progress reports)	Physical therapy	Cost-effectiveness	No differences	RoB 2: high
O'Brien *et al*[34]	RCT	Overweight patients with knee OA	120	Age: 62 y Female: 62% FU duration: 26w	Telephone-based weight management and healthy lifestyle service	Waiting list for orthopaedic consultation	Efficay (pain; WOMAC, FABQ, SF-12) Safety (adverse events)	No difference in pain or physical function. Better fear avoidance and QoL. No difference in adverse events	RoB 2: low
Odole and Ojo[39]	RCT	Knee OA	50	Age: 56 y Female: 49% FU duration: 6w	Home exercises, telephone monitoring and coaching	Clinical-based therapy	Efficacy (WHOQo- Bref)	Better results on physical and psychological health according to WHO QoL	RoB 2: high
Rutledge *et al*[35]	RCT	Low back pain	62	Age: 63 y Female: 9% FU duration: 8w	Cognitive behavioural therapy via 1 F2F and 11 phone calls	Nurse delivered, telehealth supportive psychotherapy	Efficacy (pain, BDI-2) User perception	No differences in pain, depression or patient satisfaction outcomes	RoB 2: high
Shebib *et al*[36]	RCT	Low back pain	177	Age: 43 y Female: 41% FU duration: 12w	Web application (education articles, cognitive behavioural therapy, team discussions, activity/symptom tracking, coaching, exercises)	Receiving three digital education articles	Efficacy (pain)	Better pain, impact on daily life and disability outcomes	RoB 2: high
Skrepnik *et al*[37]	RCT	Knee OA	211	Age: 63 y Female: 50% FU duration: 3 mo	Mobile application (motivational messages, goal setting) Additionally to F2F FU, wearable activity monitor and brochures on the benefit of walking	F2F FU, wearable activity tracker and brochures on the benefit of walking	Efficacy (pain; N° of steps) Safety (adverse events) User perception	More steps per day and less pain. No difference in adverse events. No difference between physician/patient satisfaction reported	RoB 2: high
Solomon *et al*[44]	RCT	Osteoporosis	879	Age: 80 y Female: 93% FU duration: 12 mo	Telephone calls to improve medication adherence Additionally to mailed educational materials	Mailed educational materials	Adherence	No differences	RoB 2: high
Tso *et al* [43]	RCT	Osteoporosis with fracture	6591	Age: 80 y Female: 100% FU duration: 4–5 mo	Telephone call (education on osteoporosis treatment) Additionally to at baseline educational material sent via mail/fax	At baseline educational material sent via mail/fax	Adherence	Better for receiving appropriate osteoporosis treatment	RoB2: high
Vallejo *et al*[38]	RCT	FM	60	Age: 56 y Female: 100% FU duration: 12 mo	Web application (cognitive behavioural therapy, exercises), possibility to send questions to a therapist	Waiting list or cognitive behavioural therapy	Efficacy (FIQR, CPSS)	Worse impact on daily functioning and better self-efficacy compared with the normal cognitive behavioural group	RoB2: high
Nero *et al*[25]	Cohort study	OA	25	Age: 62 y Female: 68% FU duration: 3 mo	Six-week long web programme (education, exercises, physiotherapy)	Twelve-week F2F programme (exercises, self-management techniques)	Efficacy (pain)	Numerically higher pain reduction, (higher baseline pain in intervention group)	ROBINS-I: low

Continued

Table 2 Continued

Study	Study design	Disease	N°	Demographics*	Intervention	Control	Outcomes	Results†	RoB‡
Peterson *et al*[26]	Cohort study	Low back pain	47	Age: 49 y Female: 70% FU duration: 1 day	Telerehabilitation assessment and assignment to treatment groups (mobilisation/manipulation, specific exercises, stabilisation)	F2F assignment to the treatment groups by another physical therapist	Efficacy (diagnostic accuracy)	No differences	ROBINS-I: moderate

*Age/Female ratio was calculated by the sum of age (mean or median) or female ratio (%) of intervention and control groups, respectively and divided by the number of groups, unless reported otherwise.
†Results are reported in respect to the comparison of the intervention with the control.
‡Overall RoB is reported according to the RoB 2 tool (low, some concern, high RoB) and the ROBINS-I tool (low, moderate, serious RoB).
BDI-2, Beck Depression Inventory 2; BPI, Brief Pain Inventory; CPSS, Chronic Pain Self-efficacy Scale; FABQ, fear avoidance beliefs questionnaire; F2F, face-to-face; FIQR, Fibromyalgia Impact Questionnaire; FM, fibromyalgia; FU, follow-up; GSES, General Self-Efficacy Scale; HADS, Hospital Anxiety and Depression Scale; HAQ-DI, Health Assessment Questionnaire-Disability Index; mo, months; OA, osteoarthritis; PASE, physical activity scale for the elderly; QoL, quality of life; RCT, randomised controlled trial; RMDQ, Roland and Morris Disability Questionnaire; RMDs, rheumatic and musculoskeletal diseases; RoB, risk of bias; SF-12, Short Form 12; SF-36, Short Form 36; TUG, Timed Up & Go test; w, weeks; WHOQo-Bref, WHO Quality of life-Bref.

on non-inflammatory RMDs. Study characteristics are detailed in table 4.

PICO 1: studies on inflammatory RMDs and mixed diagnoses

The 14 studies on inflammatory RMDs or mixed diagnoses, mainly investigated patients with RA (n=7, 50%), spondyloarthritis, inflammatory arthritis and SLE (n=3, 21% each) (tables 1 and 4). The majority of studies addressed efficacy as an outcome (n=12, 86%), followed by user perception (n=8, 57%), cost-effectiveness (n=2, 14%), adherence (n=2, 14%) and safety (n=1, 7%) (table 1). Eight of the studies were RCTs, five were cohort studies and one was a cross-sectional study. Details are given in table 1.

Efficacy outcomes in remote monitoring

In the 12 studies on efficacy, outcomes investigated were highly heterogeneous. Eleven different patient-reported outcome measures (PROMs) were reported, assessing generic quality of life,[11–15] disease severity[14 16] and activity,[17] function,[12 14] fatigue,[13] pain[13] and patient beliefs.[11] Disease activity was captured by composite scores in five studies.[12 14–17] One cohort study investigated self-efficacy[18] and two diagnostic accuracy.[19 20]

Five studies revealed better outcomes with remote monitoring, especially an improved quality of life,[11 13] fatigue and pain,[13] higher numbers of patients reaching remission,[16] lower number of patient visits[14] and reduced travel distance.[21 22] Five studies found no differences between the investigated remote intervention and the comparator group[11 12 14 15 17 18] (Berdal *et al* only for patient beliefs).

Two cohort studies assessed the value of remote care for diagnosis of patients with suspected RMDs. One study reported diagnostic accuracies of 71% for telephone and of 97% for video calls as compared with F2F visits which served as gold standard.[19] The other study reported similar diagnostic accuracy of remote diagnostics using a videoconference tool compared with F2F visit (79% correct diagnosis with both methods).[20]

Safety, cost-effectiveness, user perception and adherence

Only one RCT assessed safety aspects of remote care and revealed no differences between standard care and a remote care strategy, in which a smartphone app that records PROMs notified the rheumatologist of necessary F2F visits.[14]

Two studies investigated cost-effectiveness and showed lower expenses in the groups that received remote care.[21 22]

Five of the nine studies on user perception found no differences between the groups undergoing remote care or F2F visits.[11 14 17 22 23] However, one RCT reported a better user perception and patient-physician interaction when using an e-health platform for performing self-assessment compared with routine care.[24] Another study reported higher patient and general practitioner satisfaction in the teleconference group compared with telephone consultations alone, whereas no difference was found between teleconferences and F2F visits.

Table 3 Studies on drivers and barriers of remote care implementation in RMDs (PICO 3)

Study	Study design	Participants	Overall aim	N°	Participants caracteristics*	Remote care—drivers	Remote care—barriers	RoB†
Bullock *et al*[46]	Cross-sectional	Parents/Guardians of patients with RMDs	Survey to assess barriers to care and alternative models of care	159	–	Fewer missing days of school/work, less travel time/distance, easier appointment availability, less need for lodging, lower costs	Insurance approvals, inadequate knowledge about telemedicine	NA
Dejaco *et al*[47]	Cross-sectional	Professionals working in the field of rheumatology in EULAR countries	Survey to assess impact of COVID-19 measures on rheumatology care	1286	75% rheumatologists 11% rheumatologists in training 13% HCPs in rheumatology	Cancellation or postponement of non-urgent tests/appointments either by the service provider or by patients themselves, treatment decisions being postponed	–	NA
Ferucci *et al*[48]	Prospective cohort	Patients with RA	Assess outcomes (RAPID-3, functional status, etc) after the start of telemedicine care	122	Age: 52.2 y Female: 83% Last FU: 12 mo	Previous use of telemedicine by patients and rheumatologists, use of video calls	Inexperience in telemedicine, technical issues	ROBINS-I: serious
Ferwerda *et al*[49]	Cross-sectional	Patients with RA	Telephone interview about advantages and disadvantages of internet-based CBT	50	Age: 54.4 y Female: 50%	Less travelling time, lower costs, flexibility of time and place, no waiting times, potential ease of seeking help via internet, anonymity	Limitation on provider choice, lack of F2F contact, inexperience with telemedicine, data security issues, increased time spend at the computer, more self-discipline might be necessary	NA
Lawford *et al*[52]	Cross-sectional	Patients with hip and/or knee OA	Survey to investigate the perceptions of patients on remote delivery of exercise therapy	330	Age: 62 y Female: 78%	Saved time, ease to use, maintaining privacy, use of video calls rather than phone calls	Lack of physical contact	NA
Lawford *et al*[53]	Cross-sectional	Therapists	Survey to investigate the perceptions of therapists on remote delivery of exercise therapy	217	Age: 15 y clinical experience Female: 72%	Saved patient's time, convenient for patients, good privacy	Inexperience in telemedicine, technical issues, lack of confidence	NA
Magnol *et al*[54]	Cross-sectional	Patients with RA	Questionnaire on eHealth use (eg, internet, mobile apps, connected devices)	575	Age: 62 y Female: 78%	Membership in a patient association, and education programme, ease to use, data security	Inadequate use of technology	NA
Opinc *et al*[57]	Cross-sectional	Patients/Caregivers with RMDs	Survey on teleconsultation during the COVID-19 pandemic	244	Age: 41 y Female: 93%	Direct contact to the physician via email	Lack of possibility to perform additional tests and physical exam; inexperience in telemedicine	NA
Barber *et al*[45]	Qualitative	Primary care physician and patient researchers with OA	Interview on views on OA and an app for patient self-management	9	–	Improved understanding and communication on disease	Technical issues	NA

Continued

Table 3 Continued

Study	Study design	Participants	Overall aim	N°	Participants caracteristics*	Remote care—drivers	Remote care—barriers	RoB†
Hinman *et al*[50]	Qualitative	Physical therapists, Patients with OA	Interview on the experience of receiving/giving physical therapy exercises via teleconference	12	–	Ease to use, time efficient, flexible, empowerment to self-management; improved therapeutic relationships and patient benefits	Lack of clinical examination	NA
Knudsen *et al*[51]	Qualitative	Patients with RA	Interview on the experience of a patient-reported outcome-based telehealth follow-up	15	–	Flexible and resource-saving, improved knowledge of RA, increased communication	Difficult to accommodate to different needs, wishes and abilities of patients	NA
Mathijssen *et al*[55]	Qualitative	Patients with RA	Transcript of audio recordings regarding support for medication use and suitability of eHealth technologies	28	–	Improved information, practical and emotional support	Lack of personal interaction, privacy and security issues, quality and reliability information	NA
Navarro-Millán *et al*[56]	Qualitative	Patients with RA	Transcript of audio recodrings regarding the recording of between visit disease activity and other patient-reported outcomes and on sharing the information with the healthcare provider	31	–	Improved communication, information and social peer support	Technical issues, data collection	NA

*Age/Female ratio was calculated by the sum of age (mean or median) or female ratio (%) of intervention and control groups, respectively and divided by the number of groups, unless reported otherwise.
†Overall RoB is reported according to the ROBINS-I tool (low, moderate, serious RoB). Cross-sectional and qualitative studies were assessed using the Joanna Briggs Institute Critical Appraisal checklists which do not determine an overall RoB (therefore reported as 'NA').
CBT, cognitive behavioural therapy; F2F, face-to-face; FU, follow-up; mo, months; NA, not available; OA, osteoarthritis; RA, rheumatoid arthritis; RAPID-3, Routine Assessment of Patient Index Data 3; RMDs, rheumatic musculoskeletal diseases; RoB, risk of bias; ROBINS-I, risk-of-bias tool for non-randomised studies of interventions; y, years.

Table 4 Characteristics of studies

	PICO 1 (value of remote care)	PIO 3 (drivers and barriers)
N° of studies	34 (100)	13 (100)
RCTs	26 (77)	0 (0)
Cohort studies	7 (21)	1 (8)
Cross-sectional studies	1 (3)	7 (54)
Qualitative studies	0 (0)	5 (39)
Inflammatory RMDs and mixed diagnoses*	14 (41)	10 (77)
RA	7 (21)	6 (46)
SpA	3 (9)	–
Inflammatory arthritis	3 (9)	–
SLE	3 (9)	–
RMD not further specified	3 (9)	4 (31)
Non-inflammatory RMDs	20 (59)	3 (23)
OA	11 (32)	3 (23)
FM	2 (6)	0 (0)
Back pain	5 (15)	0 (0)
Osteoporosis	2 (6)	0 (0)
Remote care intervention†		
Remote monitoring	32 (94)	3 (23)
Remote diagnostics	2 (6)	0 (0)
Mode of delivering remote care†		
E-device for monitoring	10 (29)	0 (0)
Video/Telephone calls	27 (79)	3 (23)

Values are depicted as total number and percentage in parenthesis.
*In some studies, multiple RMDs were investigated.
†Some studies assessed multiple types of remote care intervention/mode of delivery.
FM, fibromyalgia; OA, osteoarthritis; PICO, Patients, Intervention, Comparator or Control, Outcome; PIO, Patients, Intervention, Outcome; RA, rheumatoid arthritis; RCT, randomised controlled trial; RMD, rheumatic and musculoskeletal disease; SLE, systematic lupus erythematosus; SpA, spondyloarthritis.

Two studies did not perform any statistical comparison between the interventional groups.[16 20]

Two RCTs that investigated treatment adherence to pharmacological therapy came to diverging results: one study revealed comparable adherence between remote and personal follow-ups,[12] while the second study showed that additional telephone calls over F2F visits alone can improve patient education.[15]

PICO 1: studies on non-inflammatory RMDs

Twenty studies that answered PICO 1 included patients with non-inflammatory RMDs, particularly with osteoarthritis (n=11; 55%), back pain (n=5; 25%), fibromyalgia and osteoporosis (n=2; 10% each). Efficacy as outcome was investigated in 80% of the studies (n=16), user perception in 25% (n=5), adherence in 20% (n=4), cost-effectiveness and safety in 10% each (n=2). Except for two observational cohorts,[25 26] all of the studies were designed as RCT. Details are given in table 2.

Efficacy outcomes

Similar to the studies on inflammatory RMDs, the efficacy outcomes in the studies on non-inflammatory disease were heterogeneous. The majority of outcomes were PROMs including pain,[25 27–38] disease impact,[28 29 31 33 34 38] quality of life,[30 34 39] depression,[31 35] disability,[32] beliefs and perception of disease.[30 34 40] Furthermore, the activity and mobility of patients was examined by five studies[27 29 30 37 40] and diagnostic accuracy by one study.[26] Of note, the instruments to measure the outcomes differed from study to study.

Remote care was superior to the control group in seven studies with respect to pain,[29 31 33 36 37] impact of the disease,[29 31 33] quality of life,[34 39] disability,[30] depression[31] and physical activity.[29 30 37] Seven studies found no differences between the intervention and control group for all or at least some of the investigated outcomes,[26–28 30 34 35 40] and two studies reported higher pain scores[30] and worse impact on daily functioning[38] in the intervention groups. Two studies reported only descriptive results without statistical testing.[25 32]

Safety, cost-effectiveness, user perception and adherence

No differences were found for safety outcomes, especially concerning the rates of adverse events in patients receiving telephone-based services compared with patients on a waiting list for orthopaedic consultation[34] and in patients who used a mobile app on top of clinical follow-ups compared with clinical follow-up alone.[37]

Cost-effectiveness was assessed by two RCTs. One of them reported lower total programme costs when performing two F2F visits and four telephone visits compared with performing six F2F visits.[41] The other study found no difference in societal and total healthcare costs in patients receiving five F2F visits with additional online support versus a higher number of F2F visits (mean n=12).[42]

One out of five studies that assessed user perception found a higher patient satisfaction in the intervention group.[33] No differences between remote intervention and a control group were found in this regard in four RCTs.[31 35 37 40]

Adherence was either reported as exercise or treatment adherence. Exercise adherence was found to be better in patients receiving exercises and education via telephone compared with standard physiotherapy.[29] The second study on exercise adherence did not perform statistical testing.[32] Two RCTs on medication adherence in patients with osteoporosis showed diverging results with the first study revealing higher adherence in the remote as compared with the standard group,[43] and the second showing comparable results in both groups.[44]

Barriers and drivers

Of the 13 studies addressing PIO 3 (7 cross-sectional, 5 qualitative and 1 prospective cohort study), 12 reported potential drivers and 13 potential barriers for remote care as depicted in table 3.[45–57]

One of the major issues with remote care was technology. Inadequate technical knowledge was the most frequently named barrier for remote care (n=6),[45 46 48 49 54 56] followed by concerns in data security (n=3)[49 55 56] and worries about an increased time spent in front of the computer (n=1).[49]

The other major point of concern was linked to care itself. A reduced number of F2F visits was seen critically by patients/clinicians in six studies, with potential issues regarding individual care (n=1),[51] the impossibility to perform certain clinical and laboratory tests remotely (n=2)[50 57] and the fear that remote interventions would lead to more self-responsibility of patients (n=1).[49] Study participants also raised issues about insurance and limited choice of providers (n=2)[46 49] as potential barriers.

On the other hand, the benefits for daily life were considered as one fundamental driver, for example, time savings and less missing days from work/school (n=4),[46 50 52 53] as well as a reduction of travel distance (n=2),[46 49] lower costs for lodging (n=2)[46 49] and potentially more appointment options (n=2).[46 49] Further terms commonly used in association with remote care were 'ease of use' (n=3),[50 52 54] 'convenience' and 'flexibility' (n=3).[50 51 53]

Technical aspects of remote care were also named as drivers, such as the option to contact the physician in multiple, more direct ways (eg, via email or phone) and thereby improving communication (n=4),[47 51 56 57] while also mentioning that video calls may be superior to telephone calls (n=1).[50] Furthermore, remote care may be beneficial during pandemics, or in case people are unable to leave their homes (n=1).[47]

Other individual drivers for telehealth were the possibility to connect with peers, or members from patient organisations and improve one's knowledge on rheumatic diseases (n=5).[45 51 54–56] Appropriate anonymity and data protection were seen as prerequisites for remote care (n=4).[49 52–54]

DISCUSSION

This SLR included 34 studies of remote interventions in patients with RMDs and 13 studies of drivers and barriers for the implementation of remote care. These studies were heterogeneous in various aspects, for example, with respect to the study design, the spectrum of diagnoses or the method applied to deliver remote care.

Further differences were identified regarding remote interventions, for example, in the kind of the applied intervention, in the definition of the control group and in the investigated outcomes. Eighty-two per cent of these studies assessed the efficacy of the intervention, but only one in three studies showed a better result in the intervention group (4/12 studies for inflammatory RMDs and mixed diagnoses, 6/16 studies for non- inflammatory RMDs) while in the majority of studies, remote and standard care were comparable. User perception was investigated in 41% of the studies, with only a minority of them showing a better result for the remote care groups (21%). Adherence, safety and cost-effectiveness were less often investigated. Savings in time, travel and/or costs for accommodation were indicated as the main drivers for remote care. However, technology and reduced care were cited as major barriers.

In the majority of cases, when advantages of remote care over the comparator group were observed, the former group simply received a telehealth intervention on top of standard care, or the comparator group consisted of patients not receiving any treatment (ie, being on a waiting list).

Another important finding is the overall low quality of studies, with 50% of cohort studies and RCTs yielding high/serious RoB and only 21% displaying low RoB. This was mainly caused by poor results reporting and missing outcome data. Furthermore, the studies were very heterogeneous with respect to the population studied, the experimental and control interventions as well as the scales used for outcome measurement.

Most studies focused on non-inflammatory RMDs, such as osteoarthritis and non-specific joint pain, while studies comparing F2F and remote care visits with inflammatory RMDs, particularly in an outpatient setting, were scarce. Those few studies identified revealed promising results for remote care in regard to efficacy and safety outcomes including patient satisfaction.[12 21 22]

COVID-19 has led to an increased interest in telehealth measures, however, we only identified two surveys taking a deeper look into the consequences of the pandemic on healthcare systems and teleconsultations, which is probably due to the fact that most studies on this topic have not been published yet when this SLR has been conducted.[47 57] The increased interest in telehealth due to COVID-19 makes it necessary to update the review in due time.

Cost-effectiveness may be one of the potential benefits of remote care even though telehealth interventions are not necessarily superior to standard face-to-face care. Cost-effectiveness, however, was only assessed in two studies in patients with OA.[41 42] These two studies came up with different conclusions emphasising the need for future well-conducted RCTs that address outcomes such as cost-effectiveness and quality-adjusted life years. Digital technologies may contribute to better long-term outcomes of patients with RMDs, while simultaneously saving costs and human resources. This is certainly desirable given that the demand for healthcare services will continuously increase due to an ageing population and the continuous development of medical therapies, while supply with human manpower is dwindling.[41 42]

Studies comparing different remote care approaches were only available in the field of patient education pointing towards a potential benefit of telephone calls as compared with written mailed information,[43] while telephone calls were, at least in the view of patients and providers, inferior to video calls for the diagnostic workup.[19] Studies on technologies such as virtual reality were not found.

The findings of this review are in line with previous reviews performed in 2017,[3 58] showing positive results for feasibility and patient satisfaction across various telehealth interventions such as remotely delivered consultations, monitoring of disease activity and management of patients with RMDs. In our SLR, however, a wider range of RMDs (inflammatory and non-inflammatory) were included, and we also assessed a larger number of outcomes, including safety, costs-effectiveness and adherence to treatment as well the potential drivers and barriers for the use of remote care.

Interestingly, the technical aspects of remote care were considered both, as drivers and as barriers: technical illiteracy on the one hand and the opportunity to facilitate care and connect more easily to providers and peers on the other hand were important aspects raised by patients and clinicians, and indicate the two sides of the same coin. Scepticism towards remote care may also be due to the fact that only a fraction of patients with RMDs has been in contact with it so far, as displayed by a recently published survey.[59]

While studies reported the use of applications for the purpose of remote care for patients with RMDs[16 24] and app-stores are filled with various programmes of questionable quality,[60] none of the available studies reported on the implementation of remote care into clinical practice. Future studies are needed to elaborate on the development, implementation and possible weaknesses of telehealth methods in clinical routine.

One of the major limitations of the identified studies was the lack of blinding of patients and assessors to telehealth interventions, consequently leading to a potential overestimation of effect sizes. We also recognised that none of the studies had a follow-up longer than 1 year, indicating the need for studies with longer follow-up periods for the assessment of long-term effects of these interventions. For qualitative and cross-sectional studies, we reported potential RoB solely in a descriptive manner, as cut-offs for low, moderate and high RoB have not been proposed for the JBI Critical Appraisal Checklists so far. Another possible limitation is publication bias, with negative results being published less likely than positive results. However, we found no unpublished, completed studies on clinicaltrials.gov on the topic of remote care, indicating a rather low risk for publication bias. As already mentioned above, in several studies the remote care intervention was added on top of usual care bearing the risk of a relevant placebo effect. Future trials should therefore either directly compare the telehealth intervention with conventional care or use a sham intervention (eg, providing online educational material only) in the control group. We did not find/identify any study to answer the questions in PICO 2, hence, further research about this topic is needed.

CONCLUSION

The need for new healthcare solutions is imminent due to the COVID-19 pandemic, leading to a recent increase in remote care research in RMDs. Currently available studies comparing remote with F2F care reported similar results for various efficacy, safety, adherence and user perception outcomes. The major limitations are the heterogeneity of data and substantial RoB. Technical aspects of remote care are both the biggest driver and barrier for remote care.

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REFERENCES

1 GBD 2017 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990-2017: a systematic analysis for the global burden of disease study 2017. *Lancet* 2018;392:1789–858.
2 World Health Organization. Who guideline: recommendations on digital interventions for helath system strengthening, 2019. Available: https://apps.who.int/iris/bitstream/handle/10665/311941/9789241550505-eng.pdf?ua=1 [Accessed 10 Jan 2022].
3 Piga M, Cangemi I, Mathieu A, *et al*. Telemedicine for patients with rheumatic diseases: systematic review and proposal for research agenda. *Semin Arthritis Rheum* 2017;47:121–8.
4 Higgins J, Thomas J, Chandler J. Cochrane Handbook for systematic reviews of interventions. *6.0. Cochrane* 2019.
5 Moher D, Liberati A, Tetzlaff J, *et al*. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med* 2009;6:e1000097.
6 van der Heijde D, Aletaha D, Carmona L, *et al*. 2014 update of the EULAR standardised operating procedures for EULAR-endorsed recommendations. *Ann Rheum Dis* 2015;74:8–13.
7 Sterne JAC, Savović J, Page MJ, *et al*. Rob 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019;366:l4898.
8 Sterne JA, Hernán MA, Reeves BC, *et al*. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. *BMJ* 2016;355:i4919.
9 Moola S, Munn Z, Tufanaru C. Chapter 7: Systematic reviews of etiology and risk. In: Aromataris E, Munn Z, eds. *Joanna Briggs Institute Reviewer's Manual*, 2017.
10 Lockwood C, Munn Z, Porritt K. Qualitative research synthesis: methodological guidance for systematic reviewers utilizing meta-aggregation. *Int J Evid Based Healthc* 2015;13:179–87.
11 Berdal G, Bø I, Dager TN, *et al*. Structured goal planning and supportive telephone follow-up in rheumatology care: results from a pragmatic, Stepped-Wedge, cluster-randomized trial. *Arthritis Care Res* 2018;70:1576–86.
12 de Thurah A, Stengaard-Pedersen K, Axelsen M, *et al*. Tele-Health followup strategy for tight control of disease activity in rheumatoid arthritis: results of a randomized controlled trial. *Arthritis Care Res* 2018;70:353–60.
13 Khan F, Granville N, Malkani R, *et al*. Health-Related quality of life improvements in systemic lupus erythematosus derived from a digital therapeutic plus Tele-Health coaching intervention: randomized controlled pilot trial. *J Med Internet Res* 2020;22:e23868.
14 Pers Y-M, Valsecchi V, Mura T, *et al*. A randomized prospective open-label controlled trial comparing the performance of a connected monitoring interface versus physical routine monitoring in patients with rheumatoid arthritis. *Rheumatology* 2021;60:1659–68.
15 Song Y, Reifsnider E, Zhao S, *et al*. A randomized controlled trial of the effects of a telehealth educational intervention on medication adherence and disease activity in rheumatoid arthritis patients. *J Adv Nurs* 2020;76:1172–81.
16 Salaffi F, Carotti M, Ciapetti A, *et al*. Effectiveness of a telemonitoring intensive strategy in early rheumatoid arthritis: comparison with the conventional management approach. *BMC Musculoskelet Disord* 2016;17:146.
17 Taylor-Gjevre R, Nair B, Bath B, *et al*. Addressing rural and remote access disparities for patients with inflammatory arthritis through video-conferencing and innovative inter-professional care models. *Musculoskeletal Care* 2018;16:90–5.
18 Kennedy CA, Warmington K, Flewelling C, *et al*. A prospective comparison of telemedicine versus in-person delivery of an interprofessional education program for adults with inflammatory arthritis. *J Telemed Telecare* 2017;23:197–206.
19 Leggett P, Graham L, Steele K, *et al*. Telerheumatology--diagnostic accuracy and acceptability to patient, specialist, and general practitioner. *Br J Gen Pract* 2001;51:746–8.
20 Nguyen-Oghalai TU, Hunter K, Lyon M. Telerheumatology: the Va experience. *South Med J* 2018;111:359–62.
21 Kessler EA, Sherman AK, Becker ML. Decreasing patient cost and travel time through pediatric rheumatology telemedicine visits. *Pediatr Rheumatol Online J* 2016;14:54.
22 Wood PR, Caplan L, Outcomes CL. Outcomes, satisfaction, and costs of a rheumatology telemedicine program: a longitudinal evaluation. *J Clin Rheumatol* 2019;25:41–4.
23 Ammerlaan J, van Os-Medendorp H, Scholtus L, *et al*. Feasibility of an online and a face-to-face version of a self-management program for young adults with a rheumatic disease: experiences of young adults and peer leaders. *Pediatr Rheumatol Online J* 2014;12:10.
24 Gossec L, Cantagrel A, Soubrier M, *et al*. An e-health interactive self-assessment website (Sanoia®) in rheumatoid arthritis. A 12-month randomized controlled trial in 320 patients. *Joint Bone Spine* 2018;85:709–14.
25 Nero H, Dahlberg J, Dahlberg LE. A 6-week web-based osteoarthritis treatment program: observational quasi-experimental study. *J Med Internet Res* 2017;19:e422.
26 Peterson S, Kuntz C, Roush J. Use of a modified treatment-based classification system for subgrouping patients with low back pain: agreement between telerehabilitation and face-to-face assessments. *Physiother Theory Pract* 2019;35:1078–86.
27 Amorim AB, Pappas E, Simic M, *et al*. Integrating Mobile-health, health coaching, and physical activity to reduce the burden of chronic low back pain trial (impact): a pilot randomised controlled trial. *BMC Musculoskelet Disord* 2019;20:71.
28 Azma K, RezaSoltani Z, Rezaeimoghaddam F, *et al*. Efficacy of tele-rehabilitation compared with office-based physical therapy in patients with knee osteoarthritis: a randomized clinical trial. *J Telemed Telecare* 2018;24:560–5.
29 Bennell KL, Campbell PK, Egerton T, *et al*. Telephone coaching to enhance a home-based physical activity program for knee osteoarthritis: a randomized clinical trial. *Arthritis Care Res* 2017;69:84–94.
30 Cuperus N, Hoogeboom TJ, Kersten CC, *et al*. Randomized trial of the effectiveness of a non-pharmacological multidisciplinary face-to-face treatment program on daily function compared to a telephone-based treatment program in patients with generalized osteoarthritis. *Osteoarthritis Cartilage* 2015;23:1267–75.
31 Friesen LN, Hadjistavropoulos HD, Schneider LH, *et al*. Examination of an internet-delivered cognitive behavioural pain management course for adults with fibromyalgia: a randomized controlled trial. *Pain* 2017;158:593–604.
32 Geraghty AWA, Stanford R, Stuart B, *et al*. Using an Internet intervention to support self-management of low back pain in primary care: findings from a randomised controlled feasibility trial (SupportBack). *BMJ Open* 2018;8:e016768.
33 Hinman RS, Campbell PK, Lawford BJ, *et al*. Does telephone-delivered exercise advice and support by physiotherapists improve pain and/or function in people with knee osteoarthritis? Telecare randomised controlled trial. *Br J Sports Med* 2020;54:790–7.
34 O'Brien KM, Wiggers J, Williams A, *et al*. Telephone-based weight loss support for patients with knee osteoarthritis: a pragmatic randomised controlled trial. *Osteoarthritis Cartilage* 2018;26:485–94.
35 Rutledge T, Atkinson JH, Holloway R, *et al*. Randomized controlled trial of nurse-delivered cognitive-behavioral therapy versus supportive psychotherapy telehealth interventions for chronic back pain. *J Pain* 2018;19:1033–9.
36 Shebib R, Bailey JF, Smittenaar P, *et al*. Randomized controlled trial of a 12-week digital care program in improving low back pain. *NPJ Digit Med* 2019;2:1.
37 Skrepnik N, Spitzer A, Altman R, *et al*. Assessing the impact of a novel smartphone application compared with standard follow-up on mobility of patients with knee osteoarthritis following treatment with Hylan G-F 20: a randomized controlled trial. *JMIR Mhealth Uhealth* 2017;5:e64.
38 Vallejo MA, Ortega J, Rivera J, *et al*. Internet versus face-to-face group cognitive-behavioral therapy for fibromyalgia: a randomized control trial. *J Psychiatr Res* 2015;68:106–13.
39 Odole AC, Ojo OD. Is telephysiotherapy an option for improved quality of life in patients with osteoarthritis of the knee? *Int J Telemed Appl* 2014;2014:1–9.
40 Kloek CJJ, Bossen D, Spreeuwenberg PM, *et al*. Effectiveness of a blended physical therapist intervention in people with hip osteoarthritis, knee osteoarthritis, or both: a cluster-randomized controlled trial. *Phys Ther* 2018;98:560–70.
41 Cuperus N, van den Hout WB, Hoogeboom TJ, *et al*. Cost-Utility and cost-effectiveness analyses of face-to-face versus Telephone-Based nonpharmacologic multidisciplinary treatments for patients with generalized osteoarthritis. *Arthritis Care Res* 2016;68:502–10.
42 Kloek CJJ, van Dongen JM, de Bakker DH, *et al*. Cost-Effectiveness of a blended physiotherapy intervention compared to usual

physiotherapy in patients with hip and/or knee osteoarthritis: a cluster randomized controlled trial. *BMC Public Health* 2018;18:1082.
43 Tso LS, Loi D, Mosley DG, *et al*. Evaluation of a nationwide pharmacist-led phone outreach program to improve osteoporosis management in older women with recently sustained fractures. *J Manag Care Spec Pharm* 2015;21:803–10.
44 Solomon DH, Iversen MD, Avorn J, *et al*. Osteoporosis telephonic intervention to improve medication regimen adherence: a large, pragmatic, randomized controlled trial. *Arch Intern Med* 2012;172:477–83.
45 Barber T, Sharif B, Teare S, *et al*. Qualitative study to elicit patients' and primary care physicians' perspectives on the use of a self-management mobile health application for knee osteoarthritis. *BMJ Open* 2019;9:e024016.
46 Bullock DR, Vehe RK, Zhang L, *et al*. Telemedicine and other care models in pediatric rheumatology: an exploratory study of parents' perceptions of barriers to care and care preferences. *Pediatr Rheumatol Online J* 2017;15:55.
47 Dejaco C, Alunno A, Bijlsma JW, *et al*. Influence of COVID-19 pandemic on decisions for the management of people with inflammatory rheumatic and musculoskeletal diseases: a survey among EULAR countries. *Ann Rheum Dis* 2020. doi:10.1136/annrheumdis-2020-218697. [Epub ahead of print: 06 Nov 2020].
48 Ferucci ED, Holck P, Day GM, *et al*. Factors associated with use of telemedicine for follow-up of rheumatoid arthritis. *Arthritis Care Res* 2020;72:1404–9.
49 Ferwerda M, van Beugen S, van Burik A, *et al*. What patients think about e-health: patients' perspective on Internet-based cognitive behavioral treatment for patients with rheumatoid arthritis and psoriasis. *Clin Rheumatol* 2013;32:869–73.
50 Hinman RS, Nelligan RK, Bennell KL, *et al*. "Sounds a Bit Crazy, But It Was Almost More Personal:" A Qualitative Study of Patient and Clinician Experiences of Physical Therapist-Prescribed Exercise For Knee Osteoarthritis Via Skype. *Arthritis Care Res* 2017;69:1834–44.
51 Knudsen LR, de Thurah A, Lomborg K. Experiences with telehealth followup in patients with rheumatoid arthritis: a qualitative interview study. *Arthritis Care Res* 2018;70:1366–72.
52 Lawford BJ, Bennell KL, Hinman RS. Consumer perceptions of and willingness to use remotely delivered service models for exercise management of knee and hip osteoarthritis: a cross-sectional survey. *Arthritis Care Res* 2017;69:667–76.
53 Lawford BJ, Bennell KL, Kasza J, *et al*. Physical therapists' perceptions of Telephone- and Internet Video-Mediated service models for exercise management of people with osteoarthritis. *Arthritis Care Res* 2018;70:398–408.
54 Magnol M, Eleonore B, Claire R, *et al*. Use of eHealth by patients with rheumatoid arthritis: observational, cross-sectional, multicenter study. *J Med Internet Res* 2021;23:e19998.
55 Mathijssen EG, Vriezekolk JE, Eijsbouts AM, *et al*. Support needs for medication use and the suitability of eHealth technologies to address these needs: a focus group study of older patients with rheumatoid arthritis. *Patient Prefer Adherence* 2018;12:349–58.
56 Navarro-Millán I, Zinski A, Shurbaji S, *et al*. Perspectives of rheumatoid arthritis patients on electronic communication and patient-reported outcome data collection: a qualitative study. *Arthritis Care Res* 2019;71:80–7.
57 Opinc A, Łukasik Z, Makowska J. The attitude of Polish rheumatology patients towards telemedicine in the age of the COVID-19 pandemic. *Reumatologia* 2020;58:134–41.
58 McDougall JA, Ferucci ED, Glover J, *et al*. Telerheumatology: a systematic review. *Arthritis Care Res* 2017;69:1546–57.
59 López-Medina C, Escudero A, Collantes-Estevez E. COVID-19 pandemic: an opportunity to assess the utility of telemedicine in patients with rheumatic diseases. *Ann Rheum Dis* 2020. doi:10.1136/annrheumdis-2020-218008. [Epub ahead of print: 05 Jun 2020].
60 Knitza J, Tascilar K, Messner E-M, *et al*. German mobile Apps in rheumatology: review and analysis using the mobile application rating scale (MARS). *JMIR Mhealth Uhealth* 2019;7:e14991.