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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INTRODUCTION

Rheumatic and musculoskeletal diseases (RMDs) are among the most common chronic diseases worldwide,1,2 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.3,4 For example, telehealth-based follow-ups, or self-management interventions in the form of patient education.

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.5,6 Remote care and telehealth can improve healthcare, particularly when used to complement conventional clinical care.7 In rheumatology, telehealth can be used for screening, diagnostic and monitoring purposes, as well as for patient education.

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.
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 procedures6 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 secretariat 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 studies9 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>
<thead>
<tr>
<th>Study</th>
<th>Study design</th>
<th>Disease</th>
<th>N°</th>
<th>Demographics*</th>
<th>Intervention</th>
<th>Control</th>
<th>Outcomes</th>
<th>Results†</th>
<th>RoB‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berdal et al</td>
<td>RCT</td>
<td>RA, SpA, PsA, SLE, OA</td>
<td>389</td>
<td>Age: 58 y</td>
<td>Self-management booklet, goal setting interviews, telephone FU, additionally to traditional rehabilitation programme</td>
<td>Traditional rehabilitation programme</td>
<td>Efficacy (HRQoL/PGI)</td>
<td>Better HRQoL values at discharge; no differences in other outcomes at any timepoints</td>
<td>low</td>
</tr>
<tr>
<td>Gossec et al</td>
<td>RCT</td>
<td>RA</td>
<td>320</td>
<td>Age: 57 y</td>
<td>E-health platform for health self-assessment and storing questions, additionally to rheumatology visits</td>
<td>Rheumatology visits</td>
<td>User perception</td>
<td>Better patient-physician interactions and patient perceived care</td>
<td>some concern</td>
</tr>
<tr>
<td>Khan et al</td>
<td>RCT</td>
<td>SLE</td>
<td>50</td>
<td>Age: 43 y</td>
<td>Smartphone/Web application for tracking lifestyle activities and disease triggers, telephone calls to discuss lifestyle modifications, additionally to usual care</td>
<td>Usual care as recommended by treating physician</td>
<td>Efficacy (FACIT-F; BPI-SF; QoL)</td>
<td>Less fatigue, pain and QoL outcomes</td>
<td>high</td>
</tr>
<tr>
<td>Pers et al</td>
<td>RCT</td>
<td>RA in moderate/ high disease activity</td>
<td>94</td>
<td>Age: 18–75 y§</td>
<td>Smartphone app notifying rheumatologist for the necessity of a visit</td>
<td>Standard care</td>
<td>Efficacy (N° of visits, DAS28; HAQ; RAPID-3; SF-12) Safety (adverse events) User perception</td>
<td>Lower n° of total visits, no differences in other outcomes</td>
<td>high</td>
</tr>
<tr>
<td>Salaffi et al</td>
<td>RCT</td>
<td>Early RA</td>
<td>41</td>
<td>Age: 50 y</td>
<td>Web application for disease activity assessment and user perception, telephone calls in case of active disease</td>
<td>Conventional strategy</td>
<td>Efficacy (RAID; CDAI) User perception</td>
<td>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 comparisons were made</td>
<td>high</td>
</tr>
<tr>
<td>Song et al</td>
<td>RCT</td>
<td>RA</td>
<td>92</td>
<td>Age: 55 y</td>
<td>Telephone education (medication, side effects, exercise, psychological approaches), additionally to standard care</td>
<td>Standard care</td>
<td>Efficacy (DAS28) Adherence</td>
<td>Better for compliance and medication adherence, no difference in disease activity</td>
<td>high</td>
</tr>
<tr>
<td>Taylor-Gjevre et al</td>
<td>RCT</td>
<td>Inflammatory arthritis</td>
<td>85</td>
<td>Age: 56 y</td>
<td>Remote diagnostic videoconference including physical exam by an on-site physical therapist</td>
<td>In person (F2F) rheumatology FU</td>
<td>Efficacy (DAS28; EQ-SD; RADAI) User perception</td>
<td>No differences</td>
<td>high</td>
</tr>
</tbody>
</table>

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

*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 comparison to the control with the exception of control reported in bar charts.
‡Overall RoB is reported according to the RoB 2 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’).
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</thead>
<tbody>
<tr>
<td>Amorim et al²⁷</td>
<td>RCT</td>
<td>Chronic back pain</td>
<td>68</td>
<td>Age: 58 y</td>
<td>Physical activity plan, phone calls, activity Tracker, web application, additionally to information booklet</td>
<td>Information booklet</td>
<td>Efficacy (pain, physical activity)</td>
<td>No differences</td>
<td>RoB 2: some concern</td>
</tr>
<tr>
<td>Azma et al²⁸</td>
<td>RCT</td>
<td>Knee OA</td>
<td>54</td>
<td>Age: 56 y</td>
<td>Pamphlet with physical exercises, logbook for physical activity, monitoring phone calls</td>
<td>Office-based physical therapy for 6 weeks</td>
<td>Efficacy (pain; WOMAC)</td>
<td>No differences</td>
<td>RoB 2: high</td>
</tr>
<tr>
<td>Bennell et al²⁹</td>
<td>RCT</td>
<td>Knee OA</td>
<td>168</td>
<td>Age: 62 y</td>
<td>Six telephone coaching sessions (education, physical activity, exercises and adherence strategies)</td>
<td>Physiotherapy</td>
<td>Efficacy (pain; WOMAC; PASE) Adherence</td>
<td>Better adherence, function, pain and/or physical activity</td>
<td>RoB 2: some concern</td>
</tr>
<tr>
<td>Cuperus et al³⁰</td>
<td>RCT</td>
<td>OA</td>
<td>147</td>
<td>Age: 60 y</td>
<td>Two F2F meetings (patient education, pain management, physical activity), four telephone calls (goal setting, progress reporting)</td>
<td>Six F2F meetings</td>
<td>Efficacy (SF-36 pain; physical activity, GSES)</td>
<td>Worse pain, better physical activity. No difference in QoL and self-efficacy</td>
<td>RoB 2: low</td>
</tr>
<tr>
<td>Cuperus et al³³</td>
<td>RCT</td>
<td>OA</td>
<td>147</td>
<td>Age: 60 y</td>
<td>Two F2F meetings (patient education, pain management, physical activity), four telephone calls (goal setting, progress)</td>
<td>Six F2F meetings</td>
<td>Cost-effectiveness</td>
<td>Worse for quality-adjusted life years, lower total programme costs</td>
<td>RoB 2: high</td>
</tr>
<tr>
<td>Friesen et al³¹</td>
<td>RCT</td>
<td>FM</td>
<td>60</td>
<td>Age: 48 y</td>
<td>Eight-week long online programme on pain management</td>
<td>Waiting list</td>
<td>Efficacy (FIQR; BPI; HADS) User perception</td>
<td>Better for symptoms, depression, pain, tear of pain, generalised anxiety and physical health outcomes. No difference in patient satisfaction</td>
<td>RoB 2: low</td>
</tr>
<tr>
<td>Geragthy et al³²</td>
<td>RCT</td>
<td>Low back pain</td>
<td>87</td>
<td>Age: 58 y</td>
<td>Six-week web application use for self-management, phone calls for support and encouragement, additionaly to usual care</td>
<td>Usual care (consultations and/or physiotherapy and/or pain clinics)</td>
<td>Efficacy (RMDQ; pain) Adherence</td>
<td>Only descriptive analysis, no comparisons performed</td>
<td>RoB 2: some concern</td>
</tr>
<tr>
<td>Hinman et al³³</td>
<td>RCT</td>
<td>Knee OA</td>
<td>175</td>
<td>Age: 63 y</td>
<td>Telephone calls (physical activity), additionally to help line (OA education)</td>
<td>Help line (OA education: self-management, community resources, emotional support and treatment escalations)</td>
<td>Efficacy (pain; WOMAC) User perception</td>
<td>Better physical function, pain, physical activity and satisfaction outcomes</td>
<td>RoB 2: low</td>
</tr>
<tr>
<td>Kloek et al³⁴</td>
<td>RCT</td>
<td>Knee and/or hip OA</td>
<td>208</td>
<td>Age: 63 y</td>
<td>Five F2F physical therapy sessions, web application (behavioural graded activities, exercises, disease education, progress reports)</td>
<td>Physical therapy</td>
<td>Efficacy (TUG; accelerometer) User perception</td>
<td>No difference in physical function. Slightly less sedentary behaviour. No difference in user perception</td>
<td>RoB 2: high</td>
</tr>
</tbody>
</table>

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<tr>
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</thead>
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<tr>
<td>Kloek et al42</td>
<td>RCT</td>
<td>Knee and/or hip OA</td>
<td>208</td>
<td>Age: 63 y Female: 68%</td>
<td>Five F2F physical therapy sessions, web application (behavioural graded activities, exercises, disease education, progress reports)</td>
<td>Physical therapy</td>
<td>Cost-effectiveness</td>
<td>No differences</td>
<td>RoB 2: high</td>
</tr>
<tr>
<td>O’Brien et al44</td>
<td>RCT</td>
<td>Overweight patients with knee OA</td>
<td>120</td>
<td>Age: 62 y Female: 62%</td>
<td>Telephone-based weight management and healthy lifestyle service</td>
<td>Waiting list for orthopaedic consultation</td>
<td>Efficacy (pain; WOMAC, FABQ, SF-12) Safety (adverse events)</td>
<td>No difference in pain or physical function. Better fear avoidance and QoL. No difference in adverse events</td>
<td>RoB 2: low</td>
</tr>
<tr>
<td>Odole and Ojo19</td>
<td>RCT</td>
<td>Knee OA</td>
<td>50</td>
<td>Age: 56 y Female: 49%</td>
<td>Home exercises, telephone monitoring and coaching</td>
<td>Clinical-based therapy</td>
<td>Efficacy (WHOQoL-Bref)</td>
<td>Better results on physical and psychological health according to WHO QoL</td>
<td>RoB 2: high</td>
</tr>
<tr>
<td>Rutledge et al45</td>
<td>RCT</td>
<td>Low back pain</td>
<td>62</td>
<td>Age: 63 y Female: 91%</td>
<td>Cognitive behavioural therapy via 1 F2F and 11 phone calls</td>
<td>Nurse delivered, telehealth supportive psychotherapy</td>
<td>Efficacy (pain, BDI-II) User perception</td>
<td>No differences in pain, depression or patient satisfaction outcomes</td>
<td>RoB 2: high</td>
</tr>
<tr>
<td>Shebib et al35</td>
<td>RCT</td>
<td>Low back pain</td>
<td>177</td>
<td>Age: 43 y Female: 41%</td>
<td>Web application (education articles, cognitive behavioural therapy, team discussions, activity/symptom tracking, coaching, exercises)</td>
<td>Receiving three digital education articles</td>
<td>Efficacy (pain)</td>
<td>Better pain, impact on daily life and disability outcomes</td>
<td>RoB 2: high</td>
</tr>
<tr>
<td>Skrepnik et al57</td>
<td>RCT</td>
<td>Knee OA</td>
<td>211</td>
<td>Age: 63 y Female: 50%</td>
<td>Mobile application (motivational messages, goal setting) Additionally to F2F FU, wearable activity tracker and brochures on the benefit of walking</td>
<td>F2F FU, wearable activity tracker and brochures on the benefit of walking</td>
<td>Efficacy (pain; N° of steps) Safety (adverse events) User perception</td>
<td>More steps per day and less pain. No difference in adverse events. No difference between physician/patient satisfaction reported</td>
<td>RoB 2: high</td>
</tr>
<tr>
<td>Solomon et al44</td>
<td>RCT</td>
<td>Osteoporosis</td>
<td>879</td>
<td>Age: 80 y Female: 93%</td>
<td>Telephone calls to improve medication adherence Additionally to mailed educational materials</td>
<td>Mailed educational materials</td>
<td>Adherence</td>
<td>No differences</td>
<td>RoB 2: high</td>
</tr>
<tr>
<td>Tso et al43</td>
<td>RCT</td>
<td>Osteoporosis with fracture</td>
<td>6591</td>
<td>Age: 80 y Female: 100%</td>
<td>Telephone call (education on osteoporosis treatment) Additionally to at baseline educational material sent via mail/fax</td>
<td>At baseline educational material sent via mail/fax</td>
<td>Adherence</td>
<td>Better for receiving appropriate osteoporosis treatment</td>
<td>RoB2: high</td>
</tr>
<tr>
<td>Vallejo et al18</td>
<td>RCT</td>
<td>FM</td>
<td>60</td>
<td>Age: 56 y Female: 100%</td>
<td>Web application (cognitive behavioural therapy, exercises), possibility to send questions to a therapist</td>
<td>Waiting list or cognitive behavioural therapy</td>
<td>Efficacy (FQIQ, CPSS)</td>
<td>Worse impact on daily functioning and better self-efficacy compared with the normal cognitive behavioural group</td>
<td>RoB2: high</td>
</tr>
<tr>
<td>Nero et al50</td>
<td>Cohort study</td>
<td>OA</td>
<td>25</td>
<td>Age: 62 y Female: 68%</td>
<td>Six-week long web programme (education, exercises, physiotherapy)</td>
<td>Twelve-week F2F programme (exercises, self-management techniques)</td>
<td>Efficacy (pain)</td>
<td>Numerically higher pain reduction, (higher baseline pain in intervention group)</td>
<td>ROBINS-I: low</td>
</tr>
</tbody>
</table>

Table 2 Continued
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, disease severity and activity, function, fatigue, pain and patient beliefs. Disease activity was captured by composite scores in five studies. One cohort study investigated self-efficacy and two diagnostic accuracy.

Five studies revealed better outcomes with remote monitoring, especially an improved quality of life, fatigue and pain, higher numbers of patients reaching remission, lower number of patient visits and reduced travel distance. Five studies found no differences between the investigated remote intervention and the comparator group (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. The other study reported similar diagnostic accuracy of remote diagnostics using a videoconference tool compared with F2F visit.

**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. Two studies investigated cost-effectiveness and showed lower expenses in the groups that received remote care. Two studies investigated cost-effectiveness and showed lower expenses in the groups that received remote care.

Five of the nine studies on user perception found no differences between the groups undergoing remote care or F2F visits. 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. 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>
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<tr>
<th>Study</th>
<th>Study design</th>
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<th>N°</th>
<th>Participants characteristics*</th>
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<th>Remote care—barriers</th>
<th>RoB†</th>
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<tr>
<td>Bullock et al 46</td>
<td>Cross-sectional</td>
<td>Parents/Guardians of patients with RMDs</td>
<td>Survey to assess barriers to care and alternative models of care</td>
<td>159</td>
<td>–</td>
<td>Fewer missing days of school/work, less travel time/distance, easier appointment availability, less need for lodging, lower costs</td>
<td>Insurance approvals, inadequate knowledge about telemedicine</td>
<td>NA</td>
</tr>
<tr>
<td>Dejaco et al 47</td>
<td>Cross-sectional</td>
<td>Professionals working in the field of rheumatology in EULAR countries</td>
<td>Survey to assess impact of COVID-19 measures on rheumatology care</td>
<td>1286</td>
<td>75% rheumatologists; 11% rheumatologists in training; 13% HCPs in rheumatology</td>
<td>Cancellation or postponement of non-urgent tests/appointments either by the service provider or by patients themselves, treatment decisions being postponed</td>
<td>–</td>
<td>NA</td>
</tr>
<tr>
<td>Ferucci et al 48</td>
<td>Prospective cohort</td>
<td>Patients with RA</td>
<td>Assess outcomes (RAPID-3, functional status, etc) after the start of telemedicine care</td>
<td>122</td>
<td>Age: 52.2 y; Female: 83% Last FU: 12 mo</td>
<td>Previous use of telemedicine by patients and rheumatologists, use of video calls</td>
<td>–</td>
<td>ROBINS-I: serious issues</td>
</tr>
<tr>
<td>Ferwerda et al 49</td>
<td>Cross-sectional</td>
<td>Patients with RA</td>
<td>Telephone interview about advantages and disadvantages of internet-based CBT</td>
<td>50</td>
<td>Age: 54.4 y; Female: 50%</td>
<td>Less travelling time, lower costs, flexibility of time and place, no waiting times, potential ease of seeking help via internet, anonymity</td>
<td>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</td>
<td>NA</td>
</tr>
<tr>
<td>Lawford et al 52</td>
<td>Cross-sectional</td>
<td>Patients with hip and/or knee OA</td>
<td>Survey to investigate the perceptions of patients on remote delivery of exercise therapy</td>
<td>330</td>
<td>Age: 62 y; Female: 78%</td>
<td>Saved time, ease to use, maintaining privacy, use of video calls rather than phone calls</td>
<td>Lack of physical contact</td>
<td>NA</td>
</tr>
<tr>
<td>Lawford et al 53</td>
<td>Cross-sectional</td>
<td>Therapists</td>
<td>Survey to investigate the perceptions of therapists on remote delivery of exercise therapy</td>
<td>217</td>
<td>Age: 15 y; clinical experience Female: 72%</td>
<td>Saved patient's time, convenient for patients, good privacy</td>
<td>Inexperience in telemedicine, technical issues, lack of confidence</td>
<td>NA</td>
</tr>
<tr>
<td>Magnol et al 54</td>
<td>Cross-sectional</td>
<td>Patients with RA</td>
<td>Questionnaire on eHealth use (eg, internet, mobile apps, connected devices)</td>
<td>575</td>
<td>Age: 62 y; Female: 78%</td>
<td>Membership in a patient association, and education programme, ease to use, data security</td>
<td>Inadequate use of technology</td>
<td>NA</td>
</tr>
<tr>
<td>Opinc et al 55</td>
<td>Cross-sectional</td>
<td>Patients/Caregivers with RMDs</td>
<td>Survey on teleconsultation during the COVID-19 pandemic</td>
<td>244</td>
<td>Age: 41 y; Female: 93%</td>
<td>Direct contact to the physician via email</td>
<td>Lack of possibility to perform additional tests and physical exam; inexperience in telemedicine</td>
<td>NA</td>
</tr>
<tr>
<td>Barber et al 56</td>
<td>Qualitative</td>
<td>Primary care physician and patient researchers with OA</td>
<td>Interview on views on OA and an app for patient self-management</td>
<td>9</td>
<td>–</td>
<td>Improved understanding and communication on disease</td>
<td>Technical issues</td>
<td>NA</td>
</tr>
</tbody>
</table>

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<table>
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<tr>
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<tr>
<td>Hinman et al</td>
<td>Qualitative</td>
<td>Physical therapists, Patients with OA</td>
<td>Interview on the experience of receiving/giving physical therapy exercises via teleconference</td>
<td>12</td>
<td>–</td>
<td>Ease to use, time efficient, flexible, empowerment to self-management; improved therapeutic relationships and patient benefits</td>
<td>Lack of clinical examination</td>
<td>NA</td>
</tr>
<tr>
<td>Knudsen et al</td>
<td>Qualitative</td>
<td>Patients with RA</td>
<td>Interview on the experience of a patient-reported outcome-based telehealth follow-up</td>
<td>15</td>
<td>–</td>
<td>Flexible and resource-saving, improved knowledge of RA, increased communication</td>
<td>Difficult to accommodate to different needs, wishes and abilities of patients</td>
<td>NA</td>
</tr>
<tr>
<td>Mathijssen et al</td>
<td>Qualitative</td>
<td>Patients with RA</td>
<td>Transcript of audio recordings regarding support for medication use and suitability of eHealth technologies</td>
<td>28</td>
<td>–</td>
<td>Improved information, practical and emotional support</td>
<td>Lack of personal interaction, privacy and security issues, quality and reliability information</td>
<td>NA</td>
</tr>
<tr>
<td>Navarro-Millán et al</td>
<td>Qualitative</td>
<td>Patients with RA</td>
<td>Transcript of audio recordings regarding the recording of between visit disease activity and other patient-reported outcomes and on sharing the information with the healthcare provider</td>
<td>31</td>
<td>–</td>
<td>Improved communication, information and social peer support</td>
<td>Technical issues, data collection</td>
<td>NA</td>
</tr>
</tbody>
</table>

*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.
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,25,27–29 disease impact,29,29,31,33,34,38 quality of life,30,34,39 depression,31,33 disability,32 beliefs and perception of disease,30,34,40 Furthermore, the activity and mobility of patients was examined by five studies27,29,30,37,40 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 depression31 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,26,29,30,34,35,37 and two studies reported higher pain scores30 and worse impact on daily functioning28 in the intervention groups. Two studies reported only descriptive results without statistical testing.29,32

**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 consultation34 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.35 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.35 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), followed by concerns in data security (n=3) and worries about an increased time spent in front of the computer (n=1).

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), the impossibility to perform certain clinical and laboratory tests remotely (n=2) and the fear that remote interventions would lead to more self-responsibility of patients (n=1). Study participants also raised issues about insurance and limited choice of providers (n=2) 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), as well as a reduction of travel distance (n=2), lower costs for lodging (n=2) and potentially more appointment options (n=2). Further terms commonly used in association with remote care were ‘ease of use’ (n=5), ‘convenience’ and ‘flexibility’ (n=3). 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), while also mentioning that video calls may be superior to telephone calls (n=1). Furthermore, remote care may be beneficial during pandemics, or in case people are unable to leave their homes (n=1).

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). Appropriate anonymity and data protection were seen as prerequisites for remote care (n=4).

**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. 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. 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. 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.

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, while telephone calls were, at least in the view of patients and providers, inferior to video calls for the diagnostic workup. 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 54 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, cost-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 telehealth methods in clinical routine.

One of the major limitations of the identified studies was the lack of binding 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 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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