

Abstract

In this article, we review published literature on “telerheumatology”, a term describing the use of telemedicine in rheumatology. This field has received considerable recent attention through the development of efficient digital technologies, resulting in a good level of satisfaction among patients and health care professionals. In 2020, the social distancing constraints during the COVID-19 pandemic accelerated more widespread adoption worldwide. Telerheumatology is particularly suited for patients with rheumatoid arthritis who have achieved a sustained therapeutic target of remission or low disease activity. To facilitate remote consultations and meet expectations of rheumatologists and patients, international and national guidelines have recently been proposed and existing tools, such as Patient-Reported Outcomes questionnaires, have had to be digitally adapted. In addition, telerheumatology toolkits are proposed by the Arab League of Associations for Rheumatology (ArLAR), the Association of American Medical College (AAMC), and the American College of Rheumatology (ACR) for all learners, from medical students to practicing clinicians, encouraging the acquisition of telehealth skills and facilitating their integration into their routine clinical practice. The main benefits reported for this mode of health care are greater access to specialty care, flexibility, reduced rates of missed appointments, as well as improved patient engagement and autonomy. Limitations include the absence of physical examination. However, to implement telerheumatology effectively and widely in daily clinical practice, some barriers still need to be addressed. These include training of health care professionals, technological restrictions and reimbursement mechanisms. Despite the advantages of telerheumatology, it is not intended to replace face-to-face visits, but rather as a way to enhance access to care, service delivery and health care support for patients.

Keywords: Telemedicine; Rheumatoid arthritis; COVID-19; telerheumatology

24 1. Introduction

25 According to the World Health Organisation (WHO), telemedicine is “The delivery of health care
26 services, where distance is a critical factor, by all health care professionals using information and
27 communication technologies for the exchange of valid information for diagnosis, treatment and
28 prevention of disease and injuries, research and evaluation, and for the continuing education of
29 health care providers, all in the interests of advancing the health of individuals and their
30 communities.” [1–3]. This method of care is especially recommended by the WHO to offer some
31 clinical services [4] such as tele-critical care, virtual monitoring of hospitalized patients,
32 teleconsultations, transition from emergency to ambulatory care and medical decision support [1].

33 Telemedicine can be proposed in several ways and forms [5] depending on the clinical context to
34 deliver health care such as telephone consultation, video consultation, and mobile apps [6,7]. The
35 communication methods and the type of health care professionals involved (physicians, advanced
36 practice providers, trained assistants (such as nurses and pharmacists), as well as assistants without
37 specific training) can also vary [8]. Two communication methods are possible: synchronous and
38 asynchronous [5]. Synchronous telemedicine consists of live interactions between health care
39 professionals and patients but at a distance. Also called “teleconsultation” or “remote
40 consultation”, this part of telemedicine can be conducted directly from the patient’s home through
41 a computer, a phone or a dedicated mobile app [8,9]. Asynchronous telemedicine does not require
42 real-time interactions between patients and health care professionals [10]. For example, a
43 structured questionnaire can be completed by the patient themselves and then reviewed by the
44 clinician later, who will develop a treatment strategy based on patient’s responses [11]. Also known
45 as “store-and-forward” or “eConsult” [8], asynchronous telemedicine covers the exchange between
46 providers over a secure electronic medium, involving the sharing of patient-specific information
47 and seeking clarification or advice regarding clinical care, allowing patients and providers access to
48 specialized expertise without the need for an in-person visit [12,13].

49 Telemedicine can have numerous applications and is currently implemented in many health care
50 services including, for example, emergency departments, intensive care units, pharmacies [6,7] and
51 is used in several clinical specialties such as primary care, psychiatry, dermatology, infectious
52 disease, diabetes, neurology, and cardiology [6]. In considering different disorders or diseases, all
53 steps of disease management can be covered through telemedicine: diagnosis, follow-up, disease
54 monitoring, therapeutic adjustment and therapeutic education [8,14].

55 Initially used to overcome a shortage of physicians and facilitate access to health care in
56 underserved areas, telemedicine improves patients' quality of life by providing equal access to
57 specialty services for all patients by reducing travel time and associated costs [9,14]. More recently,
58 with the growing prevalence of chronic diseases, the use of telemedicine has been expanded for
59 several reasons including to enhance the capacity to follow-up appointments and to promote closer
60 home-monitoring in order to improve outcomes for patients [15]. Furthermore, the use of
61 telemedicine has also been enhanced as the demand for flexibility of care is rising and financial
62 constraints are increasingly weighing on health care resources. This type of care thus saves time
63 and money for patients, who will not need to take time off work, which can be very constraining,
64 for travel to the clinician's office visits to receive health care [16].

65 Over the last twenty years, digital health technologies have made considerable progress with the
66 development of electronic medical records, wearable technologies and artificial intelligence. The
67 development of secured platforms able to store medical records with a high level of confidentiality
68 has facilitated the potential for virtual visits (with virtual waiting rooms if required) , notably
69 observed and set up in rheumatology, with good levels of satisfaction for patients and for health
70 care professionals [7,11]. Indeed, rheumatic diseases, through their chronic nature and the need for
71 frequent and routine disease monitoring, are particularly well suited for implementation of remote
72 consultations. The use of telemedicine in rheumatology, also called 'telerheumatology', has
73 received considerable attention in some settings as it offers special opportunities and benefits,
74 which have also been demonstrated during the COVID-19 pandemic [2].

75

76 In this literature review, we will focus on the most commonly studied form of telerheumatology,
77 the synchronous teleconsultation, applied to patients with rheumatoid arthritis (RA). The aim of the
78 review is to investigate the current place of telemedicine in RA management, to describe some
79 existing programs, highlighting their advantages and current limitations, and finally to summarize
80 some strategies to efficiently and appropriately integrate remote consultation into daily practice for
81 rheumatology services.

82 **2. Methodology**

83 a) Inclusion criteria

84 a. *Types of publications*

85 Several types of publications were included to obtain a comprehensive overview of telemedicine
86 practices in rheumatology: reviews, survey studies (questionnaires/interviews), randomized
87 controlled trials, guidelines, observational/qualitative studies, exploratory studies, editorials, and
88 commentaries. Concise or brief reports, correspondence, short communications, letters to editors
89 were excluded; clinical trials or reviews were preferred over observational studies.

90

91 b. *Types of interventions*

92 All publications about synchronous teleconsultation, applied to patients with RA, defined as an
93 intervention related to care planning, cooperation/coordination between health professionals,
94 training of health professionals, and organization of the follow-up or management of patients, with
95 or without therapeutic interventions were included. The population of patients considered was
96 restricted to adults (≥ 18 years old) with RA.

97

98 *c. Types of outcomes*

99 The outcomes considered were:

- 100 • Telerheumatology practices overview
- 101 • Advantages/disadvantages of telerheumatology
- 102 • Guidelines
- 103 • Patients' and health care professionals' satisfaction
- 104 • Impact of telerheumatology on patients' quality of life, physical and psychological well-
105 being (flares, swollen joints, anxiety, depressive symptoms), therapeutic adjustment,
106 socioeconomic outcomes and economic impact (individual, healthcare system, or societal
107 perspective)
- 108 • Impact of Covid-19 pandemic on telerheumatology implementation

109
110 *d. Databases*

111 Scientific articles were searched on the MEDLINE/Pubmed, Cochrane and EMBASE databases from
112 January 1st,2015 to September 30th,2022. The search strategy was limited to articles published in
113 English and French and based on an algorithm with the combination of appropriate key words and
114 MESH terms. The search algorithm is provided in Appendix A1.

115

116 *e. Selection of studies*

117 Two review authors (MC, SLC) independently assessed the relevance and eligibility of the
118 publications retrieved from the search algorithm, based first on title and abstracts. All publications
119 failing to meet the inclusion criteria were excluded. Then, the two reviewers independently
120 selected publications based on full-text analysis.

121

b) Data extraction

An extraction grid was used to extract information from the selected articles, according to the following categories: country, publication year, publication type, intervention type (teleconsultation with phone, video, mobile app), study objectives, participants involved in the intervention (patient, specialized physician, general practitioner, nurse, other), frequency of intervention (for example, one-time, every 3 months, once a year), study location, average participation rate of the intervention, outcomes types and main results.

The outcome of telerheumatology as reported was assessed according to the results of the studies and the opinion of the authors. Evaluation of the impact of telerheumatology was divided into 3 categories according to the following criteria:

- Positive impact: no difference from usual care or significant positive difference in measured outcomes in favor of the intervention group (telerheumatology) compared to the control group.
- Limited impact: publications discussing the advantages and disadvantages of telemedicine in RA, key barriers and opportunities, and weighing the pros and cons.
- Negative impact: significant difference in measured outcomes in favor of the control group compared to the intervention group.

3. Main messages and experts' opinion

a) Description of selected studies

In total, between January 1st,2015 and September 30th,2022, 399 references were obtained: 308 through the Pubmed algorithm and 91 through EMBASE. Among these publications, 151 were initially selected based on title and abstract. Subsequently, a full text analysis of the pre-screened articles allowed selection of 69 publications (EMBASE (n=20); pubmed (n=49)). The flowchart with the reasons of inclusion and exclusion is provided in Appendix A2.

Of the 69 selected publications, 51 were published during the COVID-19 pandemic period (between 2020 and 2022 (**Figure1.A**), 57 were mono-country studies and 12 were multi-country studies (**Figure1.B**). Several types of publications were included (**Figure1.C**): reviews (n=23), observational/qualitative studies (n=9), guidelines publications (n=9), randomized controlled trials (n=7), survey studies (n=6), editorials/commentaries (n=6), exploratory studies (n=3), mixed method studies (n=2), cross-sectional studies (n=2), an ancillary study (n=1), and a proof-of-concept study (n=1). The heterogeneity of the countries as well as the types of publications allows for a broad and real overview of telerheumatology in RA. Indeed, because the implementation of telerheumatology in different rheumatic diseases varies from each other, this selection of studies is limited to representing contemporary practice specifically in RA disease.

Of the 69 publications selected, 34 described positive impact of telerheumatology, 2 described a negative impact and 22 described a limited perspective, mainly mentioning pros and cons of telerheumatology. The impact of the 11 other publications was not assessable, as it was papers mentioning objective descriptions (reviews, brief reports) and/or guidelines, and not specific opinion about telerheumatology impact. All these results were then used to discuss pros and cons of telerheumatology according to the sections of the review.

The populations reported in most of the literature identified included adults with RA living in mixed environments (63/69 studies) whereas 4 studies focused on patients living in rural communities [17,18]. In another two studies, telemedicine experience from the rheumatologists' perspective was described (way of delivery, patient adherence, benefits and barriers) [5,19] (**Figure 2**).

b) Is telerheumatology used in current practices?

a. Particularities of RA management and rheumatology medical specialty

Between face-to-face follow-up visits, patients with RA may experience debilitating flares in disease activity which negatively impact quality of life and go unnoticed by clinicians, leaving patients feeling dominated by their disease and losing control of their own lives [11].

Based on these observations, rheumatology care providers face many contemporary challenges. These include the capacity to provide early diagnosis and treatment intervention as well as longitudinal care and monitoring to ensure optimum disease control. However, with the added challenges of an aging population and the shortage of rheumatologists worldwide, this medical specialty needs to transform its traditional approaches to service delivery in order to facilitate and guarantee their patients timely and equal access to care, making it particularly suited to benefit from the implementation of digital health supports [8,20–22].

This is especially true since the past two decades have seen a transformation of conventional management in rheumatology departments. The increasing number of patients with RA currently in remission has decreased the need for inpatient care and increased the provision of outpatient care [23,24]. At the same time, many new effective therapeutic alternatives for RA have emerged that can be administered by patients at home [23].

Therefore, a pharmaceutical care model based on follow-up teleconsultations has been considered as a suitable solution providing added value to improve the management of patients with RA without diminishing well-being [25].

b. The rise of telerheumatology during COVID-19 pandemic

Between 2015 and 2020, telerheumatology was not widely employed but mainly reserved for certain specific situations such as patients requiring specialized care in remote areas or in underserved communities, to address a regional shortage of rheumatologists, or to monitor

192 patients unable to travel [5,10]. Prior to the COVID-19 pandemic, only a few publications provided
193 data comparing the RA quality of care of telerheumatology integrated with follow-up care versus
194 face-to-face care alone [8,17,26]. Several major barriers to wider acceptance of telerheumatology
195 at that time have been identified: lack of knowledge about the opportunities offered by
196 telerheumatology, patient identification and privacy, lack of reimbursement policies [5,27].

197 In 2020, the unexpected worldwide pandemic of COVID-19 accelerated the widespread adoption of
198 telerheumatology, the objective in this context having been to limit the spread of SARS-CoV-2 and
199 its impact. As a result, a disruptive transition from face-to-face to digital medical care has been
200 triggered with a widespread shift in rheumatology ambulatory care to remote care to protect
201 patients, clinicians and hospital staff [23]. A great number of planned face-to-face consultations
202 were cancelled, postponed, or replaced by remote consultations [22,28,29].

203 Recommendations, rules and regulations regarding initiation, continuation, and exposure to various
204 treatments and social distancing were developed [1] for clinicians and patients by governments and
205 by learned rheumatology societies across the world [30], including those from the American College
206 of Rheumatology (ACR) [31] and the British Society for Rheumatology (BSR) [32].

207 Telemedicine consultations were particularly suitable for patients with RA who were on
208 immunosuppressive therapy and at risk of exposure to COVID-19 during travel or office visits, as
209 they were considered more vulnerable to severe disease morbidity or mortality [14,15]. An increase
210 in remote consultations between March and August 2020 was observed compared to the same
211 period in 2019, from 0% to 12.1% according to the US national registry Rheumatology Informatics
212 System Effectiveness (RISE) [33]. A survey made by the German Society for Rheumatology and the
213 German League against Rheumatism led in 2021 confirmed that patients with rheumatic diseases
214 were willing to use digital health technologies to better monitor symptoms and disease activity
215 [28].

216 Accelerated telerheumatology adoption by patients and rheumatologists through the COVID-19
217 pandemic, therefore catalysed change to traditional service delivery arrangements for the

218 management of RA [27,28], even if due to the unexpected nature of this global health crisis,
219 physicians were not prepared and lacked experience or training in this new type of consultation [1].
220 Two years after the pandemic, as health care innovated and improved in RA, telerheumatology
221 went from a special interest to a matter of course [34].

222

223 c) Is telemedicine effective for patients with RA?

224 a. *Suitable patients' profiles*

225 A telerheumatology consultation aims to achieve the same benefits as a face-to-face visit: to
226 provide a high quality of care for people living with RA. To do this optimally requires an effective
227 triage of patients suitable for a telerheumatology review.

228 Patients with rheumatic diseases are particularly suitable for this type of consultation, as they
229 require frequent and regular monitoring of the disease [15]. Early reports of the effectiveness of
230 telerheumatology in the context of patients with RA living in rural location, remote areas, or
231 underserved communities [7,18,26,35] suggested that teleconsultation approaches (phone or video
232 remote consultations) can be adopted in urban areas where it is often challenging to obtain a face-
233 to-face appointment because of long waiting lists in hospitals or clinics.

234 However, geographical location and ease of access to health care facilities are not the only criteria
235 to determine whether a patient is a suitable candidate for a remote consultation. Other patient-
236 related factors that should be taken into consideration before setting up remote consultation
237 include patient willingness to accept telerheumatology, the patient-rheumatologist relationship,
238 disease activity status, and the presence of any comorbidities [2,5,16,20,22,26]. Telerheumatology
239 assessment is dependent on the reliability of a patient's reporting of symptoms and treatment
240 adherence [2], as rheumatologists won't be able to perform a complete clinical examination
241 themselves, even if they could use the video consultation to have a limited view on patients' joints.
242 A reliable reporting of patient's quality of life is also important to determine the current response
243 to treatment and to decide if a treatment adjustment might be necessary or if a face-to-face visit

244 should be planned. Telemedicine is therefore ideally best suited for those patients for whom a
245 trusted relationship between the rheumatologist and their patient is already established [2].
246 Indeed, it has been shown that patients with RA presenting for follow-up visits were more satisfied
247 with the remote consultations' quality of care (phone or video consultation) compared to new
248 patients on their first-time visits [2,16]. Ideally, an initial visit should take place in a face-to-face
249 setting [7] but in some circumstances, a first remote consultation may be considered as a triage tool
250 to determine the urgency of the clinical problem (in the context of a very long waiting list, for
251 example) and possibly to identify the best-located clinic and the need for subspecialty services [36].

252 The disease activity status is also a key consideration in selection of an appropriate patient profile,
253 as patients known to be in a stable remission or low disease activity state have been demonstrated
254 to be more appropriate candidates for telerheumatology [1,22,26]. The limitations of a
255 telerheumatology consultation do not allow a full examination and review of individuals with more
256 complex disease and comorbidities [16,20]. Checking patients' comorbidities during a remote
257 consultation is complex in general, because of the limited time available, the large number of
258 potential conditions to assess and evaluate, and possible requirement for access to confirmatory
259 tests and/or evaluation by a specialist [26]. However, if active RA or disease complications are
260 identified during a telemedicine appointment, this can facilitate prioritisation of an in-person
261 follow-up visit to the clinic.

262 *b. Experience sharing of telerheumatology programs*

263 Prior to the COVID-19 pandemic the Alaska Native Medical Center [8,26] and Dartmouth-Hitchcock
264 Medical Center [17,26] were the largest and best developed initiatives integrating
265 telerheumatology into their routine practices at that time, targeting specifically underserved and/or
266 remote areas. With 200 remote consultation access points available and the establishment of
267 satellite clinics in rural New Hampshire and Vermont regions respectively [26], the medical team
268 (rheumatologists and community health aides trained to perform specific medical tasks) could
269 virtually connect with patients, mainly for follow-up visits. These huge centers' experiences were
270 very impactful in the provision of rheumatology care. It showed improved access to specialty care

271 [8] (high levels of satisfaction, an average saving of 200 driving miles and \$66.90 in transportation
272 costs per visit) and that some patients' profiles were unsuitable for telerheumatology leading to
273 uncertainty in diagnosis and difficulty in establishing effective treatment (mainly in the cases of a
274 disease complexity too high to be managed remotely by rheumatologists or a poor understanding
275 of their disease) [17,26].

276 In addition to well-integrated telerheumatology programs, pilot studies testing telerheumatology in
277 the follow-up of patients with RA have been implemented in the United States [37], Canada [38]
278 and Denmark [39]. In these studies, the remote consultation also proved to be similar to the
279 traditional rheumatology clinical consultation in terms of effectiveness, follow-up care and patient
280 satisfaction. However, in the Canadian study, dropout rates were high, with only 31 (57%) of the
281 videoconference participants and 23 (74%) of the control group completing the study [38],
282 highlighting the importance of identifying patients' needs and preferences when developing this
283 kind of models of care. A review of 13 studies exploring telemedicine in RA before the pandemic
284 showed greater effectiveness compared to face-to-face visits in 7 studies (54%) and non-inferiority
285 in 6 studies (46%) [15]. Similar non-inferiority outcomes in disease activity measures and
286 satisfaction levels with telerheumatology have also been observed in several randomized controlled
287 trials of patients with RA with stable and controlled disease activity [10].

288 During the COVID-19 pandemic, the circumstantially enforced introduction of virtual rheumatology
289 consultations in many health care settings led to the publication of several feedbacks from many
290 countries around the world, supporting various positive insights, especially in RA. First, a high level
291 of satisfaction of this consultation method has been confirmed by both patients and
292 rheumatologists in several studies from Europe (Germany [28], the Netherlands [5], Norway [16])
293 and the USA [29]. Quality of care was also highlighted in the Norwegian program, with most
294 patients (91%) reporting that they received the same quality of care from a virtual consultation as
295 during a face-to-face visit, and two thirds of them wishing to continue telerheumatology after the
296 pandemic [16]. Patients from the Netherlands would even recommend this type of consultation [5].

297 The parameters collected by physicians during telerheumatology consultations to monitor their
298 patients with RA were described by a French cross-sectional study implemented in the
299 rheumatology department of Cochin Hospital, during the first wave of the COVID-19 pandemic [40].
300 The interventions assessed included treatment escalation and/or the need for a rapid face-to-face
301 consultation or hospitalization. Patient-reported RA flares and increased C-reactive protein (CRP)
302 values were identified as key “red flags” during remote consultations to prompt rheumatologists to
303 rapidly schedule a face-to-face visit. A face-to-face consultation or hospitalization has also been
304 shown to be necessary for a minority of patients [40]. These findings were confirmed by another
305 French study and a study in the Netherlands, which found that a reduction in the number of
306 physical visits appears to be suitable for patients with stable chronic inflammatory diseases when
307 remote consultations are accompanied by electronic patient-reported outcome measures
308 (ePROMs) [5,41]. A single face-to-face visit per year may be sufficient in some patients' cases [5].

309 Among the different types of remote consultations in rheumatology, it is still difficult to determine
310 the most effective means given the very heterogeneous methods and results in the literature
311 identified on this subject. Some studies have found that patients mainly use the telephone to
312 communicate with their physician, and this has been found to be the preferred means of contact in
313 rheumatology [21]. In the Netherlands, rheumatology care was mainly provided through telephone
314 consultations (99% of patients), while the uptake of other forms of telemedicine (e.g. video
315 consultations) is still low (video: 9% of patients) [5,14]. In a study conducted in the United Kingdom,
316 clinicians had a strong preference (more than twice as much) for telephone appointments over
317 video conferencing, with patients expressing no difference between the two modes of telemedicine
318 [19]. Elderly patients are also more likely to prefer audio-only consultations to video conferencing
319 [2]. This preference is often explained by their generally limited access and knowledge of new
320 technologies [2,19]. According to official recommendations, it would be preferable to consult
321 patients to ask them about their preference between a video or telephone consultation, or to adapt
322 the consultation format according to the context. Video consultations are preferable when the type
323 of appointment includes a joint examination or that requires viewing the patient's nonverbal

324 communication [32]. Many studies have reported that the video consultation is perceived as a good
325 substitute for face-to-face clinic visits, by both patients and health care professionals [16,29]. In the
326 United States, a study of 512 patients who were consulted remotely (267 (52.1%) by telephone and
327 245 (47.9%) by video) reported 74% positive experience, with greater satisfaction via video [29].
328 Other data have indicated a much higher level of diagnostic accuracy and satisfaction with video
329 consultations than with telephone consultations [10,42]. One of the reasons given for this high
330 level of appreciation was that the video mode was considered the most reliable way for patients to
331 mimic a face-to-face visit with the possibility of easily showing their physician the findings of their
332 physical self-examinations. Furthermore, by means of visual cues, rheumatologists can further
333 evaluate physical and mental health status as conveyed by non-verbal communication [29].

334 In addition, the increasing demand for outpatient care has led to a long waiting list of patients with
335 RA. This ultimately decreases access to care for patients suffering from RA flares or reporting
336 treatment-related adverse events [43]. To alleviate this unexpected problem and maximize the
337 efficiency of rheumatology care, new innovations in digital health have opened up possibilities,
338 including decentralization of rheumatology care management [43–45]. Through a multidisciplinary
339 integrated practice unit (IPU) collaborating with RA patients, patients could be guided and
340 relocated to an outpatient rheumatology clinic if needed.

341 A Norwegian study proposed a conceptual model for decentralized remote monitoring at the
342 national level using strategic organizational management principles [43]. This remote
343 decentralization of ambulatory follow-up decision-making, which has the potential to decrease
344 hospital dependence, involves four steps:

- 345 1. Diagnosis by the rheumatologist
- 346 2. Treatment according to the recommendations of the country in question until the
347 patient is in remission
- 348 3. Patient empowered disease management once low disease activity or remission status
349 is reached, based on the Privilege Elevation and Delegation Management (PEDM)
350 approach: trained rheumatologists teach their patients to take responsibility for their

351 disease, recognize a disease flare and/or serious adverse events while continuing their
352 treatment; understand their lab tests; monitor their disease in telehealth mode.

353 4. Telehealth: monitoring of patients in remission through remote monitoring by
354 rheumatology nurses or artificial intelligence algorithms. If the disease activity flares,
355 the patient can be reassessed in person by their rheumatologist until remission is
356 achieved again.

357 Although the proposed decentralized strategy is in its infancy as illustrated in the Norwegian health
358 system, its feasibility in other countries was deemed possible, if the country's digital health
359 innovations are well mobilized with the objective of improving the efficiency of care within the
360 existing health system.

361 **4. What are the factors associated with effective telerheumatology?**

362 a) Use of patient-reported outcomes (PROs)

363 Patient-reported outcomes (PROs) are tools used for measuring disease activity and are relevant
364 indicators of symptom severity. PROs play a major role for RA disease activity management as they
365 provide the treating physician with an insight into the subjective burden of living with RA that is
366 otherwise only known to the patient themselves. Several PROs are at physicians' disposal including,
367 for example, the multidimensional health assessment questionnaire (MDHAQ), the routine
368 assessment of patient index data 3 (RAPID-3) [1], and the rheumatoid arthritis impact of disease
369 (RAID) [46]. They all have been developed to be used during, or prior to, face-to-face consultations
370 but they are generally well suited for adoption in telerheumatology [11,27,28].

371 A few studies have started to evaluate the potential of e-PRO in rheumatology management
372 highlighting a better communication between patients and rheumatologists, a saving in terms of
373 time and money, a greater autonomy of patients with both more control and flexibility on the side
374 of patients and rheumatologists [39,47–49]. In addition, this remote monitoring system allows for
375 routine patient follow-up, not just during relapses. The possibility of having a continuous record of

376 the patient's information facilitates the sending of clinical data to another health care provider if
377 the patient changes specialist, and above all, allows rheumatologists to carry out the Treat-to-
378 Target (T2T) approach by distinguishing more precisely between a disease flare and an insufficient
379 response to treatment [49]. According to a 2019 study led in Germany, 49% of German
380 rheumatologists surveyed use medical apps in their clinical routine [50], with several mobile apps
381 offering ePRO services already existing [49–51].

382 However, rheumatologists are concerned that the use of ePROs for monitoring will induce a need
383 for additional and already scarce resources. The possibility of delegating ePRO monitoring to
384 rheumatology nurses has been cited as a potential solution to offload specialist physicians [47].
385 Also, patients may feel some pressure due to the increased responsibility for monitoring their
386 symptoms, relapses, and disease activity [47]. Adequate training of staff and patients in ePRO
387 management and collection and reimbursement would promote widespread use of ePROs in
388 clinical routine and allow the full potential of ePROs to be realized [49].

389 Besides, other composite measures of disease activity and functional status can be adapted to the
390 use of telerheumatology, where patients can be trained or are able to evaluate their own swollen
391 and tender joint counts by self-examination [1,52,53]. According to the American College of
392 Rheumatology (ACR), disease activity measures (PAS-II, RAPID3) and functional status measures
393 (HAQ-II, MDHAQ, PROMIS PF-10) based on patient-reported outcomes require minor modification
394 for use in a rheumatology teleconsultation. Formal joint counts (CDAI, DAS28-ESR/ CRP, and SDAI)
395 can be measured by the patient counting the number of swollen and tender joints. In the context of
396 telerheumatology, it has been suggested that patients with a RAID score <2 would have achieved
397 the DAS-28 treatment goal [23]. The validity of these measures has yet to be evaluated. The
398 collection of electronic medical records and mobile applications could facilitate the use of these
399 measures in telemedicine [47,53].

400

b) Patient triage tools

As not all patients are suitable candidates for telerheumatology, efficient triage tools are needed to help rheumatologists to identify the patients who could benefit most from remote consultations. Kulcsar *et al.* [17] and the Arab League of Associations for Rheumatology (ArLAR) [7] have proposed a triage system for follow-up visits based on the complexity of diagnosis, clinical status, disease prognosis and treatment to be administered.

Some PROs can also be used as triage tools by providing high probability of whether or not the patient is likely to be in a remission or low disease activity state. For example, in a telerheumatology setting, nearly all patients reporting a RAID score of <2 would have attained a Disease Activity Score-28 (DAS-28) T2T goal [46].

c) Guidelines

To our knowledge, there are no guidelines for the implementation of telerheumatology specifically applicable to RA disease only. Thus, a broader perspective will be provided in this part of the review.

Official guidelines for the implementation of telerheumatology have been recently published, notably from the ArLAR[7], the BSR[32], the ACR [31], and the EULAR [54] all following the similar principles. The ArLAR [7] made recommendations to have a successful implementation of telerheumatology (**Table 1**) including, for example, the guarantee of patient confidentiality, the use of PROs tools adapted to teleconsultation and the capability for confidential prescribing for the patient through an electronic medical record system. Professional training in telerheumatology for medical staff is also recommended to ensure the best quality of care. In addition to these guidelines, the ArLAR has also developed a practical toolkit intended for health care professionals to help them in implementation of telerheumatology by providing advice on how to translate theory into practice in real-life settings and highlighting assessments relevant to the remote consultation.

427 Since the pandemic, the BSR [32] encourages implementation of telerheumatology as it is aligned
428 with the current challenges this medical specialty is facing. These guidelines are similar to those
429 proposed by the ArLAR, divided in 4 main topics: definition of a suitable patient profile for
430 telerheumatology; how to prepare for the consultation; how to conduct the remote consultation;
431 and how to document it.

432 The ACR [31] also published guidelines supporting telerheumatology implementation. In line with
433 other recommendations, these include the security of patient data and ongoing access to remote
434 consultation for appropriate patients beyond the pandemic setting. Other points of emphasis
435 include the potential for telerheumatology to improve access to care in certain situations and the
436 need for reimbursement equality between remote and face-to-face visits within the US healthcare
437 system so that patients and providers have a real choice between two recognized options in the
438 management of their disease.

439 As well, until the evidence accumulates, EULAR has formulated important principles and major
440 points to consider. These include aspects such as screening for rheumatic and musculoskeletal
441 diseases, preassessment in the referral process, disease monitoring and modification of medication
442 dosages and non-pharmacological interventions [54]. A study estimating the cost-effectiveness of
443 implementing EULAR recommendations for patients with RA starting new DMARD therapy using
444 remote monitoring stated that it is more effective and less costly than conventional monitoring
445 [55].

446 Moreover, some guidelines (the EULAR and the ArLAR in particular) have highlighted some of the
447 key barriers and facilitators to telerheumatology, providing rheumatologists with a practical toolkit
448 for implementing telehealth [7,54]. The EULAR provide suggestions on how the following barriers
449 could be resolved: patient reluctance, varying digital and health literacy skills, lack of access to
450 necessary equipment, no possibility of face-to-face clinical and instrumental examination, disease
451 burden, medical and psychological comorbidity, lack of health care provider training, lack of data
452 security, lack of approval for reimbursement from insurance companies (Table 2) [54]. The ArLAR

453 best practice guidelines recommend to inform the patient about how to prepare for a remote
454 physical examination, using appropriate educational materials [7].

455 Only few educational resources are available to teach rheumatologists about “webside manner”
456 i.e., appropriate practices or assessment methods in the context of a remote consultation [26].
457 Good verbal communication is essential during any clinical consultation, and even more so during a
458 phone call since the patients’ nonverbal communication cannot be observed. By listening carefully
459 and empathically, patients will feel heard and understood. A guide originally published by the
460 Association of American Medical College (AAMC) has been adapted by the American College of
461 Rheumatology (ACR) to define the specific telemedicine competencies needed in the rheumatology
462 specialty, regardless of clinician experience, to provide high quality of care through telehealth and
463 thus improve the management of rheumatic diseases [56–58]. Furthermore, the ArLAR and the ACR
464 developed a practical toolkit highlighting some of the key elements to facilitate implementation of
465 telehealth, for all learners, from medical students to practicing clinicians encouraging the
466 acquisition of telehealth skills and integration into their routine clinical practice [7,31]. The Royal
467 Australian College and a UK masterclass also developed general practical steps and communication
468 skills to deliver appropriate remote consultations before, during and after the telephone and video
469 consultations [59,60]. Therefore, it will be essential to develop training programs for appropriate,
470 effective, and safe use of telerheumatology [26].

471 To begin training, especially for new rheumatologists, a mix of face-to-face and remote
472 consultations supplemented by educational modules has been suggested to familiarise trainees
473 with remote assessment techniques related to RA management [10]. Telerheumatology training
474 should also incorporate the concept of triage in order to identify those patients with RA for whom
475 remote follow up is most appropriate.

476

5. What are the telerheumatology pros and cons?

a) Advantages

Telerheumatology has the potential to optimize RA management in many ways at different stages of the care pathway for patients, rheumatologists, and health care systems (**Table 2**).

Because active RA has a limited window of opportunity for early management, telerheumatology has a major role to play in optimizing disease outcomes by facilitating early adoption of T2T strategy (defined as a method of treatment associated with close monitoring, allowing treatment adjustment) [7]. It is also likely to support treatment adherence [7]. A lower rate of missed appointments for remote consultations has been highlighted, with a cancellation rate near zero during the pandemic, mainly explained by the barriers usually encountered by very ill or older patients having difficulties to travel [30].

Telerheumatology also improves the quality of care provided to patients with RA [21] by allowing closer disease monitoring [7]. Indeed, the introduction of teleconsultations between face-to-face visits, allows the detection of any change in symptoms or quality of life, monitoring of important outcomes such as joint swellings, disease flares or increase in pain levels [10], and closer monitoring of therapeutic response and treatment adjustment if needed [5,21,61]. The provision of greater flexibility in terms of the number and frequency of follow-up visits also contributes to improved quality of care [62].

In addition, telerheumatology is considered to be one of the most expeditious solutions to provide greater access to care and to address a shortage of rheumatologist specialists [23], especially in remote areas [14,20] where it offers equality of care comparable to urban areas and reduces waiting lists for rheumatology consultations [62].

Furthermore, telerheumatology is well positioned to improve and facilitate patient-rheumatologist communication by providing a rapid response to self-reporting of flares by patients [9]. At the same

501 time, this approach allows prioritisation of in-person appointments thereby potentially bringing
502 forward the next office visit where needed [21,62].

503 Telerheumatology can also circumvent some of the practical constraints associated with continuity
504 care [9,14,16,63]. For many patients, it is easier to make appointments and renew prescriptions
505 though teleconsultations. Fewer in-person visits save not only time away from work but also money
506 through reduced travel costs [21,30].

507 Telerheumatology could also be beneficial to improve patient engagement and autonomy of self-
508 management for rheumatic diseases, particularly in RA, as mentioned by the EULAR [4,64].

509 In addition, teleconsultation can reduce the risk of infectious exposure during in-person visits for
510 immunocompromised patients [63].

511

512 b) Limitations

513 Telerheumatology use is also associated with some limitations (**Table 2**), restricting its
514 implementation.

515 Among the barriers identified, the lack of physical examination during a remote consultation is
516 often mentioned [5]. Rheumatologists may perceive telerheumatology as an imprecise [19] and
517 uncertain tool [21] which could be associated with difficulties in recognizing symptoms from both
518 specialists and patients, in evaluating their condition [5], and detecting nonverbal signals
519 [10,19,21,26]. This could lead to incorrect diagnosis or inappropriate disease management. [21].

520 Some specialists may also have some doubts regarding the implementation of telerheumatology in
521 their daily practices, given the lack of validation of its clinical efficacy outcomes [27]. As such, the
522 other major limitation that is highlighted by this discussion is the lack of widespread accessibility of
523 formal training in telerheumatology delivery for health care providers and patients, who indicated
524 that there is a lack of information and knowledge about telemedicine devices [1,19,21].

525 The barriers that were often mentioned also include the need for patients to have the necessary
526 technological equipment (for example, computer, webcam, telephone with a front camera and a
527 stable wi-fi connection,) available at home. These requirements may highlight technological
528 disparities between patients and thus increase inequalities in access to care in some settings
529 [1,2,62]. In particular, elderly patients may be less familiar with more modern technologies. The
530 patients with difficult financial status also may find it difficult to obtain a private space to discuss
531 personal information, especially since many family members may share the same household [2,26].

532 Practical challenges can have a negative impact on telerheumatology consultation and wider
533 implementation. These include technological limitations of the telemedicine device used, such as
534 video quality [10], poor technology design [11] or poor voice transmission [10,26] but also logistic
535 challenges in organization of remote consultations alongside face-to-face visits within clinical
536 routines and in some settings, a lack of appropriate digital infrastructure. Concerns about the
537 security and confidentiality of patients' medical and personal data are also a well-identified issue
538 [21].

539 Reimbursement and regulatory barriers may also impact implementation of new technology and
540 practices as may occur when there are inadequate remuneration mechanisms for the health care
541 provider [10,11,14,21,26]. Crossing state lines to expand the workforce to fill the rheumatologist
542 gap and provide access to care for underserved communities may also be a limitation to successful
543 implementation of telerheumatology [65].

544 In addition, the implementation of remote consultations has been shown to have a deleterious
545 effect on clinical trials, particularly on patient recruitment. Determining their eligibility for a clinical
546 trial becomes more difficult, as measurements must be done in a face-to-face visit [66].

547 Thus, although telerheumatology holds promise as a beneficial opportunity for patients,
548 rheumatologists and health care systems in many respects, it is essential to take into consideration
549 these current limitations and propose solutions that will help improve and facilitate its
550 implementation whenever possible.

552 **6. Future perspectives about telerheumatology and experts' opinion**

553 Given the current shortage of rheumatologists, telerheumatology has been proposed as one
554 solution for improving access to health care by redistributing a scarce resource more efficiently and
555 homogeneously and thus reinforcing the attractiveness of rheumatology specialization for trainee
556 physicians [22]. Telerheumatology is also seen as a new learning tool for general practitioners to
557 improve and facilitate communication and coordination with rheumatologists [62]. However, the
558 rapid expansion in use of telerheumatology experienced during the COVID-19 pandemic has shown
559 that some aspects of this mode of health care still need to be addressed so it can be more
560 effectively used in daily clinical practice. The innovative management of RA through remote
561 consultations established at the international level by several learned societies must be developed
562 and supported at the national and local levels [1].

563 To enable the enduring use of telerheumatology and establish its place in future practices, training
564 of health care providers will be a key element [68] and a viable reimbursement system will be
565 essential and require associated adaptations to national economic and governmental policies [14].

566 Digital health innovations such as ePRO applications promise to facilitate the achievement of
567 personalised treatment goals and improve quality of care by creating a patient/specialist interface
568 to track symptoms of patients with RA and inform specialists of ongoing disease activity
569 [41,47,48,69]. Furthermore, a dedicated, highly secure platform, subject to strict regulatory rules, is
570 generally a requirement in order to conduct telerheumatology assessments and preserve medical
571 confidentiality and privacy [7,31,32]. The adoption of these tools by both patients and
572 rheumatologists will depend on the validation of efficacy data and how they are integrated into
573 clinical routine. Pilot studies have highlighted some positive points as less time spent on patient
574 histories and more on discussing their concerns and actual outcomes measured over time making
575 their assessment more accurate [48]. However, barriers to their acceptance have also been cited,
576 including lack of knowledge about appropriate computer software or applications for ePRO, ease of

implementation, price and reimbursement rate of this tool [49]. Studies evaluating the effects of using ePRO applications on these endpoints are needed in the future.

Despite the overall satisfaction and high level of adoption of telerheumatology since the COVID-19 pandemic began, telerheumatology is not intended to replace face-to-face visits [5,8,21], but rather as a bridge between periodic face-to-face consultations. These can be integrated into service delivery as a means of support to increase the availability of follow-up appointments while reducing the number of face-to-face visits and so decongesting hospital outpatient services and clinics [43,63]. Given current needs and challenges within the specialty, we do not need to depend on face-to-face visits only. It is anticipated that in-person outpatient rheumatology care will be managed with a different approach, including by patient-empowering remote consultations [43,69,70].

Telerheumatology consultations have rapidly evolved to have a valuable place in daily clinical practice, and should continue to play an important role in the management of patients with RA after the pandemic [26]. To secure its place in the coming years, patient triage to detect profiles suitable for telerheumatology, and the development of training programs and appropriate teaching materials for both practitioners and patients will be essential elements in ensuring its continued use in routine clinical practice.

7. Conclusion

Over the past two decades, conventional management of RA has been profoundly transformed by the emergence of many new therapeutic alternatives, and the increasing number of patients in sustained remission who still require outpatient review and care. However, there are considerable pressures on outpatient services and availability of clinic appointments and this is exacerbated by a shortage of rheumatologists. Telerheumatology is proving to be an approach that meets the new needs in this specialty, well accepted by both RA patients and rheumatology providers. The enhancement of the T2T approach with frequent and efficient disease monitoring, improved access

to specialty care, prioritization of available face-to-face clinic appointments for those with the most urgent needs, as well as great flexibility, make it an indispensable tool for the future of rheumatology care. Patient triage, telerheumatology training programs and appropriate teaching materials for both practitioners and patients will be key elements to optimize its use in long-term clinical practice.

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Conflict of interest

The authors have no conflict of interest to declare.

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9. Figures legends

Figure 1: Publication characteristics of selected studies (n=69)

A. Publication dates

The eligible publications have been published between January 1st,2015 and September 30th,2022. Of the 69 selected, 51 were published during the COVID-19 pandemic period (between 2020 and 2022).

B. Countries of publication

Of the 69 selected publications, 57 were mono-country studies (the United states (n=20); the United Kingdom (n=9); Canada (n=2); Australia (n=2); Italy (n=5); Germany (n=5); France (n=4); Norway (n=4); Spain (n=1); Switzerland (n=1); Denmark (n=1); Austria (n=1); Portugal (n=1); the Netherlands (n=1); and 12 were multi-country studies.

C. Publication types

The included publications were different types: reviews (n=23), survey studies (n=6), observational/qualitative studies (n=9), editorials/commentaries (n=6), Proof-of concept Study (n=1), mixed method studies (n=2), exploratory studies (n=3), randomized controlled trials (n=7), an ancillary study (n=1), cross-sectional studies (n=2) and guidelines publications (n=9).

Figure 2: Population characteristics of selected studies (n=69)

The 63/69 (92%) eligible publications analyzed rheumatoid arthritis adults in general living in mixed environments, 4/69 (5%) studies (described patients living in rural communities, and 2/69 (3%) studies focused on telemedicine experience from the rheumatologists' perspective.

RA: Rheumatoid arthritis

Table 1: The ArLAR best practice guidelines for telerheumatology

The Arab league of Associations for Rheumatology (ArLAR) made 11 recommendations for the implementation of telemedicine in rheumatology:

(1) informed consent from the patient; (2) guarantee of confidentiality to the patient; (3) transcription of the rationale for the telerheumatology and authorization to access the medical file; (4) free choice of the remote consultation option by the patient; (5) provision of appropriate educational materials to prepare the patient for telemedicine; (6) use of PRO tools adequate to telemedicine according to the rheumatologist in order to measure disease activity and functional status of the patient (which can be assessed prior to the telemedicine consultation by the RA patients themselves); (7) confidential prescription to the patient via an electronic medical record system; (8) determination of fees and reimbursement terms prior to the telemedicine consultation and communication of it to the patient; (9) compliance with ethics, applicable local laws and regulations; (10) professional training of the medical staff (rheumatologists, nursing staff) in telemedicine; (11) improvement of the local technical infrastructures to ensure equitable access to telemedicine.

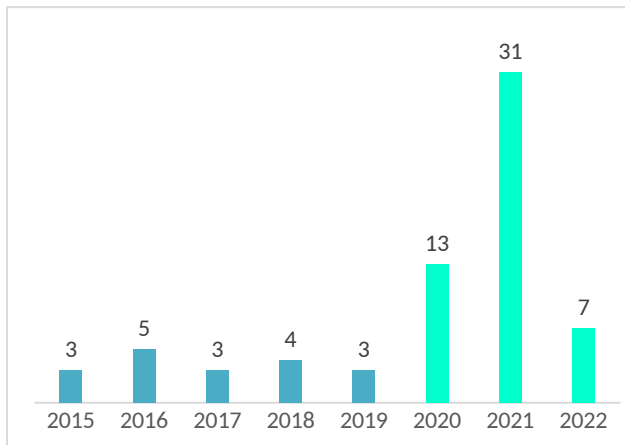
Table 2: Telerheumatology pros and cons for the patient and the rheumatologist

Telerheumatology pros and cons of the publications included in this present review have been combined in this table. Telerheumatology showed some benefits for both patients and rheumatologists. It offers greater access to health care with more flexibility and responds to the rheumatologists shortage issue. But some barriers to its implementation need to be considered, such as the absence of physical examination and the need of technological equipment.

10.Figures

Figure 1: Publication characteristics of selected studies (n=69)

A. Publication dates



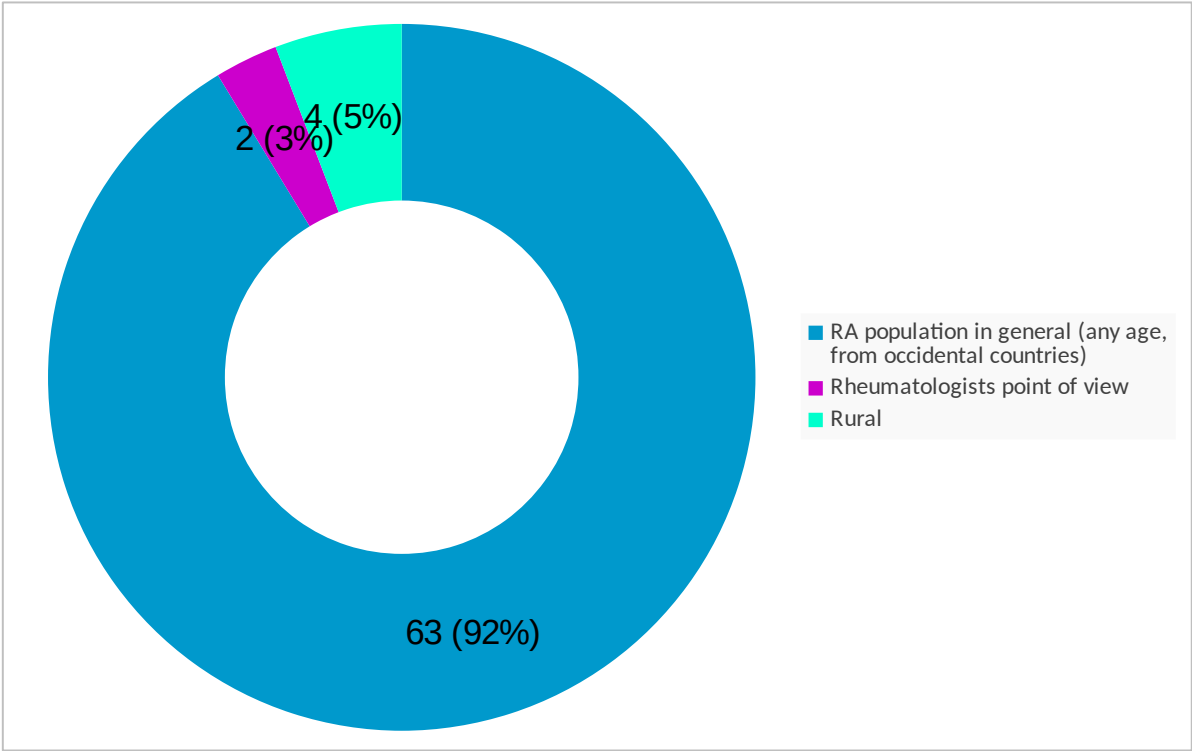
B. Countries of publication

	Number of publication
Single country (n=57)	
United States	20
United Kingdom	9
Canada	2
Australia	2
Austria	1
Italy	5
Germany	1
Spain	1
Switzerland	1
France	4
The Netherlands	1
Norway	4
Reviews	23
Editorial, Commentary	6
Observational/Qualitative	1
Mixed method studies	2
Randomized controlled trials	7
Survey studies (questionnaires/interviews)	1
Guidelines	3
Exploratory studies	1
Ancillary study	3
Cross sectional study	1
Proof-of concept Study	1
Singapore, India	1
Switzerland, USA, Germany	1
Brazil, France, UK, USA	1

C. Publication types

Reviews	23	1
Editorial, Commentary	6	1
Observational/Qualitative	Multi-country (n=12)	
Mixed method studies	2	1
Randomized controlled trials	7	1
Survey studies (questionnaires/interviews)	1	1
Guidelines	3	1
Exploratory studies	1	3
Ancillary study	2	1
Cross sectional study	1	1
Proof-of concept Study		

893 **Figure 2: Population characteristics of selected studies (n=69)**



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896 **Table 1: The ArLAR best practice guidelines for telerheumatology [7]**

ArLAR best practice guidelines for telerheumatology	
1.	Informed consent from the patient
2.	Guarantee of confidentiality to the patient
3.	Transcription of the rationale for the telerheumatology and authorization to access the medical file
4.	Free choice of the remote consultation option by the patient
5.	Provision of appropriate educational materials to prepare the patient for telemedicine
6.	Use of PRO tools adequate to telemedicine according to the rheumatologist in order to measure disease activity and functional status of the patient (which can be assessed prior to the telemedicine consultation by the RA patients themselves)

7. Confidential prescription to the patient via an electronic medical record system
8. Determination of fees and reimbursement terms prior to the telemedicine consultation and communication of it to the patient
9. Compliance with ethics, applicable local laws and regulations
10. Professional training of the medical staff (rheumatologists, nursing staff) in telemedicine
11. Improvement of the local technical infrastructures to ensure equitable access to telemedicine

897 ArLAR: Arab league of Associations for Rheumatology; PRO: patient reported outcome; RA: rheumatoid
898 arthritis

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900 **Table 2: Telerheumatology pros and cons for the patient and the rheumatologist**

	Advantages	Limits
For the patient	<ul style="list-style-type: none">• Increase the number and the frequency of follow-up consultations• Improve access to care & equality• Waiting times reduction• Flexibility (personalized care and adaptation)• Travel saving• Economic saving• Additional tool for diagnosis, treatment, rehabilitation and follow-up monitoring• Protection from spreading infections	<ul style="list-style-type: none">• Loss of physical contact• Deterioration of the patient-doctor relationship• Patients' data security• Lack of technical equipment and information on digital services• Insecure feeling because of the lack of physical examination• Technology inequalities• Patient reticence to report symptoms• Culture and language barriers
For the rheumatologist	<ul style="list-style-type: none">• Effective allocation of resources in rheumatology• Increase treatment continuity (with disease monitoring & tight control of the disease)• Additional safety and support for close monitoring• Learning opportunity and a method to improve communication with the patient	<ul style="list-style-type: none">• Absence of physical examination• Practical challenges (organization in clinical routines, poor remuneration & lack of digital infrastructure)• Telemedicine could tie up additional time resources already scarce in rheumatology• Difficulty recognizing symptoms and estimating how the patient is doing (missing non-verbal cues)• Lack of training• Difficulty in reaching patients

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