Health Policy and Technology 12 (2023) 100730

Contents lists available at ScienceDirect

Health Policy and Technology

journal homepage: www.elsevier.com/locate/hlpt

Editorial

Harnessing the potential of digital rheumatology

ARTICLE INFO

Keywords
Digital
Telemedicine
Social media
Rheumatology

Introduction

Digital approaches are the new frontier in life sciences, and rheumatology is no exception. Like the fourth pillar of a democracy, digital medicine is here to connect, improvise, transform and revolutionize the delivery of healthcare. The gains from digital approaches in research, teaching and practice in rheumatology are closely entwined, and necessary to match the requirements and rapid pace of healthcare in the post pandemic period. Whilst telemedicine has by far emerged as the most popular and attractive facet of digital health for clinicians, collateral uptake of digitized Corporate models in day to day life in the population at large open up an entire realm of exciting possibilities in medicine [1,2]. The increasing lack of rheumatologists and global COVID-19 pandemic lead to an increasing adoption of digital and remote care options in rheumatology, resulting in the publication of the first official recommendations by the European League Against Rheumatism (EULAR) and the Arab League of Rheumatology [3–5].

In this brief, members of the digital rheumatology network (DRN) touch upon the various facets of digitized medicine while outlining the potential of a bright future of rheumatology with innovative partnerships between stakeholders.

Telemonitoring

In a recent multicentre study, rheumatologists from the UK, Netherlands and Italy have been working on digitally supported monitoring strategies to optimize face-to-face visits while maintaining optimal disease control and safety [1]. In this landmark randomized controlled trial (RCT) Seppen et al. demonstrated that app supported patient-initiated follow-up (PIFU) in rheumatoid arthritis (RA) patients was safe and led to a 38% reduction of consultations, supporting promising results from a previous study by de Thurah et al. [6]. Piga et al. showed that patients that need treatment adjustments could be identified with highly reliability using virtual video consultations [7]. Knitza et al. could recently demonstrate that capillary self-sampling is well accepted among RA patients and provides reliable remote serology results [8].

Digital therapeutics

As for digital therapeutics (DTX), landmark studies showing robust evidence on efficacy and safety for rheumatic diseases are still lacking. Similar to other fields, mechanisms of DTX cover lifestyle modification, cognitive behavioural therapy or patient reported outcome monitoring. In some applications, integrated health coaches support the online program via a messenger service or phone calls. Catella et al. showed efficacy of a digital behavioural therapy for fibromyalgia management. In systemic lupus erythematosus, a DTX plus tele-health coaching intervention showed a clinically meaningful improvement in 50 patients [9]. Digital health applications (DIGAs) can be prescribed for musculoskeletal disorders such as osteoarthritis and chronic pain symptoms, but not for immune-mediated diseases such as rheumatoid or psoriasis arthritis yet [10]. At the moment, non-prescribable apps, partly in collaboration with the pharma industry are in process. Leipe reported discrepancies in ratings from patients versus health care professionals and highlights the importance of involving patients when developing and evaluating DTX.

The user experience will play a more important role in the future to improve the adherence and effectiveness of DTX. Here, the first studies are currently being conducted. Interoperability between apps and electronic records remains a major challenge. Although technically possible, it has currently not been deployed on a large scale.

Artificial intelligence / machine learning

Furthermore, artificial intelligence (AI) is gaining a lot of momentum. In rheumatology AI can represent a step towards precision medicine, leading to the improvement of patient profiling and treatment personalization [11]. New knowledge is constantly being created from clinical, laboratory and imaging data through machine learning (ML)

https://doi.org/10.1016/j.hlpt.2023.100730

Available online 16 February 2023
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algorithms which have potential to predict the individual course of a patient's disease, recognizing clinical phenotypes and automatically identifying radiological damage. Automated image recognition and disease classification through computer vision in inflammatory arthritis are the most advanced;in this regard, ML deployment on imaging data might be very helpful to support or double-check the imaging diagnosis. Folle et al. were able to demonstrate that state-of the-art algorithms such as convolutional neural networks (CNNs) were useful for the classification of hand MRI imaging [12]. For instance, the algorithm was able to identify disease-specific hot spots and to differentiate between seropositive RA and seronegative RA as well as between psoriasis arthritis. Another interesting publication by Bressem et al. showed that CNNs achieved expert-level performance in two large cohorts for the detection of radiographic sacroiliitis [13]. The colleagues also offer a DeepSpA Tool where you can freely use this AI tool to get an assessment on pelvic x-ray imaging. Not only can CNNs process DICOM data but also there is potential to automatically grade synovitis according to the widely-used Krenn's score directly on Hematoxylin and Eosin-stained slice microphotographs from synovial biopsy [14]. Recently, a deep learning algorithm has been presented that differentiates swollen from non-swollen joints in RA patients based on their dorsal finger fold pattern [15]. By predicting different grades of joint swelling and automated monitoring of metrical measurements, image recognition can also be used as a digital biomarker.

Chatbots

Chatbots are among the most intriguing implementations of AI in everyday life. Medical chatbots are ML-powered conversational solutions that help patients and healthcare providers easily connect. Chatbots have the potential to address many of the current concerns regarding the care of patients with rheumatic diseases. In particular, they may help achieve the triple aim of modern healthcare systems that encompasses improving citizens' health, enhancing patients' experience, and reducing *per capita* costs. Chatbots can improve the quality or experience of care by providing efficient, equitable, and personalized medical services. With proper algorithm training, they could serve as intermediaries between physicians for facilitating the history-taking of sensitive and intimate information before consultations. They could also be considered decision aids that deliver regular feedback on disease progression and treatment reactions to help management. Physical, psychological, and behavioral improvements in vulnerable populations may even be possible through chatbots for 24/7 assistance and health promotion, such as lifestyle coaching, healthy eating, and smoking cessation. While chatbots are no substitute for human critical thinking and high-level interactions, chatbots may emerge as a socially responsible technology to provide equal access to quality healthcare [16].

Social media

The wider use of social media has opened the realm of informatics and geosensed analytics into the public domain. The pandemic saw their use in exploring population health, active concerns, and even preempting serial waves of COVID-19 by analysing public behavior [17–19]. Further multimodal crowdsourcing of social media analytics using videos, images and texts allow storytelling of urban emergency events, bringing in potential for hidden intelligence to be deployed for anticipatory governance measures [20]. Social media platforms are also increasingly being utilized for patient education, trainee support, collaborative work and disseminating new observations work [21–23]. The challenge of current times is channelling an emerging *infodemic* into a streamlined source of valid and credit information using available technologies and collaborative efforts of various stakeholders [24,25].

We fully acknowledge that this editorial is mostly techno-centric and leaves out the social, policy, equity and ethical considerations that are essential for harnessing the potential of digital health. As healthcare evolves to seamlessly incorporate digital approaches and therapeutics, considerations for data protection, public surveillance and human rights assume greater importance for end points beyond health [25,26].

Conclusion

Digital rheumatology is constantly developing in all areas in order to sustainably improve patient care and to make the work of rheumatologists more efficient and safer. The possibility of solutions for real clinical problems is overwhelming. In the area of efficacy and safety, initial studies give confidence. Adoption of these digital solutions by both patients and health care professionals is the biggest challenge for the near future.

Funding support

None.

Ethical approval including consent

Not applicable.

Acknowledgements

None.

Declaration of Competing Interest

None.

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Latika Gupta[a,b,c,*], Martin Krusche[d], Vincenzo Venerito[e], Thomas Hügle[f], on behalf of the Digital Rheumatology Network
[a] *Department of Rheumatology, Royal Wolverhampton Hospitals NHS Trust, Wolverhampton, United Kingdom*
[b] *City Hospital, Sandwell and West Birmingham Hospitals NHS Trust, Birmingham, United Kingdom*
[c] *Division of Musculoskeletal and Dermatological Sciences, Centre for Musculoskeletal Research, School of Biological Sciences, The University of Manchester, Manchester, United Kingdom*
[d] *Division of Rheumatology and Systemic Inflammatory Diseases, University Hospital Hamburg-Eppendorf (UKE), Hamburg, Germany*
[e] *Rheumatology Unit, Department of Emergency and Organ Transplantations, University of Bari Aldo Moro, Bari, 70121, Italy*
[f] *Department of Rheumatology, University Hospital Lausanne (CHUV) and University of Lausanne, Switzerland*

[*] Corresponding author at: Department of Rheumatology, Royal Wolverhampton Hospitals NHS Trust, Wolverhampton, WV10 0QP, United Kingdom.
E-mail address: drlatikagupta@gmail.com (L. Gupta).