

Role of technology-based innovation in chronic disease management in rheumatology

Tanguy Guillotin, Alain Saraux 

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Global innovation is expanding rapidly, fuelled by the ongoing development of various communication and data sharing tools. This revolution can also be seen in the creation of specific databases, the result of collaboration between numerous experts from all over the world, representing different nationalities and medical specialities. A striking example of this dynamic is the exponential growth in citations on PUBMED, which currently stands at 36 million, demonstrating a remarkable acceleration in the field of research. In this profusion of research activities, certain medical specialities stand out for their significant involvement.

Cardiology, for example, has 525 819 results on PUBMED, closely followed by pneumology with 351 998 results and rheumatology is holding its own with 181 828 results. These impressive figures demonstrate the extent of the efforts made by these disciplines to push back the boundaries of medical knowledge. However, at the heart of this wave of medical innovation lies a crucial question: what about innovation in the management of chronic diseases in rheumatology?

Rheumatic diseases, which are often chronic and disabling, require special attention from medical research. While rheumatology is registering a large number of results on PUBMED, it is essential to develop specific advances in the monitoring and management of rheumatic diseases. Developments in technology offer unprecedented opportunities to transform the management of chronic diseases in rheumatology.¹ From mobile applications that help patients track their symptoms to connected medical devices that enable continuous monitoring, innovation is on the march.^{2–5} What's more, the collection and analysis of massive amounts of data is opening up new opportunities to understand the complex patterns of these diseases and tailor more personalised treatments.

A GREAT DEAL OF RESEARCH IS UNDERWAY TO CONTINUE IN THIS DIRECTION, BUT WHAT REALLY EXISTS IN RHEUMATOLOGY FOR PATIENTS AND DOCTORS TODAY?

In recent years, several applications have been developed to make it easier for doctors to carry out consultations, in particular by providing dosage reminders for treatments. These applications have evolved into comprehensive tools.^{6 7}

A plus for the patient

They now provide an integrated calendar of upcoming consultations, and some even enable direct communication with the health-care team, promoting optimum continuity of care. To remedy the frequent failure to comply with treatment, particularly among patients with chronic illnesses, these applications offer the possibility of recording details of treatment and dosages. They also send reminders indicating the precise time each drug should be taken. Patients can also indicate their side effects using questionnaires integrated directly into the application. In addition, some apps can synchronise with devices such as Fitbit to display data on physical activity, sleep and stress levels.⁸ This information helps with monitoring. It is also an opportunity for patients to highlight correlations between their medication intake and clinical symptoms or personal experiences, such as fatigue or stress, which trigger an inflammatory flare-up. In this way, patients can play a more active role in medical decisions and become more involved in their care. Pain management is a fundamental aspect of the treatment of chronic diseases, and is naturally aligned with global assessments of individuals using questionnaires. These questionnaires, which focus on inflammatory symptoms such as morning stiffness, waking up in the middle of the night and swollen joints, are currently entered manually into these applications. In



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Rheumatology, CHU Brest, Brest, France

Correspondence to

Dr Alain Saraux;
alain.saraux@chu-brest.fr

order to ensure comprehensive, ongoing care, a series of recommendations aimed at improving quality of life is available. These recommendations cover a range of aspects, including suggestions for home improvements to create an environment conducive to good health. Lifestyle advice is also given, in areas such as physical activity, nutrition and sleep. With regard to physical activity, personalised suggestions based on the patient's state of health are provided, encouraging appropriate exercises to maintain mobility and strengthen muscles without exacerbating symptoms. At the same time, solutions such as meditation are incorporated to prevent stress, recognised as a factor likely to aggravate pain in people with chronic illnesses. Numerous articles are available to improve the understanding of the disease, providing detailed explanations and medication advice for potentially risky events, such as an injury, an upcoming dental appointment or forgotten medication.⁹ These resources offer clear, practical information to help patients make informed decisions and manage their health effectively in specific situations.

This holistic approach aims to provide patients with practical tools and personalised advice to improve their quality of life in a variety of ways, taking into account the complexity of the challenges associated with chronic diseases in rheumatology.

An asset for professionals

These dedicated rheumatology applications are specifically designed for professional use, offering healthcare teams full remote access to various health parameters. This includes quality of life surveys, specific questionnaires and possibly a messaging function for direct communication with patients.^{10–13} With these features, practitioners can potentially conduct remote consultations based on reassuring health parameters, reducing the time spent by patients in an already demanding hospital environment. These applications go beyond remote monitoring and offer significant advantages during face-to-face consultations. They facilitate access to various diagnostic and monitoring tests, such as the DAS28 (Disease Activity Score), the ASDAS (Ankylosing Spondylitis Disease Activity Score) and the PASI (Psoriasis Area and Severity Index). These tools are essential for assessing disease activity or progression and treatment efficacy. Built-in auto-calculation features simplify the assessment process and data entry is streamlined, contributing to more efficient information gathering. In addition, these applications provide instant diagnostic probabilities, enabling healthcare professionals to make quick and informed decisions during consultations.

Crucially, these applications offer centralised access to the latest medical recommendations, age-specific dosages, information on chronic diseases and contraindications. This centralised management of data improves the overall coordination of treatment and contributes to a more effective, personalised approach to the care of patients suffering from rheumatic diseases.

WHAT ARE THE TECHNOLOGICAL CURRENT LIMITATIONS AND AREAS FOR IMPROVEMENT IN APPLICATIONS DEDICATED TO RHEUMATOLOGY?

At present, although a significant amount of data is collected manually, most rheumatology applications do not yet have the capacity to automate this information. The few applications that incorporate data from sensors, once synchronised, are often presented in raw form without any in-depth analysis of sleep, heart rate, stress, gait analysis or daily physical activity. A major advance in rheumatology would be to integrate algorithms capable of interpreting this data in the specific context of each patient. This would include lifestyle habits, medical condition and optimised state under treatment, enabling early detection of potential disease progression. This preventive approach could pave the way for early therapeutic adjustments, avoiding harmful developments that could have lasting consequences. For patients suffering from rheumatic diseases, the ideal scenario would be to design innovative solutions enabling automatic and less intrusive monitoring for the patient while providing more objective data. These solutions could involve analysing parameters reflecting joint mobility, morning stiffness, night-time awakenings and signs of inflammation. To do this, data captured by smartphone accelerometers and gyroscopes could be exploited, or sensors could be integrated directly into connected wearable devices. In other medical fields, such as endocrinology and pneumology, intelligent sensors dedicated to specific pathologies have already been developed.¹⁴ These devices provide crucial information for remote monitoring, offering a global view of the evolution of the pathology in the daily context of the patient, a perspective often inaccessible during a traditional consultation. The application of similar advances in rheumatology could not only improve the accuracy of monitoring, but also further personalise treatments for patients with chronic diseases, paving the way for more effective, tailor-made care.

It is undeniable that current solutions have benefited from digital advances, the development of specialised medical applications and the democratisation of medical knowledge, offering greater support and understanding to patients. However, despite these significant advances, it is crucial to note that these applications do not fully exploit the latest major advances, particularly when it comes to the integration of artificial intelligence. Although we currently have the ability to collect data automatically, continuous analysis is lacking. In this context, the integration of artificial intelligence into these programmes could revolutionise the monitoring of patients at home, by offering continuous and personalised monitoring, focused on the specific evolution of each individual's chronic disease.

WHAT ARE THE LIMITS FOR THE USE OF TECHNOLOGY-BASED INNOVATION IN ROUTINE PRACTICE?

Some limits of these new tools should be discussed:

- ▶ The mobile applications currently require a minimum level of computer knowledge and do not function independently. It is therefore difficult to envisage offering them as they stand to the elderly.
- ▶ They can provide insight into disease impact by remotely monitoring patient-reported outcomes but might make patients overly attentive to symptoms. This point justifies a trial to study both effectiveness but also feasibility and possible negative effects of remote symptom monitoring.¹⁵
- ▶ There is lack of real-world data regarding patient engagement with eHealth tools for remote monitoring in chronic arthritis. Future studies should use standardised measures of engagement in a daily practice setting to demonstrate the feasibility of their use.¹⁶
- ▶ We also need scientific validation of these tools, moving from promising tools to validated tools that improve the symptoms of individual patients and not only cohorts of patients.
- ▶ Last, but not least, both the economic model and cost-effectiveness of the tools remain the major limits for their dissemination.

HOW SUM UP INNOVATION IN THE MONITORING OF CHRONIC DISEASES IN RHEUMATOLOGY?

In this age of information technology, it is imperative, whatever the medical specialty concerned, to evolve by adapting medical practices. Rheumatology currently has several promising tools at its disposal and is fully embracing these digital advances.

However, there are still several challenges to overcome before we have a complete, autonomous tool for the long-term monitoring of rheumatological diseases in the home.

X Alain SarauX @alain.sarauX

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ORCID iD

Alain SarauX <http://orcid.org/0000-0002-8454-7067>

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