

Mobile health: Is your next rehabilitation's specialist in your pocket?

Kim Daniels^{1,2}, Farooq Azam Rathore³, Bruno Bonnechère^{4,5}

Abstract

The past few decades have witnessed an unprecedented surge in health-related mobile applications. However, most of these applications primarily focus on lifestyle domains such as sleep, fitness, and nutrition. A notable stride in this landscape involves the emergence of applications catering specifically to rehabilitation needs. This expert review aims to provide an encompassing overview of the wide spectrum of apps available for both assessment and rehabilitation. It delves into the existing constraints associated with these tools and deliberates on the potential avenues for future advancements and integration for future advancements and integration. The transformative potential of this mobile, affordable, and user-friendly technology in reshaping the field of rehabilitation sciences will be highlighted. This article underscores how harnessing these innovations can elevate accessibility and effectiveness in the rehabilitation processes, leading to improved overall outcomes and well-being.

Keywords: mHealth | rehabilitation | smartphone | technology | telerehabilitation | mobile applications

DOI: <https://doi.org/10.47391/JPMA.24-21>

Background

The introduction of mobile devices into the global market has brought about a revolutionary transformation in healthcare and rehabilitation sector.¹ Mobile phones have emerged as the most popular technology among the available mobile devices. The ubiquity of mobile phones transcends economic boundaries, reaching not only high-income countries but also extending their grasp to developing nations. This penetration is particularly pronounced in low- and middle-income countries (LMICs), showcasing substantial mobile phone subscription rates.

Recent strides in mobile technology, coupled with the proliferation of smartphone applications (apps), have

¹Department of PXL–Healthcare, PXL University of Applied Sciences and Arts, Hasselt, Belgium; ^{2,4}REVAL Rehabilitation Research Center, Faculty of Rehabilitation Sciences, UHasselt, Belgium; ³Armed Forces Institute of Rehabilitation Medicine (AFIRM), Rawalpindi, ⁵Technology-Supported and Data-Driven Rehabilitation, Data Science Institute, UHasselt, Belgium.

Correspondence: Farooq Azam Rathore. e-mail: farooqrathore@gmail.com
ORCID ID: 0000-0002-4759-0453

ushered in unprecedented opportunities to enhance patients' health and wellbeing. These apps, especially those in the field of mobile health (mHealth), have experienced significant growth in recent years, underscoring their potential as effective patient interventions.^{2,3}

Considering the global trend towards integrating mHealth apps into healthcare practices, it becomes imperative to comprehensively grasp their utility and implications in the field of rehabilitation, particularly in terms of assessment and intervention. This review aims to explore the use of mHealth apps in rehabilitation care, examining their benefits, limitations, and potential impact on patient outcomes. By addressing these areas of interest, we aim to contribute to a better understanding of the role of mHealth apps in rehabilitation and provide guidance for their responsible integration into clinical practice.

Evolution in mHealth in rehabilitation

The term "mHealth", as defined by the World Health Organisation, refers to a 'medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices'.⁴ In recent years, mHealth has undergone significant evolution, catalysed by the introduction of smartphones in 2007, and has profoundly impacted the field of rehabilitation.⁵

One notable development is the emergence of remote patient monitoring as a vital component of mHealth in rehabilitation. This approach leverages wearable sensors, either embedded in smartphones or external devices, to collect objective data on patient movements and activities.⁶ Advancements in sensor technology have also contributed to the development of more sophisticated external wearable devices that can now monitor various aspects of rehabilitation, including muscle activity, joint movement, stress level and balance.

Telerehabilitation has also gained prominence as a remote delivery method for rehabilitation services, facilitated by telecommunication technologies that enable real-time communication and interactive sessions between patients and therapists.⁷ To enhance patient engagement gamification, exergaming and virtual reality have occurred as effective approaches. Mobile apps and wearable devices incorporate game-like elements and interactive interfaces, making exercises enjoyable and motivating for patients.⁸

Furthermore, the integration of artificial intelligence and machine learning algorithms into mHealth solutions has further advanced rehabilitation practices. These technologies facilitate analyzing large datasets, predicting patient outcomes, and providing personalised treatment recommendations.⁹ Moreover, virtual assistants and chatbots equipped with natural language processing capabilities have provided patients with instant access to information, guidance, and support throughout their rehabilitation process.

Benefits of mHealth in rehabilitation

mHealth offers numerous benefits in the context of rehabilitation, with a strong potential to optimize patients' outcomes. One major advantage lies in the ability to remotely monitor patients' progress, enabling healthcare providers to track their rehabilitation outcomes in real-time. This capability allows for timely adjustments to treatment plans, which is particularly advantageous for individuals in rural or underserved areas. By reducing the frequency of in-person visits, mHealth technology improves access to rehabilitation services, enhances patient care, and has the potential to yield substantial cost reductions.⁶ Consequently, it emerges as a viable solution for enabling patient access to rehabilitation services, particularly in LMICs where there is a shortage of rehabilitation specialists or when long distances pose challenges to reaching healthcare centres. Leveraging mHealth tools such as remote consultations, mobile applications for self-guided exercises, and digital health monitoring systems empowers patients to receive necessary rehabilitative care. This approach not only leads to improved patient outcomes but also offers opportunities to streamline healthcare delivery and reduce associated expenses.

In addition, apps and wearable devices provide interactive platforms that offer personalised feedback, reminders, and educational resources. These technologies make exercises more engaging, increasing patient motivation and compliance with treatment plans.³

Furthermore, mHealth facilitates the collection of objective data, such as range of motion, heart rate, and step count. This data can be later analysed to identify trends, patterns, and potential issues. Healthcare professionals can then make data-driven decisions and provide targeted interventions, improving the effectiveness of rehabilitation treatments.

Challenges and barriers to adoption and implementation

Despite the numerous advantages, presented above, and the rapid expansion of the mHealth app market, it is important to address several limitations.¹⁰ Many of these

apps lack comprehensive validation studies to ensure their efficacy and reliability. Translation from research to daily use is a key challenge for moving digital health approaches to scalable national programmes.² In addition, the majority of mHealth app primarily concentrates on lifestyle aspects such as sports, sleep, and diet. Consequently, there is a limited number of apps specifically designed to address the unique needs of individuals undergoing rehabilitation. This lack of attention and focus on rehabilitation currently limits the options available for patients and healthcare professionals seeking app-based solutions to assist in the rehabilitation process.

Another major hindrance is the recognition of mHealth apps as medical devices. The COVID-19 pandemic has triggered a notable surge in the acknowledgment of mHealth, bringing about a significant acceleration in its adoption.² However, it is crucial to revise the nomenclature of mHealth interventions, as they are currently classified alongside drugs. This categorization creates challenges in terms of validating and reimbursing these interventions, and thus presents a significant impediment to the adoption of mHealth interventions, as the lack of reimbursement by the social security system, in the vast majority of countries, poses a substantial challenge. Furthermore, the degree of organization and integration of the healthcare system within the rehabilitation process exhibits country-specific variations, thereby adding to the intricate nature of this issue.¹¹

Technical considerations pose another challenge to mHealth intervention adoption. Integrating mHealth solutions with existing healthcare systems and ensuring interoperability between different platforms can be complex. Moreover, maintaining data security and privacy is critical but can also be technically demanding. The lack of standardized protocols and guidelines further complicates seamless connectivity and data exchange between different devices and systems.²

Also, user acceptance and engagement are vital for the success of mHealth interventions, but they often encounter resistance and concerns. Some individuals, particularly those with limited technological proficiency or older adults, may face difficulties adapting to mHealth tools.¹² Overcoming these challenges requires the development of user-friendly interfaces, provision of adequate training, and ongoing support.

One last barrier to overcome is the current limited evidence and research supporting the effectiveness of mHealth interventions in rehabilitation. Existing studies often suffer from small sample sizes, resulting in underpowered results.¹³ To gain the trust and support of healthcare

professionals and policymakers, it is imperative to conduct rigorous and comprehensive research. Expanding research efforts to establish the efficacy, safety, and cost-effectiveness of mHealth interventions in rehabilitation is of utmost importance. Robust studies with larger sample sizes are needed to provide convincing evidence and inform decision-making in the field.

Future directions and recommendations

To promote the effective use of mHealth in rehabilitation, collaboration and interdisciplinary research play a crucial role. Therefore, researchers, healthcare professionals, policymakers, and developers should work together to establish evidence-based guidelines and standards for mHealth use in rehabilitation. This collaborative effort aims to bridge the gap between technology development and clinical practice, ensuring that the advancements are implemented effectively.¹¹

For the successful adoption, reimbursement and policy support are necessary driving factors. Policymakers and healthcare organizations should consider incorporating these technologies into reimbursement schemes and policies. By providing financial incentives and removing reimbursement barriers, they can encourage the utilization of mHealth in rehabilitation settings.¹¹

Another issue is the sensitive nature of patient data involved in mHealth technologies. Therefore, prioritizing data privacy and security is of utmost importance. Additionally, to create successful mHealth apps, a user-centred design approach is critical. Involving end-users in the design and development process allows for the creation of intuitive and accessible technology that meets the needs and desires of the users.¹² By considering user perspectives, mHealth applications can be tailored to enhance user experience and usability.

Finally, proper training and education for healthcare professionals is crucial to enable the effective use of mHealth. They need to acquire necessary skills and knowledge to utilize these tools effectively. This includes understanding the capabilities and limitations of different mHealth tools, interpreting and utilising data generated by these technologies, and integrating them into their clinical practice.¹⁴

By embracing these emerging trends and implementing the recommendations mentioned above, the full potential of mHealth technologies in rehabilitation can be harnessed. This collective effort will lead to improved patient outcomes and enhance the delivery of care in rehabilitation settings.

Conclusion

The potential of mHealth in the healthcare sector is immense, by offering remote monitoring, enhancing patient engagement, providing real-time feedback, and facilitating the collection of objective data. Yet, realizing these advantages in rehabilitation, challenges related to accessibility, affordability, technical reliability, interoperability, and data privacy must be addressed. By overcoming these obstacles, mHealth can significantly contribute to optimizing rehabilitation outcomes while maintaining patient privacy and ethical standards.

References

1. West D. How mobile devices are transforming healthcare. *Issues in technology innovation*. 2012;18:1-11.
2. Bonnechère B, Kossi O, Mapinduzi J, Panda J, Rintala A, Guidetti S, et al. Mobile health solutions: An opportunity for rehabilitation in low- and middle income countries? *Front Public Health*. 2023;10:1072322.
3. Nussbaum R, Kelly C, Quinby E, Mac A, Parmanto B, Dicianno BE. Systematic review of mobile health applications in rehabilitation. *Arch Phys Med Rehabil*. 2019;100:115-27.
4. WHO. mHealth: new horizons for health through mobile technologies. *mHealth: new horizons for health through mobile technologies*. 2011.
5. Free C, Phillips G, Felix L, Galli L, Patel V, Edwards P. The effectiveness of M-health technologies for improving health and health services: a systematic review protocol. *BMC research notes*. 2010;3:1-7.
6. Malasinghe LP, Ramzan N, Dahal K. Remote patient monitoring: a comprehensive study. *J Ambient Intell Humaniz Comput*. 2019;10:57-76.
7. Peretti A, Amenta F, Tayebati SK, Nittari G, Mahdi SS. Telerehabilitation: review of the state-of-the-art and areas of application. *JMIR Rehabil Assist Technol*. 2017;4:e7511.
8. Matallaoui A, Koivisto J, Hamari J, Zarnekow R. How effective is "exergamification"? A systematic review on the effectiveness of gamification features in exergames. *Proceedings of the 50th Hawaii International Conference on System Sciences 2017*.
9. Campagnini S, Arienti C, Patrini M, Liuzzi P, Mannini A, Carrozza MC. Machine learning methods for functional recovery prediction and prognosis in post-stroke rehabilitation: A systematic review. *J Neuroeng Rehabil*. 2022;19:1-22.
10. Bonnechère B, Rintala A, Spooren A, Lamers I, Feys P. Is mHealth a useful tool for self-assessment and rehabilitation of people with multiple sclerosis? A systematic review. *Brain sciences*. 2021;11:1187.
11. Scott Kruse C, Karem P, Shifflett K, Vegi L, Ravi K, Brooks M. Evaluating barriers to adopting telemedicine worldwide: a systematic review. *J Telemed Telecare*. 2018;24:4-12.
12. Janols R, Sandlund M, Lindgren H, Pettersson B. Older adults as designers of behavior change strategies to increase physical activity: report of a participatory design process. *Front Public Health*. 2022;10:988470. doi: 10.3389/fpubh.2022.988470. PMID: 36620266; PMCID: PMC9811391.
13. Brydges CR. Effect size guidelines, sample size calculations, and statistical power in gerontology. *Innov Aging*. 2019;3:igz036. doi: 10.1093/geroni/igz036. PMID: 31528719; PMCID: PMC6736231.
14. Slovensky DJ, Malvey DM, Neigel AR. A model for mHealth skills training for clinicians: meeting the future now. *Mhealth*. 2017;3:24 doi: 10.21037/mhealth.2017.05.03. PMID: 28736733; PMCID: PMC5505927.