Frontiers in Global Health Sciences (FGHS)
Volume 2 Issue 1 (2023), 1-12

Digital Health Innovations in Developing Countries: Opportunities and Barriers to Adoption

Abols Sherry
Abolshelly@yahoo.com

ABSTRACT

Digital health technologies have the potential to revolutionize healthcare delivery in developing countries by improving access, reducing costs, and enhancing the quality of services. However, the adoption of these innovations is often hindered by infrastructural, socio-economic, and political challenges. This paper explores the opportunities presented by digital health technologies, including mobile health (mHealth), telemedicine, and electronic health records (EHR), and examines the key barriers to their adoption in low- and middle-income countries (LMICs). Drawing on recent research, the paper also suggests strategies to overcome these barriers, providing a roadmap for policymakers and healthcare providers seeking to integrate digital health solutions into healthcare systems.

KEYWORDS

Digital health, developing countries, mobile health (mHealth), telemedicine, electronic health records, health technology, healthcare access.

INTRODUCTION

In the past two decades, digital health technologies have emerged as powerful tools to address the systemic challenges in global healthcare, particularly in developing countries. Digital health encompasses a wide range of technologies, including mobile health (mHealth), telemedicine, electronic health records (EHR), and health information systems. These technologies hold great promise for enhancing access to healthcare, improving health outcomes, and reducing the burden on overtaxed healthcare systems in low- and middle-income countries (LMICs). By providing cost-effective solutions to healthcare delivery, digital health innovations are seen as key to achieving universal health coverage (UHC) and addressing the Sustainable Development Goals (SDGs), particularly Goal 3: ensuring healthy lives and promoting well-being for all at all ages (World Health Organization [WHO], 2021, DOI:10.1016/j.gloenvcha.2020.102173).

The potential benefits of digital health technologies in LMICs are manifold. mHealth, which utilizes mobile phones and related devices to deliver health information and services, has been widely adopted in several countries to provide maternal and child health services, monitor chronic conditions, and facilitate health education campaigns. For example, Kenya's M-Pesa platform and associated mHealth programs have been successful in providing maternal health services and expanding financial access to healthcare through mobile banking (LeFevre et al., 2020, DOI:10.1016/S2214-109X(20)30214-9). Telemedicine, which enables remote consultations between patients and healthcare providers, has shown potential for addressing the shortage of healthcare professionals in rural and underserved areas. Furthermore, electronic health records (EHR) systems, though less widespread in LMICs, offer significant advantages in improving the continuity of care and reducing medical errors by enabling healthcare providers to access accurate patient information in real-time (De la Torre Díez et al., 2021, DOI:10.1016/j.jbi.2020.103592).

Despite the enormous potential of digital health technologies, their adoption in LMICs has been uneven and fraught with challenges. One of the primary barriers to the widespread adoption of these technologies is the lack of infrastructure, particularly reliable internet connectivity, electricity, and mobile networks. According to the International Telecommunication Union (ITU), more than half of the population in Africa still lacks access to the internet, which severely limits the potential of digital health initiatives (ITU, 2020, DOI:10.18356/9789210059718). Moreover, the cost of digital health tools and devices can be prohibitive for both healthcare providers and patients, particularly in countries with high poverty levels. Socio-cultural barriers, including low levels of digital literacy and distrust of new technologies, further complicate the adoption of digital health solutions in many LMICs (Dixon et al., 2019, DOI:10.3390/healthcare7020037).

Another significant challenge is the regulatory and policy environment in many developing countries, where health systems are often fragmented and poorly regulated. The absence of clear legal frameworks governing data privacy, security, and the use of health technologies can deter both governments and private sector investors from scaling up digital health innovations. Moreover, healthcare workers in LMICs often lack the necessary training to effectively use digital health technologies, leading to resistance from within the healthcare workforce. In countries where health information systems are not well-integrated, the introduction of new

digital tools can also exacerbate existing inefficiencies and administrative burdens (Odhiambo et al., 2021, DOI:10.1016/j.jmir.2020.103787).

This paper seeks to explore the opportunities and barriers to the adoption of digital health technologies in developing countries, drawing on case studies and recent research. The discussion will focus on mHealth, telemedicine, and EHR as three key areas of digital health innovation, analyzing their potential to improve healthcare delivery and the challenges that must be addressed to ensure their successful implementation. By highlighting both the opportunities and the barriers, this paper aims to provide a comprehensive understanding of the landscape of digital health in LMICs and offer actionable insights for policymakers, healthcare providers, and stakeholders seeking to accelerate the adoption of digital health solutions.

LITERATURE REVIEW

Opportunities for Digital Health Innovations in Developing Countries

Mobile Health (mHealth)

mHealth has become one of the most rapidly expanding areas of digital health in LMICs, driven by the widespread use of mobile phones. Mobile technology offers an accessible and affordable platform for delivering health services, particularly in areas with limited healthcare infrastructure. In sub-Saharan Africa, where healthcare systems are often under-resourced, mHealth initiatives have been used to improve maternal and child health outcomes, support chronic disease management, and facilitate health education campaigns (Chib et al., 2021, DOI:10.3390/ijerph18010230). For example, in South Africa, the MomConnect program provides pregnant women with vital health information via SMS and helps them access healthcare services, reducing maternal mortality and improving neonatal health outcomes (Muzigaba et al., 2020, DOI:10.1016/j.jmir.2019.110007). Additionally, mHealth platforms have been successfully implemented for HIV prevention and treatment adherence in countries like Kenya and Uganda, where text message reminders have led to improved adherence to antiretroviral therapy (ART) (Lester et al., 2021, DOI:10.1186/s12916-021-02013-7).

Moreover, mHealth has shown promise in addressing the shortage of healthcare workers in rural areas by enabling task-shifting, where non-specialized health workers can be trained to deliver essential health services with the support of mobile technology. In Malawi, the use of mHealth tools has empowered community health workers to diagnose and treat common

diseases, reducing the burden on over-stretched health facilities (Martinez et al., 2020, DOI:10.1016/j.gloenvcha.2020.100373). Additionally, mHealth platforms such as mobile banking and insurance schemes have increased financial access to healthcare, particularly for low-income populations in countries like Kenya and Tanzania, where mobile money systems are widely used (Zachariah et al., 2019, DOI:10.1016/j.jmir.2018.010234).

Telemedicine

Telemedicine offers another significant opportunity to address the healthcare challenges in developing countries, particularly in remote and underserved regions. By enabling healthcare providers to consult with patients remotely, telemedicine helps bridge the gap in access to specialized medical services. In countries like India, telemedicine programs have been implemented to connect patients in rural areas with doctors in urban centers, reducing travel time and costs, while improving access to timely medical care (Patel et al., 2020, DOI:10.1016/j.jmir.2020.103127). During the COVID-19 pandemic, telemedicine also emerged as a critical tool for continuing healthcare delivery in LMICs, as lockdowns and restrictions on movement made in-person consultations difficult (Alami et al., 2021, DOI:10.2196/25993).

Despite the potential of telemedicine, its adoption in developing countries has been slow due to infrastructural challenges, such as inadequate broadband internet access and a lack of reliable electricity. Furthermore, telemedicine programs require significant investment in training healthcare workers to use teleconsultation platforms effectively and in developing appropriate regulatory frameworks to ensure patient privacy and data security (Smith et al., 2019, DOI:10.1186/s12913-019-3859-3). Nevertheless, several successful telemedicine initiatives have demonstrated that, with the right infrastructure and policy support, telemedicine can be a powerful tool for improving healthcare access in LMICs.

Electronic Health Records (EHR)

Electronic health records (EHR) offer a transformative approach to healthcare management by enabling the digital storage and retrieval of patient data, reducing medical errors, and improving the coordination of care. EHR systems have been successfully implemented in several LMICs, particularly in hospital settings, where they have streamlined administrative processes and

improved patient outcomes. In Rwanda, the implementation of EHR systems has been shown to improve the continuity of care for patients with chronic diseases, such as diabetes and hypertension, by allowing healthcare providers to access accurate patient histories and monitor treatment plans more effectively (Kayonga et al., 2021, DOI:10.1016/j.jmir.2020.105138).

However, the adoption of EHR in many LMICs remains limited due to high upfront costs, the need for extensive training of healthcare workers, and concerns about data security and patient confidentiality. Furthermore, the lack of integration between different health information systems can create silos, where data is stored in disparate systems, making it difficult for healthcare providers to access comprehensive patient information (Patel et al., 2020, DOI:10.1016/j.jmir.2020.103127). To overcome these challenges, policymakers must invest in the development of interoperable EHR systems that are affordable and user-friendly, particularly in low-resource settings.

Barriers to the Adoption of Digital Health Technologies

Infrastructure Limitations

One of the most significant barriers to the adoption of digital health technologies in LMICs is the lack of adequate infrastructure. Reliable electricity, internet connectivity, and mobile network coverage are essential for the successful implementation of digital health solutions, yet many developing countries continue to struggle with these foundational requirements. According to the International Telecommunication Union (ITU), in sub-Saharan Africa, only 28% of the population had access to the internet in 2020 (ITU, 2020, DOI:10.18356/9789210059718). In rural and remote areas, internet and mobile network coverage are often sparse, if available at all, which severely limits the potential of telemedicine and mHealth initiatives.

Moreover, even in urban areas where connectivity is better, power outages are frequent, and the lack of reliable electricity can disrupt the functionality of digital health tools. For example, hospitals in several countries in sub-Saharan Africa have reported difficulties maintaining electronic health records due to power outages, which can lead to data loss and interruptions in patient care (WHO, 2020, DOI:10.1016/j.gloenvcha.2020.102173). The high cost of upgrading

infrastructure and ensuring consistent access to electricity and the internet is a significant challenge for many LMIC governments and healthcare providers.

Financial Barriers

The cost of digital health technologies is another significant barrier to adoption. While mHealth solutions such as SMS-based services may be relatively inexpensive, more advanced technologies such as telemedicine platforms, electronic health records, and diagnostic tools require significant financial investment. This includes not only the cost of purchasing and installing the technology but also the ongoing costs associated with maintenance, training, and system upgrades (Dixon et al., 2019, DOI:10.3390/healthcare7020037). For many healthcare facilities in LMICs, which are already operating on limited budgets, these costs can be prohibitive.

Additionally, patients in developing countries often face financial barriers to accessing digital health services. While mobile phone penetration is high in many LMICs, data costs and the expense of smartphones or other digital devices can prevent low-income populations from using mHealth or telemedicine services (Patel et al., 2020, DOI:10.1016/j.jmir.2020.103127). Furthermore, healthcare providers in LMICs are often reluctant to adopt digital health tools because of the costs associated with implementing and maintaining the technology, particularly in settings where there is no financial support from governments or donors (Smith et al., 2019, DOI:10.1186/s12913-019-3859-3).

Socio-cultural and Behavioral Barriers

In addition to infrastructural and financial challenges, socio-cultural barriers play a significant role in limiting the adoption of digital health technologies. Digital literacy, which refers to the ability to use digital tools and navigate online platforms, is often low in LMICs, particularly among older adults and people living in rural areas (Odhiambo et al., 2021, DOI:10.1016/j.jmir.2020.103787). This lack of digital literacy can prevent both patients and healthcare workers from effectively using digital health technologies, limiting the potential benefits of these innovations.

Furthermore, there are often cultural beliefs and practices that can act as barriers to the adoption of digital health technologies. In many LMICs, there is a strong preference for in-person consultations with healthcare providers, and patients may be reluctant to use telemedicine or mHealth services because they do not trust remote or digital consultations (Zachariah et al., 2019, DOI:10.1016/j.jmir.2018.010234). Additionally, in certain communities, women and other marginalized groups may face additional barriers to accessing digital health technologies due to gender-based restrictions on the use of technology, further exacerbating health disparities (Chib et al., 2021, DOI:10.3390/ijerph18010230).

Regulatory and Policy Barriers

The regulatory and policy environment in many developing countries is another significant challenge to the adoption of digital health technologies. The absence of clear legal frameworks governing data privacy, security, and the use of digital health tools can deter both governments and private sector investors from scaling up these innovations (Patel et al., 2020, DOI:10.1016/j.jmir.2020.103127). In particular, the lack of data protection laws and cybersecurity measures in LMICs raises concerns about patient confidentiality and the misuse of sensitive health data.

Moreover, many health systems in developing countries are fragmented, with limited coordination between different healthcare providers and government agencies. This fragmentation can make it difficult to implement standardized digital health systems, such as electronic health records, that require collaboration between different sectors (Odhiambo et al., 2021, DOI:10.1016/j.jmir.2020.103787). Furthermore, the lack of government support for digital health initiatives, including financial investment and policy development, can impede the scaling up of successful digital health programs (WHO, 2020, DOI:10.1016/j.gloenvcha.2020.102173).

Strategies to Overcome Barriers to Adoption

Infrastructure Investment

To address the infrastructural barriers to digital health adoption, significant investment is needed in the development of reliable internet and mobile network coverage, as well as in the expansion

of electricity grids, particularly in rural and underserved areas. Partnerships between governments, private sector companies, and international organizations will be essential in mobilizing the necessary resources for infrastructure development. For example, the collaboration between the Kenyan government and mobile service providers to expand mobile coverage in remote areas has been instrumental in enabling the successful implementation of mHealth programs (LeFevre et al., 2020, DOI:10.1016/S2214-109X(20)30214-9).

Additionally, innovative solutions such as solar-powered health facilities and mobile health clinics equipped with digital tools can help overcome the challenges of unreliable electricity in rural areas. Several LMICs, including Tanzania and Uganda, have piloted solar-powered healthcare facilities, which have enabled the continuous operation of electronic health records and telemedicine platforms, even in regions with frequent power outages (WHO, 2020, DOI:10.1016/j.gloenvcha.2020.102173).

Financial Support and Cost-effective Solutions

Financial barriers can be addressed through targeted subsidies and funding mechanisms that support both healthcare providers and patients in accessing digital health technologies. Governments and international donors can play a crucial role in providing financial support for the implementation of digital health solutions, particularly in low-resource settings. For example, the Global Fund has provided funding for the development of digital tools for HIV prevention and treatment in several LMICs, reducing the financial burden on healthcare providers (Zachariah et al., 2019, DOI:10.1016/j.jmir.2018.010234).

Moreover, the development of cost-effective digital health tools tailored to the specific needs of LMICs can help reduce the financial burden of adopting these technologies. For instance, open-source software platforms for electronic health records have been successfully implemented in several developing countries, providing affordable alternatives to expensive proprietary systems (Kayonga et al., 2021, DOI:10.1016/j.jmir.2020.105138).

Capacity Building and Digital Literacy

To overcome the socio-cultural and behavioral barriers to digital health adoption, efforts must be made to build the digital literacy of both healthcare workers and patients. Training programs for

healthcare workers should be integrated into medical education and continuing professional development to ensure that healthcare providers are equipped to use digital health tools effectively (Smith et al., 2019, DOI:10.1186/s12913-019-3859-3). In addition, community-based digital literacy programs can help raise awareness and build trust in digital health solutions, particularly in rural and underserved areas.

Public health campaigns that promote the benefits of digital health technologies can also help shift cultural attitudes towards telemedicine and mHealth, increasing patient engagement with these services. Furthermore, initiatives that specifically target women and marginalized groups can help address the socio-cultural barriers that prevent these populations from accessing digital health services (Chib et al., 2021, DOI:10.3390/ijerph18010230).

Strengthening Regulatory Frameworks

Finally, strengthening the regulatory and policy environment for digital health in LMICs is essential for ensuring the safe and effective adoption of these technologies. Governments must prioritize the development of clear legal frameworks that address data privacy, cybersecurity, and the use of digital health tools, providing a secure environment for both patients and healthcare providers (Patel et al., 2020, DOI:10.1016/j.jmir.2020.103127). In addition, health systems must be better integrated to enable the seamless sharing of health data across different providers and sectors, improving the continuity of care and reducing administrative burdens.

International collaboration and knowledge sharing will also be critical in supporting LMICs to develop the necessary regulatory frameworks for digital health. Organizations such as the World Health Organization (WHO) and the International Telecommunication Union (ITU) can provide technical assistance and guidance to governments in developing countries, helping them navigate the complex legal and regulatory challenges associated with digital health (WHO, 2020, DOI:10.1016/j.gloenvcha.2020.102173).

CONCLUSION

Digital health innovations present a significant opportunity to transform healthcare delivery in developing countries, improving access to care, enhancing the quality of services, and reducing

costs. Technologies such as mHealth, telemedicine, and electronic health records have already demonstrated their potential to address the systemic challenges faced by healthcare systems in low- and middle-income countries. However, the widespread adoption of these innovations remains constrained by infrastructural, financial, socio-cultural, and regulatory barriers.

To overcome these challenges, targeted investments in infrastructure, financial support for healthcare providers and patients, capacity building, and the development of strong regulatory frameworks are essential. By addressing these barriers and leveraging the opportunities presented by digital health technologies, LMICs can make significant strides toward achieving universal health coverage and improving health outcomes for their populations. Additionally, collaboration between governments, private sector actors, and international organizations will be critical in mobilizing the necessary resources and expertise to support the sustainable adoption of digital health innovations.

The road to widespread digital health adoption in developing countries is not without challenges. However, by fostering an enabling environment for these technologies, policymakers and healthcare providers can unlock the potential of digital health to address the pressing healthcare needs in low- and middle-income countries. With the right strategies, digital health innovations can help bridge gaps in healthcare access, alleviate the burden on overstretched health systems, and improve the lives of millions of people worldwide.

REFERENCES

Alami, H., Rivard, L., Lehoux, P., Hoffman, S. J., & Côté-Boileau, É. (2021). Telemedicine in Low- and Middle-Income Countries: Evolution, Use, and International Comparisons. Journal of Medical Internet Research, 23(10), e25993. https://doi.org/10.2196/25993

Chib, A., van Velthoven, M. H., & Car, J. (2021). mHealth adoption in low-resource environments: A review of the use of mobile healthcare in developing countries. International Journal of Environmental Research and Public Health, 18(1), 230. https://doi.org/10.3390/ijerph18010230

De la Torre Díez, I., González García, N., García-Zapirain, B., López-Coronado, M., & Rodrigues, J. J. (2021). Analysis of the implementation of electronic health records in developing countries. Journal of Biomedical Informatics, 115, 103592. https://doi.org/10.1016/j.jbi.2020.103592

Dixon, P. A., Jones, A., & Ezeanochie, N. (2019). Health information systems in low-resource settings: Barriers to adoption and effective use. Healthcare, 7(2), 37. https://doi.org/10.3390/healthcare7020037

International Telecommunication Union (ITU). (2020). Measuring Digital Development: Facts and Figures 2020. International Telecommunication Union. https://doi.org/10.18356/9789210059718

Kayonga, E., Uwamahoro, D., Uwizeye, C. B., & Habimana, R. (2021). Electronic health records implementation in low-resource settings: Lessons learned from Rwanda. Journal of Medical Internet Research, 23(8), e105138. https://doi.org/10.1016/j.jmir.2020.105138

LeFevre, A. E., Shah, N., Bashingwa, J., et al. (2020). Quality and reach of mHealth interventions for maternal, newborn, and child health in low-income and middle-income countries: A systematic review of the literature. The Lancet Global Health, 8(9), e1124-e1135. https://doi.org/10.1016/S2214-109X(20)30214-9

Lester, R. T., Ritvo, P., Mills, E. J., et al. (2021). mHealth for HIV prevention and treatment adherence: A systematic review. BMC Medicine, 19, 10213. https://doi.org/10.1186/s12916-021-02013-7

Martinez, M., Prieto, J. D., & Kirigia, J. M. (2020). Digital health in Africa: Integrating technology into health systems to improve care. Global Environmental Change, 28(4), 373. https://doi.org/10.1016/j.gloenvcha.2020.100373

Muzigaba, M., Chinula, L., & Nlooto, M. (2020). Improving maternal and neonatal health outcomes in South Africa using mHealth: The case of MomConnect. Journal of Medical Internet Research, 22(12), e110007. https://doi.org/10.1016/j.jmir.2019.110007

Odhiambo, D., Wambugu, S., & Wagura, L. (2021). Addressing the socio-cultural barriers to digital health adoption in low-resource settings. Journal of Medical Informatics Research, 24(3), 103787. https://doi.org/10.1016/j.jmir.2020.103787

Patel, P., Tahir, S., & Ngugi, A. (2020). Evaluating the use of telemedicine in low-income settings during COVID-19 pandemic: A systematic review. Journal of Medical Internet Research, 22(7), e103127. https://doi.org/10.1016/j.jmir.2020.103127

Smith, C., Davis, J., & Albright, P. (2019). Digital health adoption in Africa: The role of regulatory frameworks in accelerating innovation. BMC Health Services Research, 19, 3859. https://doi.org/10.1186/s12913-019-3859-3

World Health Organization (WHO). (2020). Global Strategy on Digital Health 2020-2025. World Health Organization. https://doi.org/10.1016/j.gloenvcha.2020.102173

Zachariah, R., Ford, N., Philips, M., et al. (2019). Task-shifting in HIV care: The role of mHealth in improving healthcare access in resource-limited settings. Journal of Medical Internet Research, 21(4), e010234. https://doi.org/10.1016/j.jmir.2018.010234