The Impact of Digital Transformation on Healthcare Delivery in Nigeria: Challenges and Recommendations

Elechi Ubalaeze S[1], Elechi Kelechi W[2], Onyeugbo Erere G[1], Akujuobi Chinemerem D[3], Nwoda Chioma S[4]

[1]Department of Radiography and Radiological Sciences, Faculty of Health Science and Technology, University of Nigeria Enugu Campus, Enugu, Nigeria

[2]Biology of Aging Discipline, Graduate School of Biomedical Sciences, University of Texas Health San Antonio, San Antonio, Texas, United States of America.

[3]Department of Radiography and Radiological Sciences, Faculty of Health Science and Technology, University of Uyo, Nigeria.

[4]Faculty Of Pharmaceutical Sciences, University of Nigeria, Nsukka, Enugu, Nigeria.

ABSTRACT

Nigeria's healthcare system faces significant challenges, including inadequate infrastructure, workforce shortages, and a high disease burden. Digital health technologies offer promising solutions, but their implementation and impact remain limited and fragmented. This review examines the challenges of digital transformation in Nigerian healthcare and provides recommendations for overcoming these obstacles. While digital health initiatives have shown promise in improving access to care, enhancing health education, and streamlining healthcare delivery, significant challenges persist. These include infrastructure deficits, digital literacy gaps, financial constraints, regulatory issues, and concerns about data privacy and security. Rural and underserved areas face particularly acute challenges, risking the exacerbation of existing health inequalities. Overcoming the challenges of digital health transformation in Nigeria requires a multi-faceted approach. Recommendations include developing a comprehensive national digital health strategy, investing in infrastructure and digital literacy, creating a supportive regulatory environment, and fostering public-private partnerships. By addressing these challenges, Nigeria can harness the power of digital health to build a more robust, equitable, and effective healthcare system.

Keywords: digital health; telemedicine; electronic health records; mHealth; healthcare delivery; Nigeria; challenges; recommendations; health equity; policy

INTRODUCTION

Nigeria, Africa's most populous nation with over 200 million inhabitants, faces significant healthcare challenges. These include a high burden of communicable and non-communicable diseases, inadequate healthcare infrastructure, and a critical shortage of healthcare professionals [1]. The country's healthcare system is further strained by significant disparities in access between urban and rural areas, as well as socioeconomic inequalities [2].

In this context, digital transformation presents a promising avenue for addressing these issues and improving healthcare delivery nationwide. The concept of digital transformation in healthcare encompasses a wide range of technologies and approaches, including telemedicine, electronic health records (EHR), mobile health applications (mHealth), artificial intelligence (AI), and the Internet of Medical Things (IoMT) [3].

While the potential benefits of digital health technologies are substantial, their implementation in Nigeria faces numerous challenges. These range from infrastructural deficits and financial constraints to regulatory issues and cultural barriers [4,5]. Understanding these challenges is crucial for developing effective strategies to harness the power of digital health in the Nigerian context.

This review aims to provide a comprehensive analysis of the challenges facing digital transformation in healthcare delivery in Nigeria and offer recommendations for overcoming these obstacles. We explore the current state of digital health in the country, examine various digital technologies and their potential impacts, and discuss the multifaceted challenges hindering their full implementation. Additionally, we consider policy implications and provide actionable recommendations for leveraging digital technologies to strengthen Nigeria's healthcare system.

Current State of Digital Health in Nigeria

The digital transformation of healthcare in Nigeria is an evolving process characterized by both promising initiatives and significant challenges. Key developments include:

National eHealth Policy

The Nigerian government, through the Federal Ministry of Health, developed a National eHealth Strategic Framework (2015-2020) [6]. This policy document outlined the vision for using information and communication technologies (ICTs) to improve healthcare delivery in Nigeria. However, implementation of this framework has been inconsistent across different regions and healthcare levels [7].

Electronic Health Records (EHR) Implementation

While some tertiary hospitals and private healthcare facilities have implemented EHR systems, most healthcare providers, especially at the primary and secondary levels, still rely on paper-based records. The Nigerian Health Information System (NHIS) project aims to create a unified health information system nationwide, but progress has been slow [8].

A notable example is the EHR implementation at University College Hospital (UCH), Ibadan. While the system showed promise in improving patient care and administrative efficiency, several challenges emerged. These included frequent power outages disrupting system access, initial resistance from some staff members unfamiliar with digital systems, and interoperability issues with existing hospital software. The hospital had to invest in backup power systems and extensive staff training to address these challenges [9,10].

Telemedicine Initiatives

Telemedicine has gained increasing interest and adoption, particularly in the wake of the COVID-19 pandemic. Several private sector initiatives have launched telemedicine platforms, and some public institutions have established telemedicine centers. Platforms such as Tremendoc and DRO Health have provided remote consultations for as little as ₦500 to ₦5,000 per month, enabling affordable access to healthcare services [11]. Additionally, telemedicine has improved chronic disease management, providing remote monitoring for conditions like diabetes and hypertension [12].

A noteworthy example is the telehealth program implemented by Precious Gems in Opoji, Edo State. This initiative, in collaboration with the World Telehealth Initiative, aimed to improve healthcare access in rural communities. Local healthcare workers were trained to use telehealth devices for remote consultations with international specialists. The program has improved clinical knowledge for local healthcare workers and patient management while expanding healthcare access for rural communities [13].

Mobile Health (mHealth) Applications

Nigeria has seen a proliferation of mHealth applications in recent years, addressing areas such as maternal and

child health, disease management, and access to medications [14–16]. While these initiatives show promise, challenges such as low digital literacy and limited smartphone penetration in rural areas hinder widespread adoption.

For example, the "Abiye" (Safe Motherhood) project in Ondo State utilized mobile phones to connect pregnant women with health workers. While the project showed success in improving maternal health outcomes, it faced challenges such as maintaining consistent cellular network coverage in rural areas and ensuring the sustainability of free phone distribution [17,18]. However, the Abiye program led to a significant increase in maternal health services utilization, with antenatal care coverage rising from 80% in 2013 to 98% in 2016, and facility-based births increasing from 56.5% to 85.6% during the same period. This represents a 29.1 percentage point rise in facility-based deliveries over five years.

Health Management Information Systems (HMIS)

Nigeria has adopted the District Health Information System 2 (DHIS2) as the national platform for routine health data collection and reporting. However, challenges persist in ensuring consistent and accurate data entry across all healthcare facilities.

Artificial Intelligence and Machine Learning

While still in the nascent stages, there are emerging applications of AI and ML in Nigerian healthcare, particularly in areas such as disease diagnosis [19]. However, these initiatives are largely confined to research settings and have not yet been widely implemented in clinical practice.

Digital Health Training and Education

Some medical schools have started incorporating digital health modules into their curricula, recognizing the need for digital skills in healthcare [20,21]. However, there is no standardized national curriculum for digital health education, leading to inconsistencies in training across institutions.

Challenges in Digital Health Transformation in Nigeria

The digital transformation of healthcare in Nigeria faces numerous challenges that hinder its full implementation and impact:

Infrastructure Deficits

- Unreliable power supply: Frequent power outages, particularly in rural areas, disrupt the functioning of digital health systems and devices. Statistics have shown that In surveyed sub-Saharan African countries, only 34% of hospitals have consistent access to electricity [22].
- Limited Internet connectivity: Many areas lack reliable high-speed internet, which is crucial for telemedicine and real-time data exchange.
- Inadequate hardware: Many healthcare facilities lack the necessary computers, tablets, or other devices required for digital health initiatives.

Digital Literacy and Skills Gap

- Healthcare worker digital skills: Many healthcare professionals, particularly older practitioners and those in rural areas, lack the necessary digital skills to effectively use new technologies. A study by Tegegne et al. found that 51.8% of health professionals had adequate digital literacy, with significant factors including having a master's degree, access to digital technology, training in digital technology, and a positive attitude towards digital health technology. Nearly half of the participants exhibited poor digital literacy, highlighting the need for improved access, training programs, and a positive approach to digital tools in healthcare settings [23].

- Patient digital literacy: Low digital literacy among patients, especially in rural areas and among older populations, hinders the adoption of patient-facing digital health solutions.
- Technical support: There is a shortage of IT professionals with healthcare-specific knowledge to support and maintain digital health systems [6].

Financial Constraints

- High initial costs: The upfront costs of implementing digital health systems, including hardware, software, and infrastructure upgrades, are prohibitively high for many healthcare facilities [2].
- Ongoing maintenance costs: Many facilities struggle to budget for the ongoing maintenance and upgrades required for digital health systems.
- Limited government funding: Insufficient government funding has been allocated specifically to digital health initiatives [24].

Policy and Regulatory Challenges

- Inadequate legal framework: There is a lack of comprehensive legislation specifically addressing digital health, creating uncertainty around issues such as the legal status of telemedicine consultations.
- Data privacy and security concerns: The absence of robust data protection laws raises concerns about the privacy and security of digital health data.
- Lack of standardization: The absence of national standards for digital health technologies hinders interoperability between different systems [25].

Resistance to Change

- Cultural factors: Traditional beliefs and practices in some communities lead to resistance to technology-driven healthcare solutions [26].
- Professional resistance: Some healthcare workers resist the adoption of new technologies due to concerns about job security or changes to established work practices [27,28].

Equity and Access Concerns

- Urban-rural divide: The concentration of digital health initiatives in urban areas risks exacerbating existing health inequalities between urban and rural populations.
- Socioeconomic disparities: The cost of devices and data plans can make digital health solutions inaccessible to low-income populations.

Sustainability and Scalability

- Pilot project syndrome: Many digital health initiatives in Nigeria remain as small-scale pilot projects and fail to scale up to the national level.
- Donor dependency: Over-reliance on donor funding for digital health projects raises concerns about long-term sustainability.

Interoperability Issues

- Fragmented systems: The proliferation of different digital health systems that cannot effectively communicate with each other hinders the creation of a unified national health information system [29].
- Legacy systems: Integrating new digital health solutions with existing legacy systems may pose significant technical challenges.
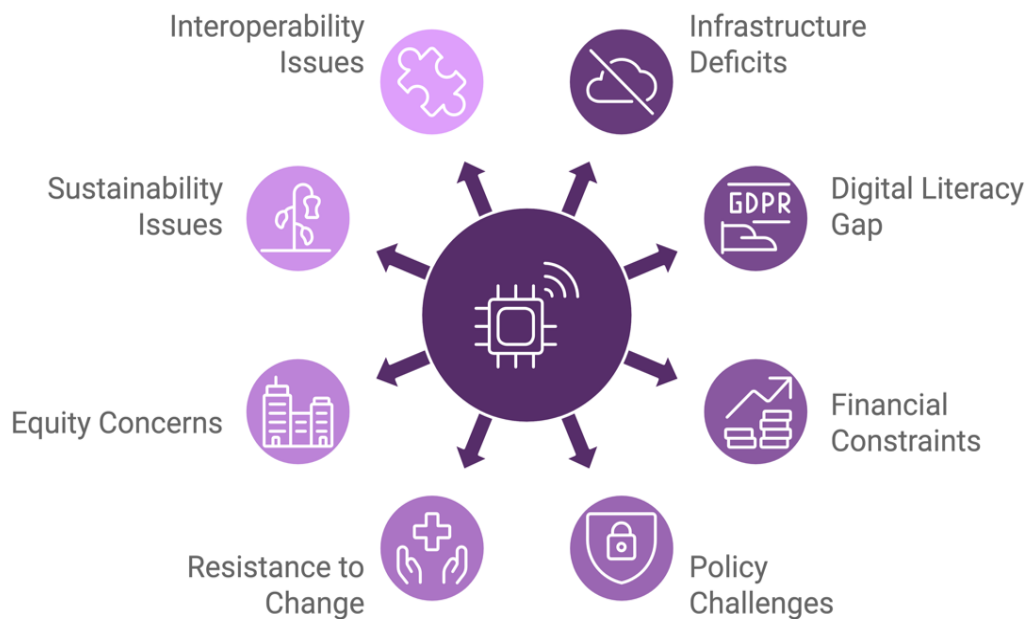
Figure 1

Recommendations for Addressing Digital Health Challenges in Nigeria

Based on the challenges identified, the following recommendations are proposed to advance the digital transformation of healthcare in Nigeria:

Develop a Comprehensive National Digital Health Strategy

Create a long-term, holistic strategy that aligns digital health initiatives with broader health system goals. Ensure the strategy addresses infrastructure development, capacity building, regulatory frameworks, and sustainable financing mechanisms. This would lead to improved healthcare delivery through better integration of technology and resources, ensuring equitable access to quality care. It would also strengthen regulatory frameworks and financing models, driving sustainable growth and innovation in the healthcare sector.

Invest in Digital Health Infrastructure

Prioritize the development of reliable power supply and internet connectivity in healthcare facilities, particularly in rural areas. Explore innovative solutions such as solar power and satellite internet to overcome infrastructure challenges in remote areas.

A successful example of this approach is the solar-powered health centers in the Niger Delta region. Through the Health Electrification and Telecommunications Alliance (HETA), several health centers were equipped with solar power systems. This intervention has provided reliable solar energy to 12 primary healthcare centers across Ondo, Delta, and Bayelsa states, significantly improving healthcare services. This initiative helped power health facilities for 24/7 operation, reducing dependence on generators and ensuring critical services like nighttime births, emergency surgeries, and vaccine storage could continue uninterrupted. The project has further impacted over 230 health facilities in Africa, with a funding commitment exceeding $10 million [30].

Enhance Digital Literacy and Skills

Integrate digital health modules into medical and nursing education curricula [31]. Provide ongoing training and support for healthcare workers to improve their digital skills. This will empower healthcare workers to

effectively utilize digital health tools, improving patient care and operational efficiency.

Implement community-based digital literacy programs to improve patient engagement with digital health solutions. This will lead to increased adoption and trust in digital health solutions, enhancing overall health outcomes.

Develop a Supportive Regulatory Environment

Enact comprehensive legislation addressing digital health, including guidelines for telemedicine practice and data protection. Establish national standards for digital health technologies to ensure interoperability and quality. These will ensure legal clarity and protection for both healthcare providers and patients in using digital health tools, fostering trust in technologies like telemedicine. National standards for digital health will enhance interoperability and quality, leading to more consistent and effective healthcare delivery across the system.

Ensure Sustainable Financing

Allocate dedicated government funding for digital health initiatives. Explore innovative financing mechanisms such as public-private partnerships and impact investing. Develop sustainable business models for digital health initiatives to reduce donor dependency.

Prioritize Equity and Access

Implement targeted interventions to bridge the urban-rural digital divide in healthcare. This will help close the urban-rural healthcare gap, ensuring underserved communities benefit from digital solutions. Develop low-cost, offline-capable digital health solutions for low-resource settings. Explore partnerships with mobile network operators to provide subsidized or free data for health-related applications as this will make healthcare more accessible, improving health outcomes in low-resource settings.

Foster Innovation and Local Solutions

Establish innovation hubs and incubators focused on digital health solutions. Encourage collaboration between healthcare providers, technology companies, and academic institutions to develop context-appropriate digital health solutions.

Improve Data Governance and Interoperability

Develop national health data standards and interoperability frameworks. Implement robust data governance protocols to ensure data privacy and security. Invest in health information exchange infrastructure to enable seamless data sharing between different health systems.

Overall, if data governance and interoperability is improved, it will enhance the security, privacy, and quality of health data, fostering trust in digital health systems [32]. It will also enable seamless data sharing across health systems, leading to better coordination of care, more informed decision-making, and improved patient outcomes [33].

Build Capacity for Implementation and Evaluation

Develop a cadre of health informatics professionals through specialized training programs. Strengthen monitoring and evaluation capabilities to assess the impact of digital health initiatives and inform evidence-based decision-making.

Promote Cultural Adaptation and Community Engagement

Engage community leaders and traditional healthcare providers in the design and implementation of digital health initiatives. Develop culturally appropriate digital health content and interfaces. Promoting cultural adaptation and community engagement will increase the relevance and acceptance of digital health solutions,

ensuring they resonate with local values and practices [4,34]. Involving community leaders and traditional healthcare providers will enhance trust and collaboration, leading to more widespread adoption and successful implementation of digital health initiatives.
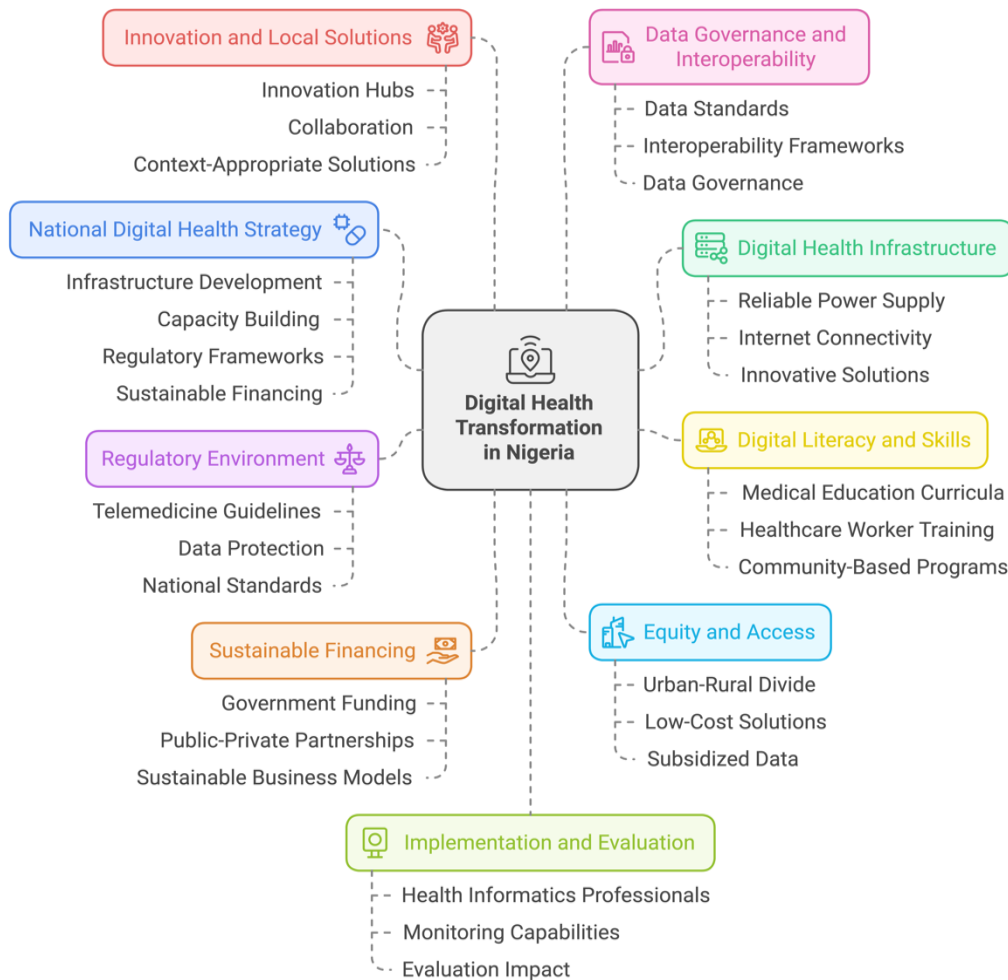

Figure 2

DISCUSSION

The digital transformation of healthcare in Nigeria represents a significant opportunity to address longstanding challenges in the country's health system. This review has highlighted the multifaceted challenges facing digital health implementation in Nigeria and proposed recommendations for overcoming these obstacles.

The challenges identified span a wide range of issues, from infrastructural deficits and financial constraints to regulatory gaps and cultural barriers. These challenges are interconnected and often compound each other. For instance, the lack of reliable power supply and internet connectivity in rural areas not only hinders the implementation of digital health solutions [4,6] but also exacerbates existing health inequalities between urban and rural populations [35].

The digital literacy gap among both healthcare professionals and patients emerges as a critical challenge that cuts across various digital health initiatives. This highlights the need for comprehensive capacity building efforts that go beyond mere technical training to include fostering a culture of digital innovation in healthcare.

The financial constraints facing digital health initiatives in Nigeria are significant and multifaceted. The high initial costs of implementing digital health systems, coupled with ongoing maintenance expenses, pose a substantial barrier, particularly for public healthcare facilities operating with limited budgets [2,36]. This

underscores the need for innovative financing mechanisms and sustainable business models to ensure the long-term viability of digital health initiatives.

The regulatory landscape for digital health in Nigeria remains underdeveloped, creating uncertainty and potential risks [37–39]. The lack of comprehensive legislation specifically addressing digital health issues, such as the legal status of telemedicine consultations and data protection, hinders the widespread adoption of digital health solutions. Developing a robust legal and regulatory framework is crucial for creating an enabling environment for digital health innovation while safeguarding patient rights and data privacy.

The issue of equity and access in digital health transformation is particularly pressing in the Nigerian context [40]. The concentration of digital health initiatives in urban areas and the potential for these technologies to be inaccessible to low-income populations risk exacerbating existing health inequalities. This highlights the need for targeted interventions to bridge the urban-rural digital divide and develop inclusive digital health solutions that cater to diverse socioeconomic groups.

Interoperability emerges as a critical challenge in the Nigerian digital health landscape [4]. The proliferation of fragmented systems that cannot effectively communicate with each other hinders the creation of a unified national health information system. Addressing this challenge requires not only technical solutions but also the development of national standards and protocols for data exchange.

The recommendations proposed in this review aim to address these challenges through a comprehensive, multi-stakeholder approach. The development of a national digital health strategy is crucial for providing a coherent framework for digital health initiatives and ensuring alignment with broader health system goals [41]. Significant investment in digital health infrastructure is needed to create the foundational elements for digital health transformation, particularly in underserved areas.

Enhancing digital literacy and skills is essential for both healthcare providers and patients to effectively engage with digital health solutions [42,43]. This requires a long-term commitment to education and training, integrated into both formal medical education and community-based programs.

The development of a supportive regulatory environment is critical for creating certainty and trust in digital health initiatives. This includes not only enacting comprehensive legislation but also establishing national standards for digital health technologies to ensure quality and interoperability.

Ensuring sustainable financing for digital health initiatives is crucial for moving beyond pilot projects to achieve nationwide impact [44]. This requires a mix of dedicated government funding, innovative financing mechanisms, and sustainable business models.

Prioritizing equity and access in digital health initiatives is essential for ensuring that the benefits of digital transformation are realized across all segments of Nigerian society. This includes targeted interventions for rural and low-income populations and exploring partnerships to reduce the cost barriers to digital health access.

Fostering innovation and local solutions is crucial for developing context-appropriate digital health technologies that address the specific needs and challenges of the Nigerian healthcare system [34,45]. This requires creating an ecosystem that supports collaboration between healthcare providers, technology companies, and academic institutions.

Improving data governance and interoperability is essential for realizing the full potential of digital health in improving healthcare delivery and outcomes. This includes developing national health data standards, implementing robust data governance protocols, and investing in health information exchange infrastructure.

Building capacity for implementation and evaluation is crucial for ensuring the effective deployment and continuous improvement of digital health initiatives [46,47]. This includes developing a cadre of health informatics professionals and strengthening monitoring and evaluation capabilities.

Finally, promoting cultural adaptation and community engagement is essential for ensuring the acceptability and effectiveness of digital health solutions in diverse Nigerian communities [48–50]. This requires engaging community leaders and traditional healthcare providers in the design and implementation of digital health initiatives and developing culturally appropriate digital health content and interfaces.

CONCLUSIONS

The digital transformation of healthcare in Nigeria presents both significant challenges and immense opportunities. While digital health technologies have shown promise in improving access to care, enhancing health education, and streamlining healthcare delivery, numerous obstacles hinder their full implementation and impact.

The challenges identified in this review - including infrastructure deficits, digital literacy gaps, financial constraints, regulatory issues, and concerns about equity and access - are complex and interconnected. Addressing these challenges requires a comprehensive, multi-stakeholder approach that considers the unique context of Nigeria's healthcare system and socioeconomic landscape.

The recommendations proposed in this review provide a roadmap for overcoming these challenges and harnessing the potential of digital health to strengthen Nigeria's healthcare system. Key among these recommendations are:

1. Developing a comprehensive national digital health strategy that aligns with broader health system goals.
2. Investing significantly in digital health infrastructure, particularly in rural and underserved areas.
3. Enhancing digital literacy and skills among healthcare providers and the general public.
4. Creating a supportive regulatory environment that addresses issues such as data privacy and telemedicine practice.
5. Ensuring sustainable financing mechanisms for digital health initiatives.
6. Prioritizing equity and access in digital health implementation to prevent the exacerbation of existing health inequalities.
7. Fostering innovation and the development of local, context-appropriate digital health solutions.
8. Improving data governance and interoperability to create a unified national health information system.
9. Building capacity for the effective implementation and evaluation of digital health initiatives.
10. Promoting cultural adaptation and community engagement in digital health design and implementation.

Implementing these recommendations will require sustained commitment and collaboration from a wide range of stakeholders, including government agencies, healthcare providers, technology companies, academic institutions, and community organizations. It will also necessitate a long-term view that recognizes digital transformation as an ongoing process rather than a one-time intervention.

As Nigeria continues its digital health journey, it is crucial to ensure that these technological advancements contribute to greater health equity and improved health outcomes for all Nigerians. By addressing the identified challenges and implementing thoughtful, context-appropriate solutions, Nigeria can harness the power of digital health to build a stronger, more resilient, and more equitable healthcare system for the 21st century.

Future research should focus on evaluating the long-term impact of digital health initiatives in Nigeria, exploring innovative approaches to overcoming persistent challenges and developing evidence-based strategies for scaling successful pilot projects to achieve nationwide impact. Additionally, comparative studies examining digital health transformation in other African countries could provide valuable insights and lessons for Nigeria's ongoing efforts.

In conclusion, while the challenges facing digital health transformation in Nigeria are significant, they are not insurmountable. With strategic planning, sustained investment, and collaborative effort, Nigeria has the

potential to leverage digital technologies to dramatically improve healthcare delivery and outcomes, ultimately contributing to the health and well-being of its more than 200 million citizens.

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