Digital Health Innovations: Transforming Healthcare Access in sub-Saharan Africa

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Abstract

Sub-Saharan Africa (SSA) faces persistent challenges in access to health care due to resource shortages, weak infrastructure, and geographical barriers, which disproportionately affect vulnerable populations. Digital health innovations offer promising solutions to these inequities. The purpose of this study is to examine how digital technologies can be leveraged to advance Sustainable Development Goal 3, ensuring healthy lives and well-being for all by improving healthcare access and equity in SSA. Using the social determinants of health (SDH) framework, this study conducted an integrative literature review using the PRISMA guidelines. Peer-reviewed articles, government reports, and relevant literature published between 2013 and 2024 were identified in PubMed, ScienceDirect, Scopus, Africa Journals Online, Google Scholar, and the Directory of Open Access Journals. Of the initial 985 records from database searches and 93 from other sources, 245 sources were left after removing duplicates. Further screening yielded 75 full-text articles, of which 62 were excluded for various reasons, leaving 13 studies for qualitative synthesis. Findings reveal that digital health can enhance healthcare delivery in underserved areas by enabling remote care and improving system efficiency, but its adoption relies on policy support, infrastructure, and community engagement. Barriers include low digital literacy, regulatory weaknesses, infrastructure gaps, and data privacy concerns. Sustainability demands integration into national strategies, stronger health information systems, and sustainable financing, alongside ethical and legal frameworks on equity and data governance. While digital health holds transformative potential in SSA, decisive policy action is essential to realise equitable and just healthcare access.

Keywords: digital health innovations; healthcare access; health equity; sub-Saharan Africa; Sustainable Development Goal 3 (SDG 3)

UNISA university of south africa PRESS
Journal of Law, Society and Development
Volume 12 | 2025 | #18989 | 22 pages

https://doi.org/10.25159/2520-9515/18989
ISSN 2520-9515 (Online), ISSN 2313-8289 (Print)

Introduction

Access to health care in sub-Saharan Africa (SSA) has long been hindered by limited resources, inadequate infrastructure, and geographical barriers, leading to disparities in healthcare access and outcomes, particularly affecting vulnerable populations (Mooketsane and Phirinyane 2015; Seidu 2020). However, the emergence of digital health innovations presents a promising opportunity to address these disparities and advance social equity and justice in healthcare delivery (Doupis et al. 2020). It was further noted by Doupis et al. (2020) that digital technologies, including telemedicine and mobile health (mHealth) solutions, have transformed healthcare access in SSA by enabling remote consultations, overcoming geographical constraints, and extending services to underserved communities. Health information systems and electronic health records have enhanced data-driven decision-making and resource allocation, promoting equitable health care (Doupis et al. 2020; Kumar and Mostafa 2020). Similarly, Jiang et al. (2017) highlighted that artificial intelligence (AI) and machine learning applications have shown the potential to improve diagnostic accuracy and treatment outcomes, contributing to enhanced healthcare access and equity. Seidu (2020) concurs that digital health innovations are pivotal in expanding healthcare access, improving data management, enhancing diagnostic capabilities, and promoting health literacy and community engagement.

Understanding the Landscape: Healthcare Challenges in sub-Saharan Africa

The healthcare landscape in sub-Saharan Africa faces numerous challenges that create barriers to equitable access to quality care. The region is grappling with a scarcity of healthcare professionals, medical supplies, and essential infrastructure, such as hospitals and clinics, as noted by Oleribe et al. (2019). The lack of basic infrastructure, such as roads and electricity, in many rural communities further exacerbates the difficulty in reaching healthcare facilities (World Health Organization [WHO] 2018). Many communities' vast distances and remote locations pose logistical challenges in delivering healthcare services (Lund et al. 2014). The financial burden of health care with high out-of-pocket expenses remains a significant obstacle, making health care unaffordable for a large segment of the population (Eze et al. 2022). Furthermore, cultural beliefs and social norms can create additional barriers to accessing health care, particularly for women and girls (Ninsiima, Chiumia, and Ndejjo 2021). The combined effect of these challenges results in considerable disparities in healthcare access and health outcomes within sub-Saharan Africa.

The Power of Digital Health: Transforming Healthcare Access

Digital health, which includes digital technologies to improve health outcomes, presents a transformative solution to healthcare challenges in sub-Saharan Africa. It has enabled remote healthcare services and the delivery of health information through telecommunications and mobile devices, respectively. These technologies have the potential to overcome geographical barriers, improve access to specialists, and enable timely interventions, as highlighted by Lund et al. (2014) and Kipruto et al. (2022).

Implementing health information systems (HIS) and electronic health records (EHRs) facilitates efficient data collection, storage, and analysis, empowering evidence-based decision-making, resource allocation, and personalised care (Kumar and Mostafa 2020). Integrating these digital health innovations holds immense promise in revolutionising healthcare access and delivery in sub-Saharan Africa.

Social Equity and Justice: The Ethical Imperative of Digital Health

Social equity and justice are essential foundations in digital health, with a growing body of literature emphasising the ethical imperative of ensuring fairness and equality in healthcare access and outcomes. As highlighted by Hendl (2024), this intersection needs to connect debates on democratisation in health care with concerns about social determinants of health. This underscores the importance of going beyond mere democratisation to engage with issues of health justice, ensuring that advances in digital health benefit all segments of society in SSA. Folk et al. (2020) further emphasise the importance of digital health interventions, mainly through mHealth technology, to cost-effectively reach underserved and vulnerable populations. Using digital platforms, healthcare services can be extended to those facing barriers to access to traditional health care, thereby promoting social justice in healthcare delivery. Hooper (2023) adds to this discourse by asserting that achieving health equity requires comprehensively addressing disparities, evaluating progress, and pursuing justice and social justice within healthcare structures and community contexts. Thinyane (2020) addresses the importance of standardising social justice principles within health informatics.

Similarly, Hosseinzadegan, Jasemi, and Habibzadeh (2020) shed light on integrating social justice into health systems to ensure equal access to health services for all individuals. Digital health innovations promise to promote social equity and justice in access to health care. By overcoming geographical barriers, reducing costs, and empowering people with health information, digital technologies can help level the playing field and ensure everyone can achieve optimal health. However, the ethical implementation of digital health solutions is crucial. Concerns about data privacy, security, and the potential to exacerbate existing inequalities due to the digital divide must be addressed. Inclusive design principles, community engagement, and robust regulatory frameworks are essential to ensure that digital health innovations benefit all members of society, especially the most vulnerable. This study underscores the need to identify the values that should guide technical solutions in the digital health domain, highlighting the ethical considerations that should underpin technological advances in health care.

Theoretical Framework: The Social Determinants of Health Model

The theoretical framework that guided this study is the social determinants of health (SDH) model, which emphasises addressing social, economic, and environmental factors to achieve health equity (Ouedraogo et al. 2021). This study outlines that all stakeholders can work towards achieving Sustainable Development Goal 3 (SDG 3),

ensuring healthy lives and well-being for all in SSA by leveraging digital health innovations. Doupis et al. (2020) explain that these technologies can transform healthcare access and promote social equity by empowering individuals with health information and services, regardless of socioeconomic status or location. Therefore, the SDH theoretical framework guides this study's exploration of how digital health innovations can contribute to achieving SDG 3 in SSA. Acknowledging the interconnectedness of health and social factors, the SDH model provides a holistic theoretical lens for understanding and addressing healthcare access challenges in sub-Saharan Africa (Figure 1).

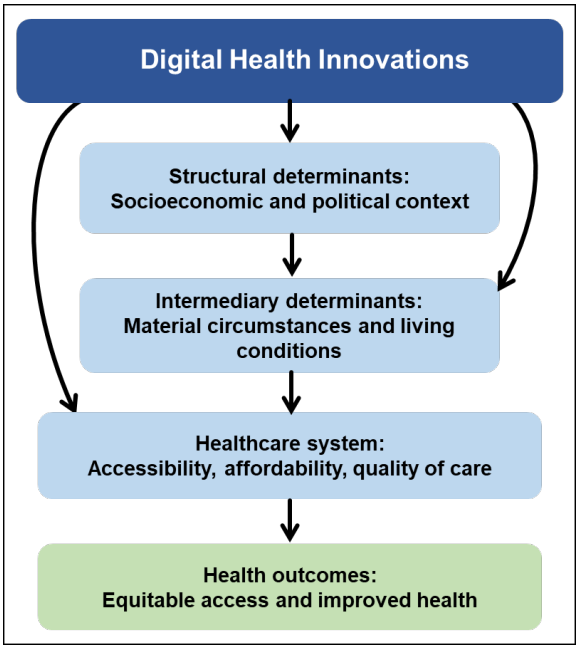

Figure 1: The social determinants of health model for digital health innovations in SSA.

Methodology

Search Strategy and Criteria

This study employed an integrated literature review methodology following the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. The guidelines were chosen to ensure a rigorous and transparent approach, minimising bias in selecting relevant studies and data (Alabadi and Aldawood 2020). The review process involved identifying and analysing peer-reviewed studies, government reports, and relevant literature published between 2013 and 2024. Databases such as the South African Bibliographic and Information Network (SABINET), Google Scholar, the Directory of Open Access Journals, and Scopus were systematically searched to identify studies conducted within SSA that explored the role

of digital technologies in transforming healthcare access and promoting social equity and justice.

The search strategy included specific keywords related to "digital health innovations," "healthcare access," "sub-Saharan Africa," including "digital health," "mHealth," "telemedicine," "eHealth," "health information systems," "artificial intelligence," and "machine learning," within the context of community engagement initiatives to improve healthcare access and equity in the region. Following the PRISMA guidelines in Figure 2, the study selection process involved screening titles and abstracts to identify potentially relevant articles. Full-text screening was then conducted to assess the eligibility of studies based on predefined criteria. Data extracted from selected studies included study objectives, methodologies, findings, and implications for healthcare access and equity in sub-Saharan Africa.

The strict adherence of this study to the PRISMA guidelines ensured methodological rigour, transparency, and reproducibility. Studies which are qualitative, quantitative, or mixed methods, and reviews, were included if they met the following criteria: They (1) focused on digital health innovations in sub-Saharan Africa, (2) examined the impact of these innovations on access and equity in health care, and (3) were published in English, between 2013 and 2024. The selected studies were critically appraised for their rigour and relevance to the research questions (Table 1). The quality assessment of the included studies was performed to evaluate the reliability and validity of the findings. The selection process was reviewed by three independent reviewers based on the inclusion criteria. Disagreements during the study selection and data extraction processes were resolved through discussion and consensus between the author and the reviewers.

Data Analysis

The findings of the selected studies were synthesised using content analysis, as described by Vourvachis and Woodward (2015), Seuring and Gold (2012), and Guo, Hao, and Albright (2019), to identify common themes, trends, and insights regarding the impact of digital health innovations on healthcare access and equity in sub-Saharan Africa. The results were systematically analysed to draw meaningful conclusions and implications for regional policy and practice.

The 13 selected documents were analysed according to established qualitative content analysis methods to identify patterns and themes in the text (Hsieh and Shannon 2005; O'Brien et al. 2009; Qu and Chen 2019). First, a coding framework, essentially a structured system for categorising themes identified in the articles, was created to guide the analysis (Majid, Rahman, and Kamaruzaman 2022; Seuring and Gold 2012). Subsequently, clear coding rules were established to maintain objectivity throughout the process (O'Brien et al. 2021; Yelverton et al. 2018). The coding system was then applied to the selected articles (Wong et al. 2020; Zastrow, Burk-Rafel, and London 2021), systematically identifying themes, patterns, and relevant information across all studies

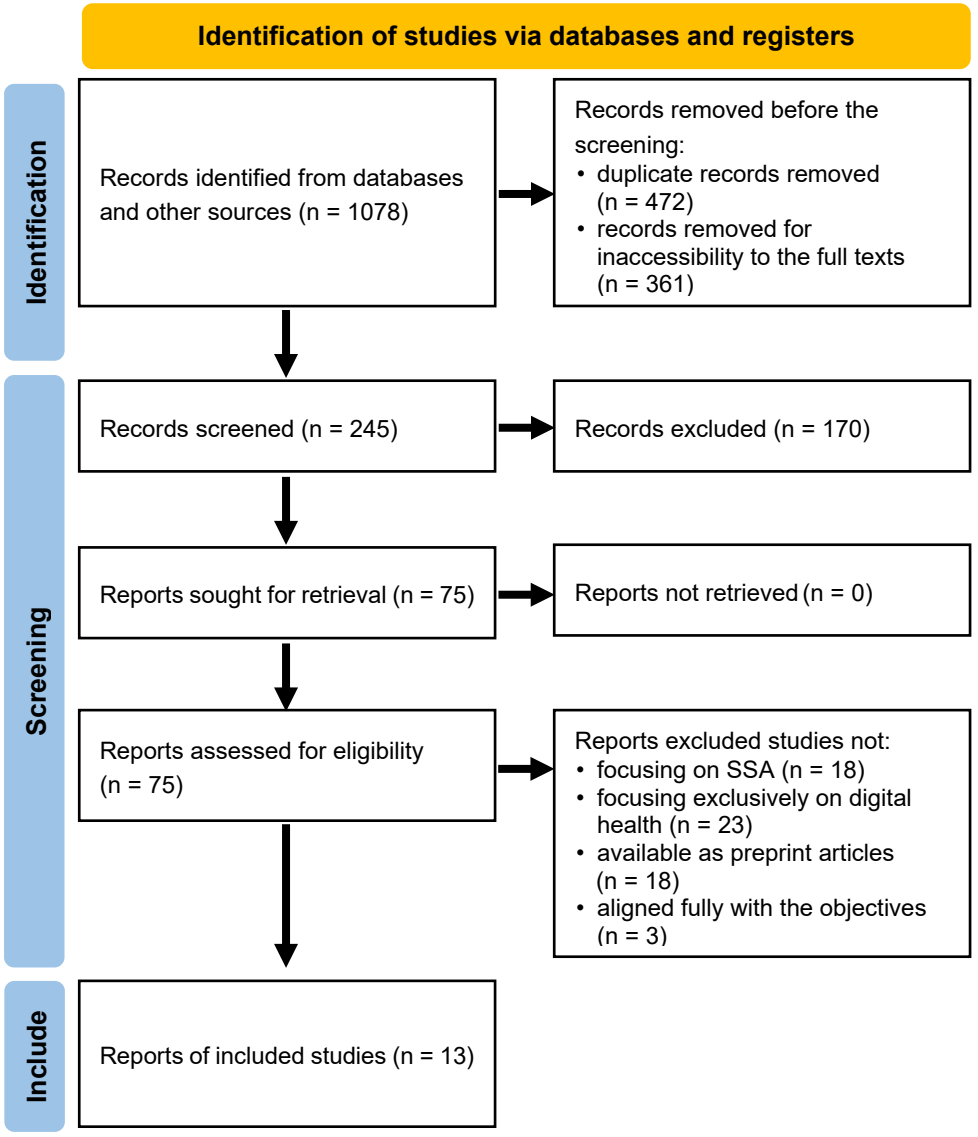

Figure 2: PRISMA flow diagram for study selection.

Table 1: Profile of eligible and selected studies.

Nr.	Publication/ Report	Title	Research Design	Data Analysis	Research Aim	Key Findings	Recommendations
1	Aboye, Simegn, and Aerts 2024	Assessment of the Barriers and Enablers of the Use of mHealth Systems in sub-Saharan Africa	Qualitative study	Thematic analysis	Identify the barriers and enablers of mHealth system usage in Ethiopia from the perspectives of patients, physicians, and healthcare executives.	Identified key barriers, such as a lack of infrastructure and training, and enablers like policy support and community engagement.	Recommend enhancing training programmes and infrastructure to support mHealth systems.
2	Betjeman, Soghoian, and Foran 2013	mHealth in sub-Saharan Africa	Review study	Narrative analysis	Review the current state of mHealth in sub-Saharan Africa and its potential impact on healthcare access.	mHealth has potential, but is hindered by limited network coverage and cultural barriers.	Suggest policy reforms and investment in mobile infrastructure.
3	Bisi 2024	Evaluating the Relationship Between Information Technology Adoption and Healthcare Outcomes in Sub-Saharan Africa	Quantitative study	Regression analysis	Evaluate the impact of information technology (IT) adoption on healthcare outcomes in sub-Saharan Africa.	IT adoption positively correlates with improved healthcare outcomes.	Recommends increased IT investment and training for healthcare providers.
4	Cambaza 2023	The Role of FinTech in Sustainable Healthcare Development in sub-Saharan Africa	Narrative review	Thematic analysis	Explore how FinTech innovations contribute to sustainable healthcare development in sub-Saharan Africa.	FinTech can enhance healthcare access through innovative payment solutions, but faces regulatory challenges.	Recommends regulatory frameworks to support FinTech in health care.
5	Campain et al. 2018	An Evaluation of the Role of Simulation Training for Teaching Surgical Skills in sub-Saharan Africa	Evaluation study	Mixed-methods analysis	Evaluate the effectiveness of simulation training in enhancing surgical skills.	Simulation training significantly improves surgical skills and patient outcomes.	Suggest wider adoption of simulation training in medical curricula.
6	Ebenso et al. 2018	Impact of Using eHealth Tools to Extend Health Services to Rural Areas of Nigeria	Mixed-methods study	Cluster analysis	Assess the impact of eHealth tools in extending healthcare services to rural Nigeria.	eHealth tools have improved healthcare access, but face sustainability challenges.	Recommends integrating eHealth tools with existing healthcare infrastructure.

Nr.	Publication/ Report	Title	Research Design	Data Analysis	Research Aim	Key Findings	Recommendations
7	Karamagi et al. 2022	eHealth or e-Chaos: The Use of Digital Health Interventions for Health Systems Strengthening in sub-Saharan Africa	Scoping review	Thematic synthesis	Explore the use of digital health interventions to strengthen the health system in sub-Saharan Africa.	Digital health interventions have mixed outcomes; coordination issues hinder success.	Suggest better coordination and alignment of digital health initiatives with national health priorities.
8	Mooketsane and Phirinyane 2015	Health Governance in sub-Saharan Africa	Policy analysis	Qualitative content analysis	Analyse health governance issues in sub-Saharan Africa.	Governance challenges undermine health service delivery and access.	Recommend governance reforms and capacity building.
9	Ouedraogo et al. 2021	Towards Achieving the Family Planning Targets in the African Region: A Rapid Review of Task-Sharing Policies	Rapid review	Thematic analysis	Review task-sharing policies in the African region to achieve family planning targets.	Task sharing is effective in improving family planning services, but requires policy support.	Recommend policy adjustments to support task-sharing initiatives.
10	Seidu 2020	Mixed Effects Analysis of Factors Associated with Barriers to Accessing Health Care Among Women in sub-Saharan Africa	Mixed-methods study	Mixed effects model	Analyse factors associated with healthcare access barriers among women in sub-Saharan Africa.	Socioeconomic status and geographical location are significant barriers to healthcare access.	Recommends targeted interventions to address socioeconomic and geographical barriers.
11	Tahir, Mars, and Scott 2022	A Review of Teleradiology in Africa: Towards Mobile Teleradiology in Nigeria	Review study	Meta-analysis	Review the current state and future potential of teleradiology in Africa.	Teleradiology can enhance diagnostic services, but is limited by technological and regulatory barriers.	Suggest developing mobile teleradiology solutions and addressing regulatory issues.
12	Udenigwe, Omonaiye, and Yaya 2023	Gender Transformative Approaches in mHealth for Maternal Healthcare in sub-Saharan Africa	Systematic review	Thematic analysis	Explore gender-transformative approaches in mHealth for maternal health care.	Gender-sensitive mHealth interventions improve maternal health outcomes.	Recommend scaling up gender-transformative mHealth interventions.
13	Wamala and Augustine 2013	A Meta-Analysis of Telemedicine Success in Africa	Meta-analysis	Meta-analysis	Evaluate the success of telemedicine interventions in Africa.	Telemedicine has successfully improved healthcare access but faces sustainability challenges.	Suggest integrating telemedicine with national healthcare systems and policies.

to extract meaningful insights. After completion of the initial coding, the results were analysed to identify broader overarching themes (O'Brien et al. 2009; Olding et al. 2015).

The approach was flexible and iterative, meaning the codes were continuously refined and adjusted as new patterns emerged from the data (Anugrah and Hermawan 2019; Qu and Chen 2019). This adaptability allowed the researcher to capture insights that might have been missed with a rigid approach. Finally, the coded data were organised into clear themes that provided a comprehensive overview of the impact of digital health innovations in sub-Saharan Africa. This systematic organisation ensured that the study analysis remained rigorous, consistent, and transparent while creating a coherent narrative aligned with the study objectives. To strengthen the reliability of the study findings, two independent reviewers assessed the quality of included studies using predetermined criteria. Any disagreements during study selection and data extraction were resolved through discussion and consensus, enhancing the robustness of the study conclusions.

Results

Seven themes emerged from the rigorous data analysis (Table 2; Figure 3). These themes are described below.

Impact of Digital Health Innovations on Healthcare Access and Delivery

Data analysis showed that digital health innovations are increasingly recognised for their transformative potential in SSA, particularly in addressing healthcare access disparities. Betjeman et al. (2013) and Wamala and Augustine (2013) highlight that telemedicine and mHealth technologies have significantly expanded healthcare services to remote and underserved populations. Bisi (2024) further reinforces this notion by demonstrating a positive correlation between information technology adoption and improved healthcare outcomes. The potential of FinTech solutions to revolutionise healthcare financing and access is explored by Cambaza (2023). Ebenso et al. (2018) explain how eHealth tools can be used to extend healthcare services to rural areas and further illustrate how digital platforms have improved service delivery by improving communication between healthcare providers and patients, leading to better health outcomes. The scoping review by Karamagi et al. (2022) maps the extensive landscape of digital health interventions employed to strengthen health systems. Likewise, Udenigwe, Omonaiye, and Yaya (2023) emphasise the potential of mHealth in addressing maternal healthcare challenges. However, these advancements also present challenges, including the need for robust digital infrastructure and ongoing training for healthcare professionals, as noted by Tahir et al. (2022).

Table 2: Themes identified from the selected studies.

Nr.	Theme	Description	Authors and Publication Year
1	Impact of digital health innovations on healthcare access and delivery.	Examines how digital health technologies transform healthcare access and delivery in SSA.	Betjeman, Soghoian, and Foran 2013; Ebenso et al. 2018; Tahir, Mars, and Scott 2022; Wamala, and Augustine 2013
2	Factors influencing adoption and implementation of digital health innovations.	Identifies and analyses the factors influencing the adoption and implementation of digital health technologies in the region.	Aboye, Simegn, and Aerts 2024; Karamagi, et al. 2022; Mooketsane and Phirinyane 2015
3	Challenges and opportunities of digital health innovations.	Explores the potential challenges and opportunities associated with digital health technologies in SSA.	Cambaza 2023; Seidu 2020; Tahir, Mars, and Scott 2022
4	Adoption of digital health innovations for specific purposes.	Discusses the adoption of specific digital health innovations in the region and their intended purposes.	Campain et al. 2018; Ouedraogo et al. 2021; Udenigwe, Omonaiye, and Yaya 2023
5	Benefits and barriers to adoption of digital health innovations.	Analyses the perceived benefits and barriers from the perspectives of healthcare providers and patients.	Aboye, Simegn, and Aerts 2024; Bisi 2024; Wamala and Augustine 2013
6	Sustainability and scalability of digital health innovations.	Focuses on the factors influencing the sustainability and scalability of digital health innovations in SSA.	Karamagi et al. 2022; Ouedraogo et al. 2021
7	Ethical and legal considerations in digital health.	Examines the region's ethical and legal implications of implementing digital health technologies.	Karamagi, et al. 2022; Udenigwe, Omonaiye, Yaya 2023

Factors Influencing the Adoption and Implementation of Digital Health Innovations

Various factors, including policy support, infrastructure availability, and community engagement, influence the adoption and implementation of digital health innovations in SSA. Aboye, Simegn, and Aerts (2024) emphasise the importance of aligning digital health initiatives with national health policies of countries in the SSA region to ensure widespread adoption and sustainability. Karamagi et al. (2022) discuss the need for

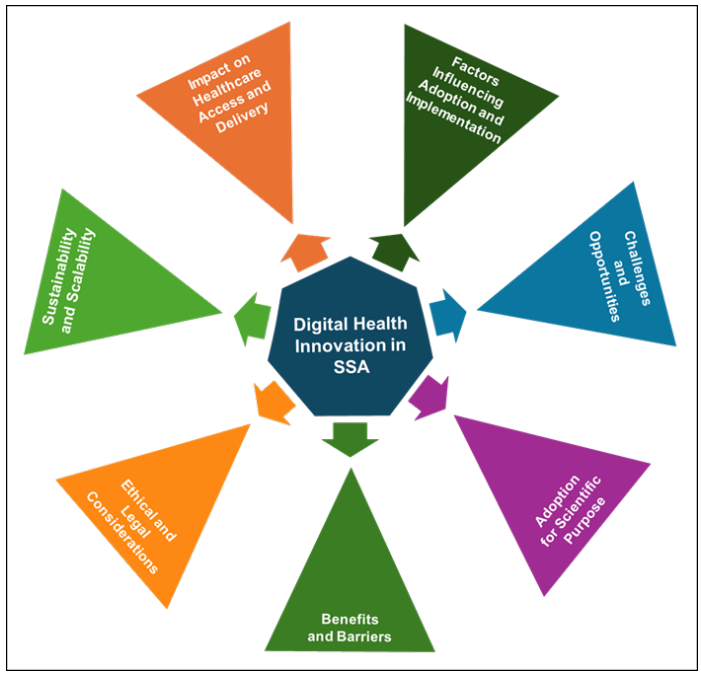

Figure 3: The seven themes extracted from the literature.

strong governance structures to oversee the implementation of digital health projects, ensuring that they are integrated into existing health systems rather than operating in isolation. Mooketsane and Phirinyane (2015) point to the importance of local cultural and social contexts in shaping the acceptance of digital health technologies, indicating that successful implementation requires a deep understanding of these factors.

Challenges and Opportunities of Digital Health Innovations

While digital health innovations offer significant opportunities for improving healthcare access, the findings showed that they also present challenges that must be addressed to realise their full potential. Cambaza (2023) and Seidu (2020) identify several barriers to successfully implementing digital health technologies, including regulatory issues, infrastructure deficits, and resistance from healthcare providers accustomed to traditional care methods. These challenges are compounded by the limited financial resources of the countries in the region, which can hinder the scalability of digital health solutions. Despite these obstacles, Tahir et al. (2022) suggest substantial opportunities for leveraging digital health to address critical healthcare needs, particularly in rural areas where traditional healthcare infrastructure is lacking.

Adoption of Digital Health Innovations for Specific Purposes

Furthermore, the review indicated that the adoption of digital health innovations in SSA is often driven by specific healthcare needs, such as maternal and child health, infectious

disease management, and healthcare provider training. For example, Campain et al. (2018) document simulation training in surgical skills, improving healthcare providers' competency in rural areas, while Tahir et al. (2022) delve into the potential of teleradiology. Similarly, Ouedraogo et al. (2021) highlight the role of mHealth applications in maternal health care, particularly in promoting antenatal care attendance and reducing maternal mortality rates. In the same vein, Udenigwe, Omonaiye, and Yaya (2023) explore the use of gender-transformative mHealth interventions that address healthcare access and gender inequalities, demonstrating the versatility of digital health innovations in addressing various public health challenges.

Benefits and Barriers to Adoption of Digital Health Innovations

The findings further underscore the benefits of adopting digital health innovations in SSA and the associated barriers. Aboye, Simegn, and Aerts (2024) show that digital health technologies, such as EHRs and telemedicine, have simplified healthcare processes, making it easier for providers to manage patient information and deliver care remotely. However, Bisi (2024) and Wamala and Augustine (2013) note that barriers such as limited digital literacy among healthcare workers and patients, concerns about data privacy, and the high cost of implementing digital health systems, can impede widespread adoption. Furthermore, Aboye, Simegn, and Aerts (2024) provide valuable information on barriers, including lack of awareness, inadequate infrastructure, and financial constraints that impede the use of mHealth systems in Ethiopia. Seidu (2020) further explores the barriers to access to health care among women in SSA, indicating the influence of socioeconomic factors, levels of education, and geographical location.

Sustainability and Scalability of Digital Health Innovations

This review underlined the need to make digital health innovation sustainable and scalable in countries in SSA for long-term impact. Karamagi et al. (2022) emphasise the need for digital health initiatives to be integrated into national health strategies and supported by sustainable funding models. Ouedraogo et al. (2021) argue that scaling up successful digital health interventions requires a focus on building local capacity and fostering partnerships between governments, the private sector, and international organisations. The same authors focus on the role of task-sharing policies in expanding access to family planning services, highlighting the importance of adaptive policies that facilitate the integration of digital health solutions into existing healthcare delivery models.

Ethical and Legal Considerations in Digital Health

Finally, this study sheds light on the implementation of digital health technologies in SSA and raises several ethical and legal considerations that must be addressed to ensure that these innovations are used responsibly. Udenigwe, Omonaiye, and Yaya (2023) discuss the potential for digital health technologies to exacerbate existing inequalities if not carefully managed, particularly with respect to data privacy and access to

technology. Karamagi et al. (2022) explain the need for robust legal frameworks to protect patient data and ensure that digital health initiatives adhere to ethical standards.

Discussion

The use of integrative review methodologies to analyse healthcare trends is a prevalent and acceptable approach in the global literature, as exemplified by the research of Detter, Tukkel, and Ljovkina (2021) and Payán-Sánchez et al. (2021), which underscores the importance of robust research methods in understanding healthcare dynamics and promoting sustainable practices. The analysis reveals that digital health innovations have transformative potential to improve access and equity to health care in SSA. This agrees with Du Plessis and Bam (2018), who explain that embracing technological advancements in healthcare systems worldwide can improve access, efficiency, and quality of care, contributing to sustainable healthcare development. This is consistent with Li et al. (2023) and Reyers and Selig (2020), who highlight the role of digital solutions in improving health services and achieving sustainable development goals. Telemedicine and mHealth technologies have emerged as pivotal tools, addressing geographical barriers and extending healthcare services to underserved populations, mostly in rural areas (Bisi 2024; Cambaza 2023). In line with the findings of this study, Haleem et al. (2021) report that telemedicine facilitates virtual consultations and remote monitoring, reducing the reliance on traditional physical infrastructure and improving access to specialised care. A study by Agbeyangi and Lukose (2025) further underscores the importance of effective adoption of information technology in improving healthcare outcomes in the region. Together, these digital solutions mark a significant shift in healthcare delivery, enabling more efficient patient care.

Furthermore, the findings of this study are supported by Ogundaini, De la Harpe, and McLean (2021), who indicate that mHealth technologies empower healthcare providers and patients by allowing seamless communication and access to health information through mobile platforms. In support of this study's findings, Rohwer et al. (2024) note that these platforms have been instrumental in promoting digital health literacy, equipping individuals to engage with healthcare systems and access necessary services effectively. Moreover, other studies also corroborate these results, showing that health information systems and EHRs have improved the quality and accuracy of data management, facilitating better decision-making and continuity of care (Motsi and Chimbo 2024; Mugauri et al. 2025). Olawade et al. (2024) concur that adopting artificial intelligence (AI) and machine learning technologies further enhances these systems, enabling personalised care and optimised treatment pathways.

Despite these advancements, the successful implementation of digital health innovations faces significant challenges. The analysis highlights infrastructure deficits, regulatory hurdles, and resistance from healthcare providers as major obstacles (Mooketsane and Phirinyane 2015). Additionally, limited digital literacy among patients

and healthcare workers and concerns about data privacy present further barriers to widespread adoption (Seidu 2020; Wamala and Augustine 2013). Addressing these challenges requires collaborative efforts among governments, stakeholders in the private sector, and international organisations to invest in sustainable infrastructure, training, and supportive regulatory frameworks (Karamagi et al. 2022). Tailoring digital solutions to address specific healthcare needs, such as maternal health and infectious disease management, can also enhance the impact of these technologies (Ouedraogo et al. 2021; Udenigwe, Omonaiye, and Yaya 2023).

Finally, sustainability and scalability are critical to ensuring the long-term success of digital health initiatives. Integrating these innovations into national health strategies and securing sustainable funding models are essential for scaling successful projects (Karamagi et al. 2022; Ouedraogo et al. 2021). Furthermore, ethical and legal considerations, particularly regarding data privacy and equitable access, must be addressed to prevent exacerbating existing inequalities (Udenigwe, Omonaiye, and Yaya 2023). The findings show that digital health innovations in sub-Saharan Africa cannot be disentangled from the structural, systemic, and contextual determinants shaping healthcare delivery. The interaction among innovative digital products, health information systems, digital literacy and community engagement, and policy support creates pathways to improved health outcomes (Figure 4). However, sustainability, scalability, and healthcare equity depend on aligning these domains with local realities, governance frameworks, and resource capacities. Thus, the framework provides a holistic lens for understanding how digital health can transition from isolated interventions to systemic enablers of equitable healthcare in the region.

The Findings through the SDH Theoretical Lens

When applying the SDH framework, the study findings clearly illustrate how various factors shape the adoption and effectiveness of digital health innovations in SSA. The framework emphasises that health outcomes are not determined solely by healthcare services but also by a wide range of social, economic, and environmental factors.

First, economic stability and infrastructure are critical to SSA's access to digital health innovations, such as telemedicine and mHealth solutions. Limited financial resources and infrastructure deficits, particularly in the digital infrastructure, pose significant barriers (Cambaza 2023; Seidu 2020). For these technologies to be sustainable and scalable, substantial investments in digital infrastructure and financial support are crucial, aligning with the focus of the SDH framework on economic stability as an important determinant.

Furthermore, the social and community context is critical in determining the successful adoption of digital health technologies. The SDH framework highlights the importance of social networks and community relationships in influencing health behaviours. Implementing digital health innovations requires tailoring these technologies to the local context, considering cultural and social dynamics (Mooketsane and Phirinyane

2015). Therefore, community engagement through targeted digital literacy programmes and culturally sensitive interventions is essential to ensuring widespread acceptance.

Education and literacy also emerge as significant factors influencing the adoption of digital health technologies. The SDH framework considers education as a determinant of health, noting that higher literacy levels can lead to improved health outcomes. The study underscores the importance of equipping healthcare providers and patients with digital skills to fully leverage these innovations (Aboye, Simegn, and Aerts 2024; Bisi 2024).

Moreover, the study discusses how health systems and governance structures impact the integration and sustainability of digital health solutions in SSA. Strong governance and alignment with national health policies are critical to incorporate these innovations effectively into existing health systems (Aboye, Simegn, and Aerts 2024; Karamagi et al. 2022). This perspective aligns with the emphasis of the SDH framework on policy as a determinant of equitable healthcare access. Ethical and legal considerations are also key factors, particularly regarding data privacy and the risk of exacerbating existing inequalities. The findings emphasise the need for inclusive legal frameworks to ensure digital health innovations contribute positively without unintended negative consequences (Karamagi et al. 2022; Udenigwe, Omonaiye, and Yaya 2023).

Therefore, while digital health innovations can potentially transform healthcare access in SSA, their success depends on addressing crucial social determinants such as economic stability, education, governance, and cultural acceptance.

Policy Implications

This study highlights significant policy implications for healthcare systems and policymakers in SSA. The successful implementation of digital health innovations requires a comprehensive approach that addresses infrastructure, human capacity, and regulatory frameworks to promote social equity and justice in healthcare access.

Strategic Investment Priorities

Several measures are essential for effectively leveraging digital health innovations to promote social equity and justice in access to health care in the region (Seidu 2020), help reduce health disparities, and bring SSA closer to achieving universal access to quality healthcare services for all populations (Doupis et al. 2020). These are:

- digital health infrastructure, including internet connectivity, mobile networks, and electronic health record systems;
- health information systems, and the strengthening of data management and integration capabilities;
- digital literacy programmes, and training for both healthcare providers and patients; and

- community engagement to foster local participation in programme design and implementation.

Implementation Strategies for Healthcare Improvement

Advancing healthcare quality and equity requires evidence-informed strategies that strengthen system capacity and responsiveness. The approaches outlined below focus on optimising service delivery, fostering inclusion, and supporting sustainable improvements in patient outcomes:

- Equip healthcare providers with the necessary tools and training to optimise healthcare delivery and improve patient care.
- Integrate gender transformative approaches into digital health programmes to advance equity and inclusion, ensuring both men and women benefit equally from these advancements.
- Align policies with targeted strategies to make significant strides towards universal healthcare access.

Regulatory and Governance Framework Requirements

Robust governance structures are central to the ethical and effective integration of digital health technologies. The following framework priorities emphasise accountability, data protection, and multi-sector collaboration as foundations for equitable digital transformation:

- Data privacy safeguards: Establish frameworks that protect patient information while promoting innovation.
- Digital literacy policies: Prioritise training initiatives to increase effective use of digital tools.
- Community-centred design: Ensure initiatives are culturally relevant and responsive to local needs through community involvement in programme design and implementation.
- Multi-stakeholder coordination: Overcoming challenges of technology adoption and infrastructure gaps requires a coordinated effort among governments, international organisations, and local stakeholders.

Therefore, the policy landscape in SSA must evolve to support integrating digital health solutions, address persistent healthcare challenges, and promote gender equity. By fostering a culture of research, innovation, and evidence-based decision-making, policymakers can drive sustainable improvements in healthcare delivery and ensure equitable access to quality healthcare services across the region. These efforts, grounded in the principles of social determinants of health, are critical to the long-term success of

digital health initiatives in SSA. The road map to sustainable digital health for transforming healthcare access in SSA is articulated in Figure 4.

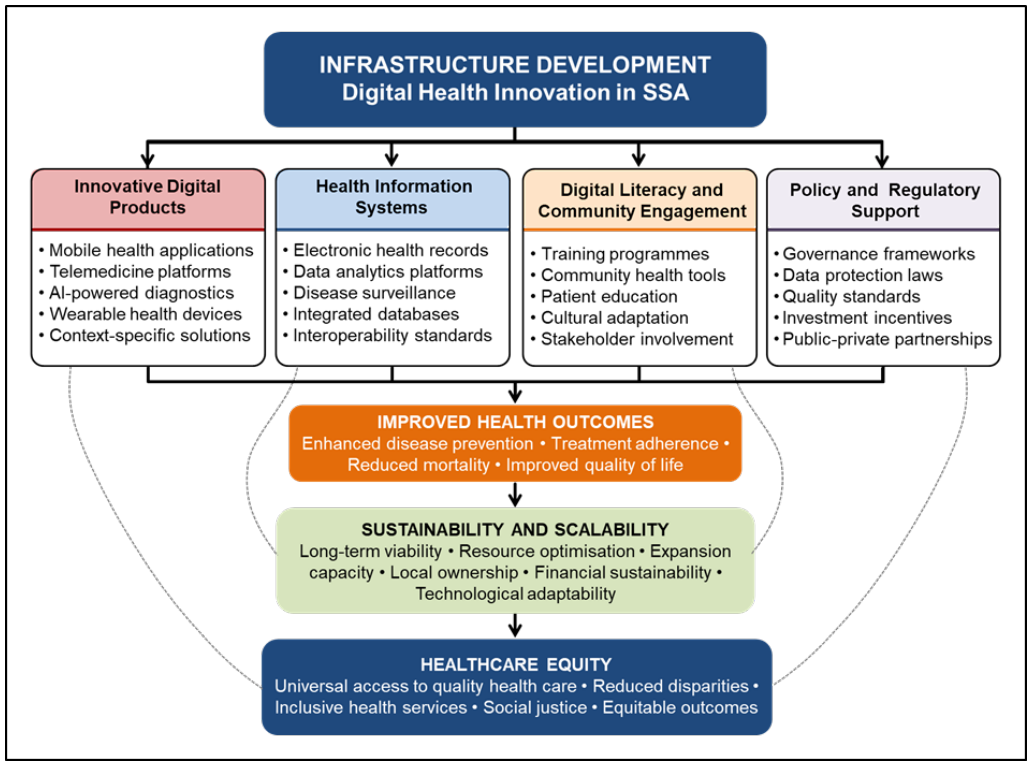

Figure 4: The conceptual framework for digital health innovations in sub-Saharan Africa.

Conclusion

Digital health innovations have enormous potential to transform healthcare access and promote equity in sub-Saharan Africa. Strategic deployment of technologies such as telemedicine, mHealth, AI, and health information systems, along with community engagement initiatives, can drive progress towards achieving universal access to health care in line with SDG 3. The study highlights the importance of addressing social determinants of health and promoting digital literacy to ensure inclusive and equitable access to healthcare services. By investing in digital infrastructure, fostering gender-transformative approaches, and aligning policies with these innovations, stakeholders can create a more just and sustainable healthcare system for all populations in the SSA region. The window of opportunity to leverage digital transformation for healthcare equity is now. Policymakers, development partners, and healthcare leaders must act decisively within the next five years to establish the foundational infrastructure and regulatory frameworks to determine whether millions across SSA gain or remain excluded from quality health care in the digital age.

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