Digital Medicine in Frontline Healthcare: The Role of Digital Health Technologies on Health Outcomes in Uganda

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DOI: https://doi.org/10.47772/IJRISS.2026.100800082

Received: 12 August 2026; Accepted: 17 August 2026; Published: 26 August 2026

ABSTRACT

Digital health technologies are transforming healthcare delivery by improving access to healthcare services, enhancing clinical decision-making, strengthening disease surveillance, and promoting health system efficiency. In Uganda, the adoption of innovations such as telemedicine, mobile health (mHealth), electronic medical records (EMRs), artificial intelligence (AI), and digital disease surveillance has increased as part of efforts to strengthen healthcare delivery and achieve Universal Health Coverage. However, evidence on their impact on health outcomes remains fragmented.

This qualitative literature review synthesized published evidence on the role of digital health technologies on health outcomes in Uganda. Relevant literature published between 2015 and 2026 was identified through Google Scholar, PubMed, Scopus, Web of Science, and publications from the World Health Organization and the Uganda Ministry of Health. Studies were purposively selected and analyzed thematically. The review identified five themes: digital health adoption; improved access to healthcare; enhanced quality of care and clinical decision-making; strengthened disease surveillance and health system performance; and barriers to implementation.

The findings show that digital health technologies have improved healthcare accessibility, timeliness of care, patient follow-up, disease surveillance, health information management, and healthcare worker performance. However, inadequate infrastructure, limited technical capacity, interoperability challenges, financing gaps and data security concerns continue to hinder their effectiveness. The review concludes that digital health technologies have considerable potential to improve health outcomes in Uganda if supported by stronger digital infrastructure, workforce capacity, digital governance, and effective policy implementation.

Keywords: Digital medicine, digital health technologies, telemedicine, mobile health, electronic medical records, health outcomes, Uganda, qualitative literature review.

INTRODUCTION

Digital medicine has emerged as one of the most transformative developments in contemporary healthcare, driven by the rapid advancement of digital technologies and their integration into clinical practice.

The convergence of healthcare and digital technologies has transformed healthcare delivery globally. The capability of health systems to prevent disease, aid clinical decision-making, improve delivery of services, and deliver better patient outcomes has been increased by the advances in information and communication technologies (ICTs) such as artificial intelligence (AI), cloud computing, electronic health records (EHRs), mobile health applications (mHealth), wearable devices, remote patient monitoring, and digital diagnostics

(Coravos et al., 2019) (Topol E, 2019). The World Health Organization (WHO) sees the potential of digital health to be a strategic enabler of resilient, equitable and people-centred health systems and a key contributor towards reaching the Sustainable Development Goals (SDGs) for health Universal Health Coverage (UHC) by 2030 (Dhingra & Dabas, 2020).

Persistent global challenges, such as a lack of healthcare workers, growing disease burden, rising healthcare expenditure, weak health information systems, and unequal access to quality healthcare are among the factors that contribute to the rising use of digital health technologies. The use of technologies like telemedicine, mobile health (mHealth), clinical decision support systems (CDSS), electronic health records, remote patient monitoring, and digital diagnostics has proven to have great promise in enhancing access to healthcare services, diagnostic capabilities, continuity of care, and evidence-based clinical practice. But digital empowerment is dependent on enablers such as digital infrastructure, interoperability, governance, financial resources, workforce capabilities, and an enabling regulatory environment (Agarwal et al., 2023; Dhingra & Dabas, 2020; Labrique et al., 2020).

In low and middle income nations, and especially sub-Saharan Africa, with ongoing resource constraints, health worker shortages and inequitable access to health services, the role of digital medicine is especially relevant. While many digital health interventions are being implemented with significant investment from governments and development partners to enhance primary health care and service delivery, many interventions are disjointed, under-integrated and challenging to sustain, and thus have limited contribution to health systems performance (WHO, 2023a; Labrique et al., 2020). The government of Uganda has put a strong focus on digital transformation by developing the National eHealth Strategy (NES) and the Health Information and Digital Health Strategic Plan (HIDHS), which seek to advance interoperability, enhance data quality, facilitate evidence-based decision making, and increase access to quality health care services (Ministry of Health, 2021).

Despite these efforts, there is still a lack of understanding about the broader effects of digital health technologies on clinical outcomes, with the majority of studies concentrated on specific digital health technologies, and not on the aggregated impact when they are used together to enhance frontline health care. Therefore, there is a need to combine all the evidence and increase the knowledge about the role of digital health technologies on health outcomes in the Ugandan health system. For this reason this chapter is divided into seven sections. It starts with a conceptual review of Digital medicine, Digital health technologies, Frontline health care and health outcomes, followed by a theoretical review and empirical review of literature, both at a global level, and detailed literature review of literature on a African and Ugandan level.

Rationale

Digital health technologies continue to profoundly revolutionize healthcare delivery by improving access to services, strengthening clinical decision-making, and enhancing health system performance (WHO, 2021; Steinhubl & Topol, 2018). In Uganda, the Ministry of Health has adopted digital health policies and strategic frameworks to promote the integration of digital technologies into healthcare delivery and accelerate progress towards Universal Health Coverage (Ministry of Health Uganda, 2023).

Despite these efforts, evidence on the impact of digital health technologies on health outcomes in Uganda remains fragmented, with most studies focusing on specific interventions or disease programmes rather than providing a comprehensive synthesis of their overall contribution to healthcare accessibility, quality, efficiency, and patient outcomes. Furthermore, implementation challenges such as inadequate infrastructure, limited digital literacy, interoperability constraints, and data security concerns continue to affect the successful adoption of digital health innovations (MoH, 2023; WHO, 2021).

Therefore, a qualitative literature review is necessary to critically synthesise existing evidence on the influence of digital health technologies on health outcomes in Uganda. The review will identify current knowledge, highlight research gaps, and provide evidence-based recommendations to inform policy, practice, and future research aimed at strengthening digital health implementation and improving health outcomes in Uganda.

METHODS AND MATERIALS

The study adopted a literature review as method and tool for identifying, analyzing, synthesizing and interpreting the existing scholarly evidence on the role of Digital Health Technologies on Health Outcomes in Uganda. A literature review was deemed suitable as it allows for research findings from a variety of studies to be drawn together and patterns to emerge, gaps in knowledge to be identified, and a general overview to be achieved of a research problem without having to collect primary data (Snyder, 2019b; MacDonald, 2014). Literature review was performed and sources of information consisted of peer-reviewed journal articles, scholarly books, government documents, policy documents, technical documents, conference papers and publications from recognised international organisations like World Health Organisation (WHO), World Bank, Uganda Ministry of Health, and other reputable research institutes. The electronic databases that were searched were PubMed/MEDLINE, Scopus, Web of Science, Google Scholar, ScienceDirect, SpringerLink, Wiley Online Library, Taylor & Francis Online, IEEE Xplore and African Journals Online (AJOL). These databases are chosen due to their broad scope of health sciences, digital health, medical informatics and public health research.

The literature search used a combination of the following terms: Digital medicine", "Digital health", "Digital health technologies", "eHealth", "mHealth", "Telemedicine", "Electronic Health Records", Artificial Intelligence in healthcare, Clinical Decision Support Systems, Remote Patient Monitoring, Health outcomes, Health-care delivery, Primary health-care and Uganda and Sub-Saharan Africa. Boolean operators (AND, OR) were used to increase the chances of obtaining relevant studies.

The review focused on publications between 2015 and 2026, and seminal works predating 2015 were only considered essential if they addressed the study's theoretical and conceptual insights. The review search is crucial because it assesses the evidence and compares different interpretations of the literature, it looks for areas of agreement or disagreement, it highlights gaps that need to be addressed in the methodology and/or the context, and it identifies gaps which justify further exploration (Snyder, 2019; Creswell & Creswell JD, 2018).

The studies were included if they included digital health and digital medicine interventions; studied health outcomes, healthcare delivery, service quality, efficiency, patient experience, and/or clinical outcomes; were conducted in Uganda or in contexts that would provide evidence that is relevant to Uganda and similar contexts in LWICs; were published in English; and were published in peer-reviewed journals or credible institutional publications. The studies were excluded if: methodological information was insufficient; they were specific to technological development and not focused on the healthcare application; they were editorials or opinion pieces with no empirical or conceptual relevance; were duplicate of information already provided by more comprehensive publications.

After the database search, the retrieved records were subjected to screening based on the title and abstract and then included in the study based on the fulfillment of the study objectives. Article content was then analysed in detail of those that were included in full test review. Backward/forward citation tracking of some essential publication was used to identify additional relevant publications and to assure thorough literature coverage. The data gathered consisted of authors, year of publication, and country of study, study aims, study design, digital health intervention, study population, main results, reported health outcomes, highlighted challenges and recommendations.

Thematic synthesis of the collected evidence was used to analyse the evidence. These findings were organized into key themes aligned with the aims of the review: underlying technologies of digital health in Uganda, enhanced access to health services, diagnostic accuracy, treatment adherence, and quality of care, health outcomes, healthcare system efficiency, barriers and opportunities for digital transformation.

Evidence was prioritised by using recent peer-reviewed studies and publications by internationally recognised organisations to ensure credibility, validity and reliability of the evidence. The old landmark studies were only taken into consideration if they provided fundamental concepts or historical background relevant to digital medicine. A number of sources were compared in order to increase the robustness of the synthesis, and to minimise the risk of bias due to the use of individual sources only.

LITERATURE REVIEW

Introduction to Digital Medicine

Digital medicine is the clinically focused application of digital technologies for diagnosis, monitoring, treatment and disease prevention (Mangion & Piller, 2025; Yeung et al., (2023). While Ronquillo Y & Korvek SJ, (2023) defined digital medicine as the application of technologies like artificial intelligence (AI), mobile apps, wearable sensors, telemedicine, electronic health records (EHR) and remote monitoring systems to support clinical decision making and enhance patient outcomes. These definitions show that digital medicine is not just about the digitization of health information but also the development of technology to be brought into everyday clinical practice to shape health care provision optimally.

Health systems scholars, on the other hand, call for a more comprehensive definition of digital medicine as a healthcare systems transformation that includes technology, governance, organizational processes, health workforce capacity, interoperability, and policy changes. Health systems scholars, however, argue for a broader understanding of digital medicine as a healthcare systems transformation, encompassing technology, governance, organizational processes, health workforce capacity, interoperability and policy changes (WHO, 2021). The bigger picture is that digital medicine is not a matter of using new technologies, but of (re)designing the healthcare system to be more efficient, equitable, and of better quality.

Digital medicine has developed in line with the rapid developments of information and communication technology in the past few decades. In the early days, the uses of digital technology were mainly in areas such as hospital information systems, which helped to digitize patient information and enhance administrative efficiency. Technology, however, has made a huge impact on the range of digital medicine, with telemedicine, mobile health (mHealth), clinical decision support systems, AI-assisted diagnostics, remote patient monitoring, precision medicine and digital therapeutics (WHO, 2023a). This transformation has been further hastened by the COVID-19 pandemic, which emphasised the need for digital technologies to ensure healthcare continuity in times of limited face-to-face interaction. The pandemic has shown the adaptability and resilience of digitally enhanced healthcare systems, as digital platforms became essential for delivering remote consultations, monitoring patients' conditions, tracking disease outbreaks and sharing information, as Ndayishimiye et al., (2023) noted.

Digital medicine's scope has consequently broadened from helping in clinical care to boosting health systems' overall performance. Digital medicine today is defined as interventions that address patients, health providers, health managers and health policy makers (WHO, 2023a). These interventions enable electronic patient records, tele-consultations, remote diagnostics, health workforce training and supply chain management, as well as public health surveillance and evidence-based decision making for policy. This broader scope demonstrates how digital innovations have evolved from contrasting and small-scale to becoming part of digital health systems that can promote better health system performance across a range of levels.

The significance of digital medicine can be seen in countries of low and middle-income (LMICs), where the healthcare system often struggles with a lack of skilled healthcare workers, poor quality of infrastructure, poor quality of health information systems, and geographical inequities in access to health services. Digital medicine can help overcome these challenging issues, such as access to health services, disease surveillance, clinical decision making and continuity of care, as noted by (Manyazewal et al., 2021). Likewise, the (Dhingra & Dabas, 2020) highlights that smartly applied, digital health interventions are poised to help reach the goals of Universal Health Coverage by promoting access to quality health services for the less-served by leveraging technical solutions that can provide greater access and equity across geographic and socioeconomic barriers.

But a number of papers warn that digital medicine is more than just a technological innovation. Digital medicine's effectiveness is shaped by digital infrastructure, internet connection, electricity supply, the skills of the workforce, governance, interoperability, funding, cyber security and supportive regulatory frameworks, as cited by (Yeung et al., 2023). These enabling conditions are not equally accessible in many African countries, such as Uganda, which leads to unequal uptake and impact of digital health technologies (Ssebibubbu et al., 2026).

Digital medicine offers many opportunities to bolster health services, but its impact is highly context dependent and both system and institutional settings.

Digital medicine is now an important part of the health sector reforms going on in Uganda. The Ministry of Health, (2021) has made the integration of interoperable health information systems, electronic medical records, telemedicine, mobile health platforms, digital surveillance systems, and other tools as key priorities to enhance healthcare quality and accessibility. These are all part of national strategies and commitments to support the strengthening of frontline health care, evidence-based decision making, and the efficiency of the health system (Ministry of Health, 2021). However, the potential of digital medicine in the country's healthcare system remains untapped, due to a range of implementation challenges such as low digital literacy of health workers, digitisation costs, suboptimal infrastructure, and weak interoperability.

DIGITAL HEALTH TECHNOLOGIES

Understand the concept and definition of Digital Health Technologies

Digital health technologies (DHTs) are the backbone of digital medicine in the current era and are essential in the current healthcare systems. They include a wide spectrum of information and communication technologies (ICTs), software application, connected medical devices, and digital platforms to facilitate disease prevention, diagnosis, treatment, rehabilitation, health promotion and health system management.

Digital Health technologies enable real-time data collection, communication, clinical decision making, patient engagement and evidence-based healthcare delivery. According to Hu et al., (2025), digital health technologies involve Artificial Intelligence (AI), telemedicine, wearable devices, remote patient monitoring, and predictive analytics that improve healthcare quality, patient safety and personalized care. Digital health technologies refers to a combination of software, hardware, mobile applications, cloud computing, artificial intelligence, wearable technologies and interoperable information systems to improve health system efficiency and patient-centred care (Ronquillo Y & Korvek SJ, (2023). Likewise, Yeung et al., (2023) claim that the digital health technology fosters patient-centric, personalized, and data-driven healthcare that allows for the interaction of clinicians and patients beyond the healthcare institution. Similarly, (Ndayishimiye et al., 2023) noted that digital technologies have emerged as key drivers to enhance health system resilience, continuity of care and healthcare accessibility after COVID-19.

While there is a consensus that digital health technologies have transformative potential, there are different concepts of what transformative means. While technology-oriented researchers tend to focus on digital tools that are used in healthcare (Yeung et al., 2023), health systems scholars consider digital health technologies to be socio-technical systems that require supportive governmental policies, organizational preparedness, workforce capabilities, interoperability, funding, and regulatory measures to yield tangible health benefits (WHO, 2021). Digital health technologies therefore need to be viewed as part of a wider health system transformation, rather than solely as technological innovations, that allows the delivery of efficient, equitable and patient-centred health services (WHO, 2021).

Digital Health Technologies classified into seven categories

There are a variety of digital health technologies that have different roles in health care systems. The WHO, (2023a) categorises digital interventions based on: 1) clients and patients; 2) healthcare providers; 3) health system managers; 4) data service managers. This functional classification is an illustration of how digital technologies are designed to support health systems and health services beyond clinical uses to improve patient, organizational and population health (WHO, 2023a). A clinical point of view, there are a number of different broad categories for digital health technologies. The first includes telemedicine and telehealth technologies that allow for remote consultations, diagnosis, treatment, referrals to specialists and follow-up, via digital communications (WHO, 2023). This has been a more significant development in enhancing healthcare access for underserved and geographically remote individuals and communities (Gilbert et al., 2020).

The second type are mobile health (mHealth) technologies that can use mobile phones, smartphones, tablets, and wireless communications to provide health information, patient education, reminders for medicines, disease monitoring, and patient-to-provider and provider-to-patient communication (WHO, 2023a). With mobile phones being widely used in low- and middle-income countries, mHealth is one of the most accessible digital health interventions to enhance healthcare delivery (Ndayishimiye et al., 2023).

The third types are Electronic Health Records (EHRs) and Electronic Medical Records (EMRs). These technologies enable the efficient storage, retrieval, sharing and management of patient data between health care institutions, ensuring security. The (Ministry of Health, 2021), interoperable electronic health records improve continuity of care, strengthen clinical decision-making, and enhance the quality of health information management. Likewise, World Health Organisation (WHO, 2023a) identifies EHRs as key elements of digitally connected healthcare systems.

Artificial Intelligence (AI) and Clinical Decision Support Systems (CDSS) are also among the growing segments.AI and Clinical Decision Support Systems (CDSS) is another fast-growing segment. AI systems can use large data sets of health information to assist in disease prediction, medical imaging interpretation, disease risk stratification, and personalized treatment recommendations, while CDSS can work with clinicians to deliver evidence-based recommendations, alerts and reminders, and diagnostic support to enhance clinical decision making (Topol E, 2019; WHO, 2023a). While AI technologies are continually being developed and updated, the latest research shows their growing role in diagnostic imaging, precision medicine, and predictive analytics (Yeung et al., 2023).

Digital health technologies also encompass Remote Patient Monitoring (RPM) technologies, which use wearable sensors, connected medical devices and Web of Things (IoT) technologies to monitor patients' physiological parameters outside of the healthcare setting. These systems can help to detect clinical deterioration early, better manage chronic diseases, minimize hospital re-admissions, and facilitate continuity of care, especially for chronic disease patients (Ndayishimiye et al., 2023; WHO, 2023a).

There is a third group of digital diagnostic technologies that combine digital imaging, AI, laboratory information systems, and point-of-care diagnostic technologies, aiming to enhance the accuracy of diagnosis and speed up clinical decision making. Technologies are gaining more significance in enhancing diagnostic capability, especially in the resource constrained health care delivery setting, where limited human resources and laboratory equipment are still huge challenges in the provision of care (WHO, 2023a; Yeung et al., 2023).

Digital medicine is seeing emerging technologies like block-chain. Furthermore, generation of real world evidence is emphasized to validate the digital health applications, and (Subramanian et al., 2021) introduce the concept of crypto pharmacy, which is a digital medicine application that employs hybrid block-chain to solve the problems in the pharmaceutical supply chain, with the aim of providing greater transparency and security in pharmaceutical transactions. Innovation in the generation of evidence to enable the adoption of digital health tools into clinical decision making is discussed by the authors (Stern et al., 2022).

In the future, the digital twin's integration with advanced computational models can be used to create innovative personalized medicine solutions. In their work (De Domenico et al., 2025), the authors discuss the potential of digital twins, built with a wealth of data and AI, to model and simulate biological systems, and enable precision medicine, highlighting the need for mechanistic and multi-scale modeling.

Overall, the literature demonstrates that digital health technologies are interconnected rather than independent innovations. Their effectiveness depends on interoperability, integration into routine clinical workflows, user acceptance, digital literacy, supportive governance, financing, and adequate digital infrastructure (WHO, 2021; Ministry of Health, 2021). Thus, digital transformation cannot happen in isolation and therefore complementary technologies will need to be coordinated for successful implementation.

Health Outcomes

Health outcomes are the measurable changes in an individual's or population's health resulting from health care interventions, public health programmes or activities of the health system in general. They offer an objective perspective on the effectiveness of health services to meet their objectives of improving health, reducing disease burden and enhancing patients' quality of life. World Health Organisation (WHO, 2023a), defines health outcomes as any improvement in health status, functional capacity, disease progression, survival or well-being of a patient or population that can be described as a result of the healthcare system or interventions. Health outcomes are therefore now a key focus when measuring the effectiveness, efficiency, quality and equity of health care delivery.

Today, researchers can be found who believe health outcomes are more than just morbidity and mortality. Patient-reported outcomes, improvements in healthcare processes, access to services, quality of care, patient experience, and organizational performance are increasingly the focus of the evaluation of modern healthcare, including digital health interventions (DHI), note Scheibe et al., (2023) This broader view is a move away from focusing on disease-centred health care evaluation measures but towards measures of health care that focus on the value of interventions to patients.

Likewise, Brenner et al., (2023) suggest that multidimensional outcome measures are needed to assess the effectiveness of digital health interventions as opposed to the classic clinical outcomes. The scoping review they have conducted shows that effective assessment measures should cover indicators on clinical effectiveness, safety, and satisfaction of users, healthcare efficiency, accessibility and health system performance. This multidimensional measurement reflects the fact that digital technologies can exert an impact on healthcare delivery that is indirect, affecting clinical processes, communication and decision making before any clinical differences are clinically measurable or clinically significant in terms of morbidity or mortality.

Although there is general consensus that the importance of health outcomes is of paramount importance, there is variation in scholars' focus. The main clinical researchers' definitions of health outcomes are in terms of physiological improvement, disease control, symptom reduction, functional recovery and rates of survival. Other researchers in the health sector, however, prefer a wider perspective that includes aspects of health-system accessibility, responsiveness, and continuity of care, equity, patient empowerment and quality of life. Likewise, the (Organisation for Economic Co-operation and Development (OECD, 2023) emphasizes that the ultimate goal of digital health is to enhance the health system's performance and clinical outcomes by leveraging health data, digital technologies and patient-centred care.

This wider context is especially useful for digital medicine since there are many digital health technologies that are not designed to cure diseases, but to enhance the processes of delivering health care that will have an impact on patient outcomes. Electronic health records, for instance, aid continuity of care, telemedicine boosts access to health care, clinical decision support systems enhance diagnostic accuracy, and remote patient monitoring facilitates the early detection of clinical deterioration. These enhancements have a cumulative effect to improve health, which is achieved not by therapeutic effects of the improvements themselves, but by delivering more timely, coordinated and evidence-based health care.

Dimensions of Health Outcomes

The effects of health can be described in many dimensions and these dimensions involve multiple interrelated areas, all of which are indicative of the effectiveness and quality of care provision. Historically, health assessment was largely based on mortality, morbidity and measures of clinical outcomes for specific diseases. But today's health systems are increasingly aware that successful health care goes beyond just survival to improving functional status, patient experiences, healthcare access, safety, efficiency and quality of life (Scheibe et al., 2023).

A significant dimension is clinical outcomes that encompass disease control, symptom alleviation, functional improvement, recovery rates, morbidity and mortality. These indicators are still core as they have a direct link to the effectiveness of medical interventions. They are frequently not enough to assess the impact of digital health technologies, however, whose impact may not be immediate, but rather improvements to how health care is delivered Scheibe et al., 2023; Hatef E et al., 2023; Brands et al., 2022).

A second dimension consists of patient-reported outcomes, such as patient satisfaction, perceived quality of care, treatment adherence, health-related quality of life and patient engagement. With a stronger focus on the patient-centred approach to healthcare, these measures are now viewed as being important metrics for performance in health systems, as they reveal patients' perceptions and experiences of care, which can be captured by clinical measures alone (Scheibe et al., 2023).

The third dimension is about the outcomes of health systems, such as health system access, efficiency, continuity, timeliness, accuracy, patient safety, and equitable health system service delivery. Ideally, digital health interventions should now further bolster these health system dimensions, enabling better information flow, evidence-based decision making, better coordination between health system actors and better health system management for patients throughout their health journeys (WHO, 2023a).

Taken together, they illustrate that health outcomes are no longer measured just in terms of mortality and morbidity. Rather, a comprehensive evaluation of health care takes a more holistic view that incorporates clinical, patient-centred and health system measures. This multidimensional perspective is important for the current study because digital health technologies can impact health outcomes by enhancing the access to healthcare, quality of care, diagnostic precision, treatment adherence and compliance, patient safety, patient satisfaction, and eventually by lowering the disease burden and preventable death rate.

Frontline Healthcare in Uganda

Frontline healthcare refers to the first point of contact between individuals, families, and the healthcare system where essential health services are delivered. It encompasses preventive, promotive, curative, rehabilitative, and palliative care provided through primary healthcare facilities, community-based services, and lower-level health institutions. According to the World Health Organisation (WHO, 2023a), frontline healthcare is fundamental to achieving Universal Health Coverage (UHC) because it ensures that essential health services are accessible, affordable, equitable, and responsive to the health needs of communities. Frontline healthcare providers include medical officers, clinical officers, nurses, midwives, pharmacists, laboratory personnel, and community health workers who deliver routine healthcare services within communities and primary healthcare facilities.

The concept of frontline healthcare is closely aligned with the principles of primary healthcare articulated in the Declaration of Astana, which emphasizes accessible, people-centred, integrated, and community-oriented healthcare services (WHO & UNICEF, 2020).

Contemporary literature recognizes frontline healthcare as the cornerstone of resilient health systems because it promotes early disease detection, timely diagnosis, continuity of care, disease prevention, and effective referral systems. Moreover, strengthening frontline healthcare contributes significantly to reducing preventable morbidity and mortality while improving overall population health outcomes (WHO, 2023a).

Uganda's Healthcare System

Uganda operates a decentralized healthcare system comprising public, private not-for-profit, and private for-profit and traditional healthcare providers. The Ministry of Health is responsible for policy formulation, regulation, planning, resource mobilization, and overall stewardship of the health sector, while local governments oversee the implementation and management of health services within district (Ministry of Health Uganda, 2024).

The public healthcare delivery system is organized into a hierarchical referral structure designed to provide progressively specialized healthcare services. Community health services constitute the foundation of the system and are supported by Village Health Teams (VHTs). These are followed by Health Centre II facilities that provide outpatient services and preventive healthcare, Health Centre III facilities offering maternity and laboratory services, Health Centre IV facilities providing emergency surgical and inpatient care, district and general hospitals, regional referral hospitals, and finally the National Referral Hospitals that offer highly specialized healthcare services (Ministry of Health Uganda, 2024). Although Uganda has made notable progress in expanding healthcare infrastructure and increasing healthcare utilization, the health system continues to face

significant challenges, including shortages of skilled healthcare workers, inadequate financing, limited medical equipment, weak health information systems, overcrowded facilities, and geographical disparities in access to healthcare. These constraints disproportionately affect rural and underserved communities where primary healthcare facilities often constitute the only accessible source of healthcare services (World Bank, 2024).

Primary Healthcare and Frontline Services

Primary healthcare (PHC) forms the foundation of Uganda's healthcare system and serves as the principal mechanism through which frontline healthcare is delivered. The World Health Organisation (WHO, 2023b) defines primary healthcare as a whole-of-society approach that aims to maximize population health by bringing comprehensive healthcare services as close as possible to where people live and work. It emphasizes health promotion, disease prevention, diagnosis, treatment, rehabilitation, and palliative care throughout an individual's life course.

In Uganda, frontline primary healthcare services are primarily delivered through Health Centre II, III, and IV facilities alongside community-based health programmes coordinated by Village Health Teams. These facilities provide essential services including immunization, maternal and child health, family planning, HIV/AIDS management, tuberculosis control, malaria diagnosis and treatment, nutrition services, and management of common communicable and non-communicable diseases (Ministry of Health Uganda, 2024).

Recent studies indicate that strengthening primary healthcare remains one of the most cost-effective strategies for improving population health and achieving Universal Health Coverage. Nevertheless, healthcare delivery at the primary care level continues to be constrained by inadequate staffing, shortages of essential medicines, poor infrastructure, insufficient diagnostic capacity, weak referral systems, and fragmented health information systems. These limitations reduce the quality, accessibility, and continuity of healthcare services, particularly within rural districts (WHO, 2023a; World Bank, 2024).

Community Health Workers

Community Health Workers (CHWs), commonly known as Village Health Teams (VHTs) in Uganda, constitute an essential component of frontline healthcare delivery. They act as the interface between communities and formal healthcare facilities by providing health education, disease surveillance, health promotion, preventive services, community mobilization, and referral of patients requiring specialized medical care. According to the Ministry of Health, (2024), VHTs play a pivotal role in extending healthcare services to hard-to-reach communities, particularly where shortages of professional healthcare workers limit access to essential healthcare.

The importance of community health workers has increased considerably with the expansion of digital health technologies. Digital tools such as mobile health (mHealth) applications, electronic reporting systems, digital decision-support tools, and mobile disease surveillance platforms have enhanced the capacity of VHTs to collect health data, monitor patients, communicate with healthcare professionals, and provide timely referrals. The World Health Organization (WHO, (2023b) reports that digital technologies improve the efficiency, accuracy, and timeliness of community-based healthcare services while strengthening disease surveillance and continuity of care.

Despite these contributions, community health workers continue to face numerous operational challenges, including inadequate training, insufficient supervision, and inconsistent remuneration, limited access to digital devices, poor internet connectivity, and inadequate technical support. These constraints reduce the effectiveness of digital health interventions and limit the ability of VHTs to fully utilize digital technologies in routine healthcare delivery. Addressing these challenges requires sustained investments in capacity building, supportive supervision, digital infrastructure, and integration of community health workers into national digital health strategies.

SUMMARY

The literature shows that digital health technologies have significant potential in Uganda to increase access, continuity and quality of care, improve clinical decision making, increase treatment adherence, increase health system efficiency, and increase patient safety. Uganda has made significant strides in implementing a national digital health agenda with its Health Information and Digital Health Strategic Plan, which supports patient-level digital systems, electronic medical records (EMRs), mHealth, telehealth, digital surveillance and interoperable health information systems (Ministry of Health, 2021; WHO, 2023c).

At present, Electronic Medical Records (EMRs), DHIS2/electronic health information systems, and mobile based services or mHealth are among the most mature technologies that are used in Uganda, and telemedicine and telehealth are gaining traction. Clinical decision-support systems, digital diagnostics, remote patient monitoring and artificial intelligence are still fairly new. Uganda EMR has widely been rolled out in public health facilities, but there are still significant interoperability issues (Ministry of Health, 2025).

However, there are several challenges discussed in the literature, including lack of infrastructure, financial resources, technical capacity and lack of interoperability and platform integration. Uganda has a large number of digital health innovations but many are operating in isolation, thus, failing to allow for effective exchange and utilisation of health information (Alunyu Egwar et al., 2024; Ministry of Health, 2023).

CONCLUSION

Overall, there remains a key gap in knowledge as most of the studies conducted in Uganda focus on testing individual technologies, specific diseases or implementation processes and do not assess the multifaceted health impacts of multiple digital health technologies. Empirical studies to explore the impact of digital health technology on access, quality of care, diagnostic accuracy, treatment adherence, patient safety, satisfaction, and morbidity and health outcomes in frontline health care settings are therefore needed.

Abbreviations

AI Artificial Intelligence

EHR Electronic Health Records

EMR Electornic Medical Records

CDSS Clinical Decision Support Systems

OECD Organisation for Economic Co-operation and Development

MoH Ministry of Health

UHC Universal Health Coverage

VHT Village Health Team

WHO World Health Organisation

DECLARATION

Kareodu R Conceived and designed the study, performed the literature search, review, synthesis and interpretation of the findings; drafted the manuscript; critically revised the content for significant intellectual input; approved the final manuscript for publication.

Kareyo M**:** Helped to synthesize and interpret the results; assisted in drafting the manuscript and in critically

reviewing it for intellectual content; and approved the final manuscript for publication. The final manuscript has been read and approved by all of the authors and each author agrees to be accountable for all aspects of the work.

Conflict of interest

The authors declare that they have no conflicts of interest

Ethical approval: Not application

Consent to participate: Not application

Consent to publication: Not application

Availability of data: Not application

Funding: Not application

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