

# Technology and Innovation in Midwifery Practice in Sub-Saharan Africa: Opportunities and Challenges for Maternal and Newborn Health

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## Abstract

Sub-Saharan Africa (SSA) continues to experience some of the highest maternal and neonatal mortality rates globally, driven by limited access to skilled care, shortages of trained health personnel, and inadequate health system infrastructure (World Health Organization [WHO], 2023). Midwives, as frontline maternal health providers, are uniquely positioned to address these gaps. In recent years, technological innovations from mobile health (mHealth) applications and telemedicine platforms to portable diagnostic devices and e-learning tools have emerged as transformative opportunities to strengthen midwifery practice in the region (UNFPA, 2021; Bila et al., 2022).

This article explores the integration of technology and innovation into midwifery practice in SSA through a narrative review of peer-reviewed literature, program evaluations, and selected case studies from Ghana, Kenya, and South Africa. The analysis identifies significant opportunities, including enhanced access to care for rural populations, improved clinical decision-making, strengthened data collection and monitoring, expanded training capacity, and increased community engagement through digital health communication (Amoakoh-Coleman et al., 2023; Yadav et al., 2022).

However, the adoption of these innovations faces persistent challenges. Key barriers include limited digital infrastructure, inconsistent policy and regulatory frameworks, high implementation costs, low digital literacy among health workers, cultural resistance to technology-based care, and concerns over data privacy (Till et al., 2023; Owzor and Adeniyi, 2023).

The findings underscore that while technology has the potential to amplify the benefits of midwifery-led care, sustainable impact will require targeted investments in digital infrastructure, capacity building for midwives, integration into national maternal health strategies, and multi-sectoral collaboration between governments, development partners, and the private sector. Harnessing technology effectively could accelerate progress toward Sustainable Development Goal 3, reduce preventable maternal and neonatal deaths, and advance equitable, woman-centered care across SSA.

**Keywords:** Midwifery, Sub-Saharan Africa, Technology, Innovation, Mhealth, Telemedicine, Maternal Health, Newborn Care

## Introduction

Maternal and neonatal health outcomes remain a critical public health challenge in Sub-Saharan Africa (SSA), a region that disproportionately bears the global burden of maternal and newborn mortality. Despite concerted international efforts and significant progress in many parts of the world, SSA continues to account for approximately 70% of global maternal deaths and nearly 40% of neonatal deaths each year (World Health Organization [WHO], 2023). These figures underscore persistent inequities in access to quality maternal health

services and highlight the need for targeted interventions in the region. In several SSA countries, the maternal mortality ratio (MMR) remains alarmingly high often exceeding 500 deaths per 100,000 live births and neonatal mortality rates frequently surpass 25 deaths per 1,000 live births (UNICEF, 2022). These adverse outcomes predominantly result from preventable or manageable conditions such as postpartum hemorrhage, hypertensive disorders like preeclampsia, infections including sepsis, and complications arising from preterm birth. Such conditions require timely, skilled care during pregnancy, labor, and the postpartum period, which remains inaccessible to many women due to systemic health system challenges.

Midwives, as frontline health professionals, play a pivotal role in addressing these challenges. Recognized by global health authorities such as the WHO, the United Nations Population Fund (UNFPA), and the International Confederation of Midwives (ICM), midwives are capable when adequately educated, trained, and supported of delivering up to 87% of essential sexual, reproductive, maternal, newborn, and adolescent health services (UNFPA, 2021). In many SSA countries, midwives constitute the backbone of maternal health care delivery, particularly in rural and underserved settings where physician availability is severely limited. They provide critical antenatal, intrapartum, and postnatal care, family planning services, and newborn care, often operating in resource-constrained environments. However, their potential impact is frequently undermined by systemic barriers including shortages of skilled personnel, inadequate infrastructure, limited access to continuous professional development, and constrained supply chains for essential medicines and equipment (Priebe et al., 2024).

Amid these challenges, technological innovations have begun to emerge as promising avenues to support and transform midwifery practice across SSA. The rapid proliferation of mobile technologies and digital health solutions in recent years has created opportunities to address some of the longstanding limitations of health systems in low-resource settings. Mobile health (mHealth) applications, for instance, have been employed to facilitate communication between midwives and clients, provide appointment reminders, deliver health education, and support adherence to clinical guidelines (Amoakoh-Coleman et al., 2023). Telemedicine platforms have enabled remote consultations and specialist support, bridging geographic and workforce gaps that hinder timely decision-making (Bila et al., 2022). In parallel, the development and deployment of low-cost, portable diagnostic tools such as handheld ultrasound devices and fetal heart rate monitors have enhanced midwives' clinical capacity in the field, enabling more accurate assessment of maternal and fetal well-being without reliance on centralized facilities (Venkatayogi et al., 2023).

Moreover, digital platforms have facilitated innovative approaches to midwifery education and training. E-learning modules, virtual simulations, and remote mentorship programs have expanded opportunities for pre-service and in-service training, helping to mitigate the challenges posed by geographic isolation and limited faculty availability (Isangula et al., 2021). These tools contribute not only to improved clinical competence but also to midwives' professional empowerment and retention.

The integration of technology into midwifery practice holds the potential to improve maternal and neonatal health outcomes in multiple ways. First, it can increase access to skilled care by overcoming geographic barriers and extending reach into remote communities. Second, technology can enhance the timeliness and quality of clinical decision-making through decision support systems and real-time data sharing. Third, it can strengthen referral networks by facilitating communication and coordination between different levels of care. Fourth, digital tools can improve the efficiency and accuracy of health data collection, which is essential for monitoring, evaluation, and health system planning (Till et al., 2023). Lastly, by reducing administrative burdens through digitization of records and reporting, midwives may

be able to devote more time to direct patient care, thus promoting respectful and patient-centered maternity services (Yadav et al., 2022).

Despite these promising benefits, several formidable challenges impede the widespread adoption and sustainability of technology-driven midwifery interventions in SSA. Many rural and underserved areas still face inadequate digital infrastructure, including limited internet connectivity and unreliable electricity supply, which restricts the usability of digital tools (O'Brien et al., 2023). Additionally, there is often a lack of comprehensive policies and regulatory frameworks to guide the implementation, standardization, and scale-up of digital health technologies within midwifery and maternal health services. Financial constraints including high initial investment costs and ongoing maintenance expenses pose barriers to long-term sustainability. Furthermore, limited digital literacy and resistance to change among some health care providers can affect acceptance and effective use of new technologies. At the community level, socio-cultural perceptions and distrust of digital interventions may reduce client engagement. Lastly, the digitization of health information raises critical concerns regarding data privacy, security, and ethical use, which must be addressed through appropriate governance mechanisms as health systems increasingly rely on digital solutions.

## **Rationale for the Article**

The application of technology in midwifery practice within SSA remains an evolving and somewhat fragmented field. While isolated pilot projects and country-specific initiatives have shown promising improvements in maternal and newborn health indicators, their lessons are often localized and not systematically synthesized or scaled across the region (Till et al., 2023; Bila et al., 2022). This gap limits the potential for knowledge exchange and coordinated efforts to accelerate progress. Given the global commitment to achieving Sustainable Development Goal (SDG) 3.1 aiming to reduce the global maternal mortality ratio to fewer than 70 per 100,000 live births by 2030 there is an urgent imperative to explore and document how technological innovation can be harnessed to strengthen midwifery care models in SSA. A comprehensive understanding of both the enabling factors and the barriers to implementation is critical to inform evidence-based policies and investments.

## **Objectives**

This article seeks to:

- Identify and describe key technological innovations currently being utilized in midwifery practice across SSA.
- Assess the opportunities these innovations offer for improving maternal and neonatal health outcomes.
- Explore the challenges and barriers to adoption, sustainability, and scale-up of technology-enabled midwifery services.
- Provide actionable policy and practice recommendations to support effective integration of technology within midwifery-led models of care in SSA.

By systematically examining both the opportunities and challenges associated with technology integration in midwifery, this article aims to contribute to the evidence base that policymakers, practitioners, donors, and educators can use to strengthen maternal and newborn health systems in the digital age.

## **Methodology**

This article adopts a narrative review methodology to comprehensively explore the landscape of technology and innovation in midwifery practice within Sub-Saharan Africa (SSA). The narrative review approach was selected for its flexibility in integrating a wide variety of evidence sources, including peer-reviewed research studies, program reports, policy

documents, and grey literature. This approach is particularly suited to the dynamic and multidisciplinary nature of digital health innovations, allowing for a nuanced understanding of emerging trends, diverse technological applications, and contextual challenges in SSA midwifery care (Shaturaev, 2021; Fausak, 2024). The review aims to synthesize existing knowledge rather than produce a quantitative meta-analysis, thereby providing a broad yet detailed perspective on how technology is shaping midwifery practice across different SSA settings.

To ensure relevance and currency, the review focused on literature published between 2010 and 2024, a period marked by rapid expansion of mobile technology and digital health initiatives in the region (WHO, 2019; Till et al., 2023). Studies, reports, and articles were included if they addressed midwifery or midwifery-led maternal and newborn health services and explicitly involved technology or innovation. Technologies considered included digital health interventions such as mobile health (mHealth) applications, telemedicine platforms, electronic health records (EHR), low-cost portable diagnostic tools, and digital education or simulation-based training platforms (Amoakoh-Coleman et al., 2023; Venkatayogi et al., 2023; Isangula et al., 2021). The geographical scope was confined to SSA countries to ensure contextual specificity, given the unique health system challenges and infrastructural constraints of the region (Bila et al., 2022; O'Brien et al., 2023). Publications not meeting these criteria, such as those focusing solely on physician-led care, non-maternal health topics, or outside the specified timeline or region, were excluded. Only English-language sources were reviewed due to resource constraints.

A systematic search strategy was employed across major academic and grey literature databases, including PubMed, Scopus, Web of Science, and Google Scholar. Search terms combined keywords and Medical Subject Headings (MeSH) related to midwifery (e.g., “midwifery,” “midwives,” “maternal health”), technology and innovation (e.g., “digital health,” “mHealth,” “telemedicine,” “mobile health,” “innovation,” “technology”), and regional focus terms (e.g., “Sub-Saharan Africa,” “Ghana,” “Kenya,” “Nigeria,” among others). Boolean operators (“AND,” “OR”) were used to refine and broaden searches where appropriate. In addition, citation tracking and manual screening of reference lists from key publications supplemented the database search to capture relevant studies possibly missed in initial searches (Shaturaev, 2021).

Data extraction was conducted systematically using a pre-designed template capturing essential study characteristics such as authorship, publication year, country of focus, study design or report type, description of the technology or innovation, target population and setting, outcomes related to midwifery practice or maternal and newborn health, and identified challenges or barriers to implementation. Given the heterogeneity of included sources, findings were synthesized thematically. Themes were organized around categories of technology (e.g., mHealth, telemedicine, diagnostics, education) and their role in enhancing midwifery care, with narrative summaries supported by illustrative case studies to provide concrete examples of technology integration in SSA contexts (Till et al., 2023; Christiansen et al., 2023).

While this review did not apply a uniform or comprehensive quality appraisal across all sources, a selective quality assessment was performed to ensure credibility and validity of included peer-reviewed studies. Adapted criteria from the Mixed Methods Appraisal Tool (MMAT) were used to evaluate methodological rigor, study design, data quality, and reporting transparency (Hong et al., 2018). Grey literature and programmatic reports were appraised based on relevance to the review objectives, clarity of methodology, source credibility, and contribution to understanding practical implementation realities. This combined approach balances inclusiveness with critical appraisal, ensuring that the

synthesized evidence provides a trustworthy foundation for discussing opportunities and challenges of technology-enabled midwifery in SSA.

## **4. Overview of Technology and Innovation in Midwifery**

Technology in midwifery refers to the broad spectrum of tools, platforms, and innovations that aim to improve the delivery, accessibility, quality, and safety of maternal and newborn health services. These technologies include digital health solutions, medical devices tailored for low-resource environments, innovative training platforms, and emerging artificial intelligence applications. Together, they empower midwives the primary providers of maternal care in many Sub-Saharan African (SSA) contexts to overcome systemic barriers and enhance clinical outcomes.

### **4.1 Digital Health Tools**

Digital health innovations have become central to transforming midwifery care in SSA, offering novel ways to extend reach and improve service quality. Telemedicine platforms enable midwives in rural or underserved areas to consult remotely with obstetricians and specialists, facilitating real-time decision-making and reducing delays in referral (Bila et al., 2022). For example, the ECHO Project in Rwanda utilizes video conferencing to mentor midwives, build capacity, and support case management from a distance (Allen Watts and Malone., 2021).

Mobile health (mHealth) applications are widely adopted for client communication, appointment reminders, health education, and clinical decision support. The Safe Delivery App is a prominent example, designed to provide midwives with access to evidence-based guidelines, instructional videos, and emergency protocols that enhance adherence to best practices during labor and delivery (Christiansen et al., 2023). In South Africa, MomConnect has scaled to a national level, sending tailored SMS messages to pregnant women and creating feedback loops that support midwives in delivering responsive care (Mutangadura, 2021). These digital tools improve not only clinical management but also patient engagement and satisfaction.

Decision-support systems embedded in mHealth platforms help midwives follow protocols for hypertensive disorders, hemorrhage, and neonatal resuscitation, reducing clinical errors and enhancing outcomes (Amoakoh-Coleman et al., 2023). Additionally, electronic health records (EHR) systems, while less widespread, are being piloted to digitize patient data, facilitate continuity of care, and support health information management (Till et al., 2023).

### **4.2 Medical Devices and Innovations**

Innovative medical devices tailored for low-resource settings address critical gaps in maternal and fetal monitoring. Portable ultrasound devices have become increasingly affordable and user-friendly, enabling midwives in SSA countries such as Tanzania and Ghana to perform antenatal scans that detect fetal anomalies and identify high-risk pregnancies without the need for referral to tertiary facilities (Venkatayogi et al., 2023). This decentralization of diagnostic capacity improves early intervention and birth preparedness. Similarly, handheld fetal heart rate monitors are employed in Nigeria and Uganda to detect fetal distress during labor, helping midwives to make timely decisions about referrals and interventions (Zbelo, 2024). Low-cost simulation tools for obstetric emergencies such as mannequins for practicing neonatal resuscitation and hemorrhage management have been integrated into training programs, improving midwives' clinical skills and confidence (Isangula et al., 2021). These innovations combine affordability, portability, and ease of use, making them well suited to SSA's infrastructural realities.

### **4.3 E-Learning Platforms for Midwifery Training**

E-learning has emerged as a critical enabler of continuous professional development for midwives in SSA, overcoming challenges related to distance, faculty shortages, and funding constraints. Digital education platforms provide interactive modules, case studies, and virtual simulations that reinforce theoretical knowledge and clinical competencies. For example, the Life-saving Instruction for Emergencies (LIFE) e-learning platform has been successfully implemented in multiple SSA countries to improve midwives' emergency obstetric and newborn care skills (Isangula et al., 2021).

In addition, virtual reality (VR) and augmented reality (AR) technologies are being piloted in training institutions in Ghana and Kenya to simulate complex clinical scenarios in a safe environment, enhancing experiential learning and retention (Barteit et al., 2021). Such immersive tools hold promise for future scale-up, though their high cost and infrastructure requirements currently limit widespread adoption.

### **4.4 Artificial Intelligence (AI)-Assisted Risk Prediction**

AI applications in midwifery are at an early stage but show significant potential for improving maternal health outcomes. AI algorithms can analyze clinical data, vital signs, and patient histories to predict risks of complications such as pre-eclampsia, preterm labor, and sepsis, enabling midwives to prioritize high-risk cases and optimize referral pathways (Nyakiongora., 2024). In South Africa and Kenya, pilot studies are evaluating AI-based decision support tools integrated into mobile platforms to augment midwives' diagnostic accuracy and resource allocation (Bila et al., 2022). Ethical considerations around data privacy and algorithmic bias remain key concerns for future implementation.

### **4.5 Current Adoption Status in Sub-Saharan Africa**

The adoption of midwifery technologies across SSA is heterogeneous, influenced by national policies, infrastructure availability, workforce readiness, and funding mechanisms. Ghana's MOTECH platform integrates SMS messaging with clinical decision support, improving antenatal care attendance and tracking across rural districts (Amoakoh-Coleman et al., 2023). Kenya's MomCare initiative combines digital payments with maternal health tracking to enhance service uptake in informal settlements, while supporting midwives with real-time patient monitoring (Izudi et al., 2023). South Africa has been a leader in piloting telemedicine consultations, portable diagnostics, and AI research, benefiting from more advanced digital infrastructure and policy frameworks (Kachimanga et al., 2023; Nyakiongora., 2024). However, many SSA countries face persistent barriers including limited internet connectivity, power outages, insufficient digital literacy among midwives, and financing gaps that impede scaling and sustainability (O'Brien et al., 2023; Feroz et al., 2022). Community resistance due to mistrust or cultural beliefs about technology further complicates uptake in some settings. Thus, while promising technologies are emerging, widespread integration into routine midwifery practice requires continued investment, policy support, and context-sensitive implementation strategies.

## **5. Opportunities Presented by Technology and Innovation in Midwifery**

Technological innovations in midwifery have the potential to transform maternal and newborn care in Sub-Saharan Africa by addressing systemic challenges and expanding the capacity of midwives to deliver high-quality services. These opportunities can be thematically categorized as improved access and coverage, capacity building, clinical decision support, data collection and monitoring, and community engagement.

## 5.1 Improved Access and Coverage

Telehealth technologies have expanded the reach of midwifery services, especially in remote and underserved areas where geographic and infrastructural barriers limit access to skilled care. Through telemedicine platforms, midwives can connect with obstetricians and specialists for real-time consultations, case discussions, and emergency support, reducing delays in diagnosis and referral (Kachimanga et al., 2023). For example, in Rwanda, the ECHO Project has successfully enabled midwives in rural clinics to access expert guidance via virtual meetings, improving clinical outcomes and professional confidence (Allen Watts and Malone., 2021). Telehealth also supports remote antenatal consultations and monitoring, minimizing the need for pregnant women to travel long distances, which is particularly critical during pandemics or crises limiting mobility (; Feroz et al., 2022).

## 5.2 Capacity Building

Digital education platforms and virtual simulations offer scalable and flexible training opportunities to enhance midwives' knowledge and skills. E-learning modules, such as the LIFE platform, allow midwives to access evidence-based content at their convenience, addressing challenges related to staffing shortages and geographic dispersion (Isangula et al., 2021). Virtual reality simulations further enrich training by providing immersive, risk-free environments to practice obstetric emergencies, improving readiness for real-life scenarios (Barteit et al., 2021). These tools facilitate continuous professional development and help standardize the quality of midwifery education across regions with varying resources (O'Brien et al., 2023).

## 5.3 Clinical Decision Support

Mobile applications and emerging artificial intelligence (AI) tools provide midwives with valuable decision-support systems that improve diagnostic accuracy, protocol adherence, and referral timeliness. Apps like the Safe Delivery App offer step-by-step clinical guidelines and emergency checklists, enabling midwives to manage complications effectively on-site (Christiansen et al., 2023). AI algorithms under pilot in South Africa and Kenya analyze patient data to predict risks such as pre-eclampsia or preterm labor, allowing early intervention and prioritized care (Nyakiongora., 2024). Such decision-support technologies can reduce maternal and neonatal mortality by enhancing the timeliness and appropriateness of care (Venkatayogi et al., 2023).

## 5.4 Data Collection and Monitoring

Digital health solutions have revolutionized the collection, management, and utilization of maternal and newborn health data. Electronic registers and mHealth tracking systems enable midwives to record patient information more accurately and in real time, improving continuity of care and facilitating timely follow-up (; Feroz et al., 2022). Programs like Ghana's MOTECH platform combine data collection with client reminders, enhancing antenatal care attendance and early identification of complications (Amoakoh-Coleman et al., 2023). Improved data availability supports health system planning, resource allocation, and policy formulation, while also enabling monitoring and evaluation of maternal health interventions at scale (Izudi et al., 2023).

## 5.5 Community Engagement

Mobile messaging and digital communication tools provide effective channels for community education and engagement, empowering pregnant women and families with critical information. SMS-based programs like South Africa's MomConnect deliver tailored antenatal and postnatal health messages, reminders for clinic visits, and alerts on danger signs, contributing to increased service uptake and health literacy (Mutangadura, 2021). These tools also facilitate two-way communication, allowing women to provide feedback and seek advice, fostering trust and a supportive care environment (O'Brien et al., 2023).

Engaging communities digitally helps overcome barriers related to misinformation, cultural beliefs, and healthcare hesitancy (; Feroz et al., 2022).

## **6. Challenges to Technology Adoption in Midwifery**

While the integration of technology into midwifery practice holds substantial promise, multiple challenges continue to hinder effective adoption and scale-up across Sub-Saharan Africa (SSA). These challenges span infrastructural, workforce, financial, regulatory, cultural, and data security domains, each requiring targeted strategies for sustainable solutions.

### **6.1 Infrastructure Gaps**

One of the most pervasive obstacles is the limited digital infrastructure in many rural and underserved areas of SSA. Poor internet connectivity and unreliable electricity supply significantly restrict the functionality of telehealth platforms, mobile applications, and digital education tools (O'Brien et al., 2023). Many health facilities lack consistent power to charge devices or sustain internet access, forcing midwives to revert to paper-based systems or limit the use of digital tools. For example, in parts of rural Ghana and Kenya, intermittent electricity and weak network signals have disrupted teleconsultations and real-time data transmission, compromising care continuity (Kachimanga et al., 2023).

### **6.2 Workforce Readiness**

Limited digital literacy among midwives represents another critical barrier. Many practicing midwives, particularly those trained before the digital era, have insufficient training and confidence in using mobile health technologies or electronic record systems (Owhor and Adeniyi., 2023; Isangula et al., 2021). This gap impairs the efficient utilization of decision-support apps and e-learning platforms, reducing the potential benefits of technology interventions. Furthermore, ongoing professional development programs often fail to include adequate digital skills training, leaving workforce capacity underprepared for technology integration (Amoakoh-Coleman et al., 2023).

### **6.3 Cost and Sustainability**

Financial constraints significantly impact the procurement, implementation, and maintenance of technology solutions in SSA midwifery services. Many digital health initiatives rely heavily on donor funding or pilot project grants, which are often time-limited and geographically restricted (; Feroz et al., 2022). The high costs associated with purchasing medical devices, securing reliable internet, software licensing, and technical support pose sustainability challenges for health systems with competing priorities. Additionally, recurring expenses such as device repairs and software updates are frequently overlooked, leading to technology abandonment after initial deployment (O'Brien et al., 2023).

### **6.4 Policy and Regulation**

The absence or inadequacy of comprehensive policies and regulatory frameworks governing digital midwifery practice impedes coherent integration of technology into maternal health services. Many SSA countries lack clear guidelines on telemedicine, data management, digital training standards, and ethical considerations specific to midwifery (Kachimanga et al., 2023). This regulatory vacuum leads to uncertainty among providers, potential legal risks, and difficulties in scaling successful pilot programs. Policymakers must establish standards that address licensing, quality assurance, and accountability for technology-enabled midwifery care.

### **6.5 Cultural Acceptance**

Cultural beliefs and community preferences continue to influence the acceptance of technology-mediated maternal health care. In some SSA contexts, communities exhibit mistrust or skepticism toward digital tools, favoring traditional birth attendants and



conventional practices over unfamiliar technology (Owhor and Adeniyi., 2023). Resistance may stem from concerns about privacy, lack of personal interaction, or fear of technology replacing human care. Midwives and program implementers must engage communities sensitively to build trust, demonstrate benefits, and ensure culturally appropriate use of technology.

## **6.6 Data Security and Privacy**

As midwifery care increasingly digitizes patient information, risks related to data security and privacy become paramount. Many health facilities in SSA lack robust cybersecurity measures, exposing sensitive maternal and newborn health data to breaches, unauthorized access, or misuse (Ogundaini et al., 2024). Weak data protection frameworks and insufficient provider training on confidentiality exacerbate these vulnerabilities. Protecting patient rights and complying with international standards for data privacy are essential to maintain trust and ethical standards in digital midwifery practice.

## **7. Case Examples from Sub-Saharan Africa**

### **7.1 Kenya: mHealth Maternal Care Apps**

Kenya has made significant strides in adopting mobile health (mHealth) technologies to enhance maternal care delivery, particularly in underserved and rural areas. The mPlus Maternal Health Platform, developed by mHealth Kenya, provides pregnant women with tailored health education, appointment reminders, and direct communication with healthcare providers, improving antenatal care attendance and maternal health outcomes (Amoakoh-Coleman et al., 2023). Another initiative, the KeNuM (Kenya Nurses and Midwives Platform), offers digital professional development resources, including training modules and clinical guidelines, thereby supporting continuous education for midwives (Mwalabu et al., 2024). Studies evaluating mHealth interventions in Kenya report improved healthcare access and client empowerment, contributing to reductions in maternal and neonatal morbidity (Kachimanga et al., 2023; Ogundaini et al., 2024).

### **7.2 Ghana: Tele-Ultrasound Services for Rural Clinics**

In Ghana, tele-ultrasound services have been implemented to bridge diagnostic gaps in remote and underserved communities. The Vodafone Ghana Foundation has launched a mobile ultrasound program that enables pregnant women in rural Eastern Region communities to receive free prenatal imaging, facilitating early detection of complications and timely referrals to specialized care (Venkatayogi et al., 2023). Similarly, the Telecel Ghana Foundation provides mobile ultrasound scanning units staffed by trained health professionals, transmitting images remotely to specialists for interpretation, thus enhancing diagnostic capacity in rural clinics (Izudi et al., 2023). Pilot studies confirm the feasibility and effectiveness of tele-ultrasound programs in improving maternal and neonatal health outcomes in low-resource settings (Ogundaini et al., 2024).

### **7.3 South Africa: E-Learning Midwifery Programs**

South Africa has pioneered the integration of e-learning platforms into midwifery education to address workforce capacity challenges and promote ongoing professional development. The Health[e]Foundation collaborates with institutions to offer online courses and training modules accessible via Learning Management Systems such as Moodle, enabling midwives to update their skills remotely and flexibly (Mwalabu et al., 2024). Research evaluating such e-learning programs demonstrates improvements in midwives' clinical knowledge and practice, supporting better maternal and newborn care (Barteit et al., 2021). The digital

training approach is considered vital for sustaining a skilled midwifery workforce in the context of increasing technological adoption in healthcare (O'Brien et al., 2023).

### **Synthesis of Findings**

The review of technological innovations in midwifery across Sub-Saharan Africa (SSA) reveals several cross-cutting themes that illustrate both the transformative potential and persistent barriers to adoption in diverse contexts. While opportunities abound to enhance maternal and neonatal health outcomes through digital tools, the extent and pace of integration vary considerably across countries and settings.

### **Technology's Impactful Areas**

Technology is proving most impactful in improving access and coverage of skilled midwifery care, particularly through telehealth and mHealth applications that overcome geographic and infrastructural barriers. For example, mHealth platforms in Kenya, such as the Mobile for Reproductive Health (m4RH) and Linda Mama initiatives, have facilitated timely antenatal assessments and patient follow-up in rural communities (Amoakoh-Coleman et al., 2023; Sowon et al., 2022). In Ghana, tele-ultrasound services have enabled midwives in rural clinics to transmit images to specialists for remote review, reducing delays in diagnosing high-risk pregnancies (Owhor and Adeniyi., 2023). Additionally, digital platforms for capacity building such as South Africa's MomConnect program and university-based virtual simulation platforms have demonstrated effectiveness in standardizing and enhancing midwifery training despite workforce shortages and resource constraints (Feroz et al., 2021; Rasesemola and Molabe, 2025).

The use of clinical decision support tools, including mobile apps and AI-assisted algorithms, also shows promise in augmenting midwives' diagnostic accuracy and care coordination, potentially reducing preventable maternal and neonatal mortality (Ogundaini et al., 2024; Kachimanga et al., 2023). Moreover, digital solutions for data collection and monitoring such as electronic partographs and mobile-based health registers are facilitating real-time patient tracking and health surveillance, thus supporting evidence-based planning and quality improvement (Priebe et al., 2024). Community engagement via SMS messaging has also been shown to improve maternal health education, antenatal care (ANC) attendance, and timely care-seeking behavior in multiple SSA contexts (Gayesa et al., 2023).

### **Areas of Slow Adoption and Persistent Challenges**

Despite these successes, widespread adoption of technology in midwifery remains uneven, hampered by several key challenges. Infrastructure gaps most notably unreliable electricity and limited internet connectivity remain fundamental barriers in many rural SSA settings, restricting consistent use of digital tools (Yadav et al., 2022; WHO, 2023). Workforce readiness is another constraint, with many midwives lacking sufficient digital literacy and formal training to optimally utilize technology (Kachimanga et al., 2023). These challenges are compounded by financial and sustainability issues, as many innovations depend on short-term donor funding without long-term integration into national health systems (Owhor and Adeniyi., 2023).

Policy and regulatory frameworks governing digital health applications in midwifery are often underdeveloped or absent, creating uncertainty and hindering scale-up (UNFPA, 2021). Cultural acceptance also plays a critical role; in some communities, resistance to technology-mediated care stems from mistrust or a preference for traditional birth attendants (Priebe et al., 2024). Furthermore, growing concerns about data security and privacy highlight the need for robust governance frameworks and provider training to protect sensitive maternal health information (WHO, 2023).

### **Balancing Opportunities and Challenges in SSA Contexts**

The comparative analysis across SSA highlights that countries with stronger digital infrastructure and supportive policy environments such as South Africa and Kenya tend to exhibit higher technology adoption rates and integration into midwifery practice (Sowon et al., 2022; Rasesemola and Molabe, 2025). Conversely, nations with more pronounced resource constraints face slower uptake despite demonstrated potential benefits. Successful programs typically feature strong community engagement, stakeholder buy-in, and capacity building aligned with local contexts (Ogundaini et al., 2024).

### **Enhancing Midwifery-Led Care through Technology**

Linking these findings to the established benefits of midwifery-led care models underscores how technology can amplify those benefits. By improving access to skilled care, digital tools enable midwives to reach women in remote areas, aligning with midwifery's holistic and community-centered philosophy (UNFPA, 2021). Capacity building platforms strengthen midwives' clinical competence and confidence, supporting the delivery of respectful, evidence-based care. Decision-support applications enhance clinical effectiveness and timely referrals, reducing preventable complications (Bila et al., 2022). Moreover, data-driven monitoring and feedback loops contribute to quality assurance and health system responsiveness.

In essence, technology serves as an enabler that can help midwifery-led models overcome systemic barriers related to geography, workforce limitations, and resource constraints ultimately contributing to improved maternal and neonatal health outcomes in SSA.

## **9. Policy and Practice Implications**

The integration of technology into midwifery practice in Sub-Saharan Africa presents both an urgent opportunity and a strategic imperative for health policymakers, educators, and practitioners. To fully harness the potential of digital innovations to improve maternal and neonatal health outcomes, several policy and practice priorities must be addressed.

### **Integration into National Maternal Health Strategies**

Governments should explicitly incorporate technology adoption into their national maternal and newborn health policies and strategic plans. Embedding digital health solutions within existing frameworks ensures alignment with broader health system goals, facilitates coordinated implementation, and promotes sustainability beyond pilot projects. This includes formalizing guidelines for telemedicine, mHealth platforms, and digital data management tailored to midwifery-led care models. By doing so, countries can create enabling environments that encourage innovation while safeguarding quality and equity in maternal health services.

### **Strengthening Midwifery Education with Digital Skills Training**

Digital literacy and competency must be prioritized in midwifery education and ongoing professional development. Curricula should integrate training on the use of digital health tools, data security, and telehealth communication to prepare midwives for technology-enabled practice. In-service training programs leveraging e-learning and simulation can provide flexible opportunities to upgrade skills without disrupting service delivery. Building this workforce readiness is critical to ensuring midwives are confident and proficient users of technology, maximizing the benefits for maternal and newborn care.

### **Establishing Sustainable Funding Mechanisms**

Sustainable financing models are essential to scale and maintain technology innovations in midwifery practice. Governments, donors, and development partners should collaborate to establish funding streams that cover not only initial procurement but also ongoing costs such

as maintenance, software updates, training, and technical support. Innovative financing approaches, including blended public-private funding and performance-based incentives, can enhance resource mobilization and cost-effectiveness. Planning for long-term sustainability from the outset reduces the risk of technology abandonment and promotes integration into routine health service delivery.

#### **Building Public-Private Partnerships for Innovation**

Effective public-private partnerships (PPPs) can accelerate the development and dissemination of technological solutions tailored to maternal health needs. Partnerships with technology companies, telecommunications providers, academic institutions, and non-governmental organizations facilitate knowledge sharing, resource pooling, and innovation. Such collaborations have proven successful in SSA contexts evident in mobile network operators supporting mHealth initiatives and universities developing e-learning platforms. Encouraging PPPs fosters an ecosystem conducive to continuous technological advancement and scalable impact in midwifery-led care.

### **Recommendations and Limitations**

#### **Recommendations**

To maximize the benefits of technology integration in midwifery-led care across Sub-Saharan Africa, a phased approach is recommended:

##### **Short-term:**

- Implement targeted digital literacy programs for midwives, focusing especially on those working in rural and underserved areas to build foundational skills in using digital health tools.
- Launch pilot projects in selected rural midwifery units to test and refine technology solutions such as telehealth consultations, mHealth applications, and portable diagnostic devices, ensuring adaptability to local contexts.

##### **Medium-term:**

- Develop and disseminate standardized protocols and guidelines for telemidwifery practice, ensuring consistent quality, ethical standards, and data security.
- Facilitate integration of midwifery digital tools with broader health information systems to promote seamless data sharing, monitoring, and referral coordination across health sectors.

##### **Long-term:**

- Pursue national scale-up of successful technology interventions, embedding them sustainably within maternal health services.
  - Drive policy reforms that formalize digital health roles in midwifery, strengthen regulatory frameworks, and incentivize innovation.
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- Establish sustainable financing models through diversified funding streams and public-private partnerships to support ongoing maintenance, training, and infrastructure upgrades.

#### **Limitations**

- There is a limited availability of technology impact studies focused specifically on midwifery within SSA, constraining comprehensive assessment of effectiveness.
- Existing evidence may be biased toward better-resourced countries with more advanced digital infrastructure, such as South Africa and Kenya, limiting generalizability to more resource-constrained settings.
- There are notable gaps in longitudinal data tracking maternal and neonatal health outcomes over time following technology interventions, hindering evaluation of long-term impacts.

- Future research should aim to address these gaps, incorporating diverse SSA contexts and employing robust study designs to generate more generalizable evidence on the role of technology in strengthening midwifery-led care.

## Conclusion

This review highlights significant opportunities for technology to transform midwifery-led maternal and newborn care across Sub-Saharan Africa. Digital innovations from mHealth platforms and tele-ultrasound to e-learning and clinical decision support tools have demonstrated their potential to improve access, enhance midwives' capacity, and strengthen care quality in diverse settings. However, persistent challenges such as infrastructural limitations, workforce digital literacy gaps, funding constraints, policy shortfalls, cultural resistance, and data security concerns continue to impede widespread and sustainable adoption.

When effectively paired with strong midwifery models that prioritize holistic, community-centered care, technology can serve as a powerful enabler bridging geographic and resource barriers and contributing meaningfully to reductions in maternal and neonatal morbidity and mortality. Realizing these transformative potential demands coordinated, multi-sectoral collaboration involving governments, healthcare providers, educators, technology developers, funders, and communities. Together, stakeholders can foster equitable access to innovative solutions and build resilient health systems that support the well-being of mothers and newborns across the region.

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