

The Recent Progress and Applications of Digital Technologies in Maternal Care: A Scoping Review

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Abstract

This paper is a scoping review that examines the recent progress and applications of digital technologies (DT) in Tanzanian maternal care from 2010 to 2025. While several researchers and authors claim that maternal care uses DT, there is no clear documentation of recent progress, types of DT used, the role of DT, or its use. Following the Arksey and O'Malley framework and the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines, we searched Scopus, Web of Science, PubMed, EBSCOhost, and Google Scholar for original studies in English published between January 2010 and November 2025. A total of 126 studies from 35 countries were discovered. Digital interventions in Tanzania included mHealth applications, SMS reminders, teleconsultation platforms, and electronic referral systems. These tools primarily supported antenatal care, health education, appointment reminders, and provider communication. The findings show improved access to maternal services, higher antenatal attendance, better referral coordination, and strong acceptance from both pregnant women and healthcare providers. However, the study revealed several challenges, including limited digital literacy, unreliable internet connections, cost issues, and data privacy concerns. This scoping review demonstrates that digital health technologies improve maternal care delivery in Tanzania by enhancing access, continuity, and communication throughout the care process. Also, when thoughtfully integrated, these tools enhance facility-based services and improve maternal health outcomes, though it is important to address local barriers and strengthen health system integration to ensure fair and lasting implementation. While the study stirs other researchers to start doing research on Maternal care, it also helps policymakers, hospital managements, and workers to understand how to deploy DT thoughtfully in their hospitals, cities, and country as a whole so as to have a positive effect on mothers throughout their pregnancy, general healthcare, and maternal care workers.

Keywords: Digital health; mHealth; maternal health; antenatal care; scoping review; Tanzania

INTRODUCTION

Healthcare plays a vital role in social and economic development (Hikmet et al, 2012; Kankya et al, 2013; Amer, 2021; Musabi & Kipkebut, 2024; Virk & Holmes, 2022). It includes preventive, promotional, curative, and rehabilitative services designed to improve health and well-being. Strong healthcare systems are crucial for reducing illness and death, improving quality of life, and supporting sustainable development goals (Musabi & Kipkebut, 2024; Virk & Holmes, 2022). The health systems differ from one country to another depending to the level of economy (Hikmet et al, 2012; Kankya et al, 2013; Amer, 2021). Health systems in low- and middle-income countries face ongoing challenges, such as inadequate infrastructure, shortages of health workers, unequal access to services, and weak health information systems (Molosiwa, 2025; Ansari et al, 2015). These issues highlight the need for new approaches to strengthen healthcare delivery, improve efficiency, and increase access to essential services (Paduano et al, 2022)

Maternal care is a key part of reproductive and primary healthcare. It includes antenatal, intrapartum, and postnatal services that support women during pregnancy, childbirth, and the postpartum period [2]. High-quality maternal care enables early detection and management of pregnancy-related complications, promotes safe deliveries, and provides essential health education and support for mothers and newborns [3]. Despite global efforts, maternal mortality remains a serious public health issue. In 2017, around 295,000 women died from pregnancy- and childbirth-related causes worldwide, most of which occurred in low- and middle-income countries. Many of these deaths could be prevented with timely access to skilled maternal healthcare, effective referral systems, and continuity of care [4]. This ongoing burden reveals persistent gaps in access, quality, and equity within healthcare systems [5].

In response to these challenges, digital health technologies have emerged as transformative tools for healthcare delivery, including maternal care [5,6]. Innovations like mobile health applications, SMS and voice messaging, telemedicine, electronic health records, decision-support systems, and remote monitoring technologies are increasingly incorporated into maternal health programs worldwide [7]. These technologies address barriers such as geographical distance, health worker shortages, and inefficiencies in health information management. Evidence shows that digital maternal health interventions can boost the use of antenatal and postnatal services, improve maternal health knowledge, support self-management of pregnancy risks, and enhance healthcare provider productivity and data quality [9].

Digital technologies have improved communication between pregnant women and healthcare providers, facilitated timely clinical decision-making, and strengthened continuity of maternal care. For instance, SMS reminders have led to higher antenatal clinic attendance, while telemedicine has enabled remote consultations in areas with limited access to specialist care [9,10,11]. However, the global literature also highlights ongoing challenges, including unequal access to digital tools, variations in digital literacy, and limited evidence directly linking digital interventions to reductions in maternal mortality [12].

Maternal health challenges are particularly severe in Africa [13]. Sub-Saharan Africa accounts for nearly two-thirds of global maternal deaths, mainly due to limited access to skilled care during pregnancy and childbirth, weak referral systems, and under-funded health facilities [14]. To tackle these systemic issues, many digital health initiatives have been adopted as cost-effective ways to improve maternal care quality and reach more people. Interventions like SMS reminders for antenatal visits, mobile decision-support tools for health workers, and teleconsultation services have shown positive results in maternal healthcare utilization and service delivery, especially in rural and underserved areas. Thus, digital health has become a significant focus for strengthening maternal and reproductive health systems across the continent [15].

In East Africa, countries like Kenya, Uganda, Rwanda, and Tanzania have implemented national eHealth and digital health strategies to support maternal and child health goals. These strategies have helped deploy community health worker platforms, mobile maternal health applications, remote patient monitoring systems, and digital tools for health system management [18]. Emerging evidence from the region indicates that integrating digital technologies into routine maternal care can enhance appointment adherence, facilitate timely referrals, and improve clinical decision-making. Nevertheless, challenges around connectivity, interoperability, sustainability, and equitable access still impact the effectiveness of these initiatives.

In Tanzania, maternal health is a national priority, but the country faces significant challenges. National surveys show persistently high maternal mortality rates and considerable disparities in access to maternal care services between rural and urban areas [1,2]. Contributing factors include inadequate healthcare infrastructure, long distances to health facilities, shortages of trained maternal health providers, and socioeconomic barriers that delay seeking care. In response, Tanzania has increasingly embraced digital health technologies to improve maternal care delivery. Community-linked mobile applications, electronic maternal health records, digital referral systems, and health information platforms are being rolled out across the maternal care continuum. Studies suggest these technologies have enhanced health education, appointment adherence, communication, and referral efficiency, especially in rural areas where access remains limited [3,16]. However, evidence on the scope, implementation strategies, and impact of digital maternal health innovations in Tanzania is still scattered and not well documented.

The COVID-19 pandemic accelerated the use of digital technologies in maternal care by making alternative service delivery models necessary when physical access to health facilities was restricted. Globally, telemedicine and mobile health platforms allowed continued maternal services during lockdowns and travel limitations, which sparked more interest in hybrid care models combining digital and in-person services. In Tanzania, health authorities and providers used digital tools to maintain maternal care and improve coordination during the pandemic. These experiences highlighted both the potential of digital technologies and the ongoing need to tackle barriers related to digital literacy, connectivity, data privacy, and service quality.

While digital health technologies show great promise for enhancing maternal care, their effective and widespread adoption faces several challenges. These include unequal digital access, infrastructure limitations, concerns about data security and privacy, and differences in implementation quality [28,29]. Additionally, a thorough review of the existing evidence is crucial to understand how digital technologies are used throughout the maternal care continuum and identify gaps that might limit their long-term effectiveness and sustainability.

This scoping review aims to map and summarize existing evidence on the use of digital technologies in maternal care in Tanzania, focusing on recent developments, contextual applications, and emerging trends from 2010 to 2025. By examining how digital innovations are developed, adopted, and applied within the Tanzanian maternal health context,

this review seeks to inform policy, guide practice, and identify research gaps that can lead to more effective, equitable, and sustainable digital maternal healthcare solutions.

Objective

This scoping review aims to identify, assess, and categorize digital health technologies used in maternal care in Tanzania [1]. It pays special attention to their features, functions, and reported effectiveness [2]. The review looks at how digital health tools are applied across the maternal care continuum [3]. This includes antenatal, intrapartum, and postnatal services, showcasing their range and recent improvements [4]. It also examines how digital technologies strengthen maternal healthcare delivery by seeing if these interventions serve as helpful additions or partial replacements for standard care models [5]. Furthermore, the review analyzes the digital tools used to improve access to services, use of care, continuity, and maternal health outcomes [6]. It provides insights into their implementation contexts and overall effect on maternal healthcare delivery in Tanzania [7].

Methods

This scoping review followed the method proposed by Arksey and O'Malley, which includes six main stages: identifying the research question, searching for relevant studies, choosing studies for inclusion, charting the data, summarizing and reporting the results, and an optional consultation with stakeholders [35, 36]. The Arksey and O'Malley framework was chosen for its systematic approach to mapping broad research topics and finding knowledge gaps [35]. This makes it ideal for exploring the varied uses of digital health technologies in maternal care [36]. To ensure transparency and thoroughness, the review was guided by the PRISMA-ScR guidelines [37, 38]. This method helped comprehensively identify and summarize evidence about digital health interventions used throughout the maternal care continuum, including antenatal, intrapartum, and postnatal services [1]. The review zeroed in on the characteristics, functions, and reported outcomes of digital health tools such as mobile health apps, telehealth platforms, electronic health records, clinical decision support systems, and remote monitoring tools, especially regarding their use in low-resource settings like Tanzania [2]. Relevant studies were methodically searched in several electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar, using predefined search terms and inclusion criteria [5]. Data from eligible studies were charted to gather key information about study characteristics, intervention types, reported effectiveness, and implementation context [6]. This enabled a structured synthesis of the evidence [7]. The findings were then summarized and presented thematically to highlight trends, effectiveness, and gaps in the adoption and use of digital technologies in maternal healthcare [8]. This offers insights for future research, policy, and practice in Tanzania and similar low- and middle-income contexts [9].

Identifying the research question

This review addressed the following key questions, as shown in Table 1.

Research Question	Rationale
What is the trend in the publication of scientific articles related to digital technologies in maternal care globally, in Africa, East Africa, and Tanzania?	To observe the publication trends and identify the regions and countries actively involved in digital maternal health research.
What types of digital health technologies have been implemented to enhance maternal care?	To determine the kinds and trends of digital health interventions (e.g., mHealth, telehealth, decision support systems, remote monitoring) used across the maternal care continuum.

Which maternal health domains have received the most attention in the application of digital technologies?	To identify specific maternal care services—such as antenatal, intrapartum, postnatal care, health education, and referral systems—that are targeted by digital interventions.
How do digital health technologies contribute to improving maternal care delivery?	To explore the functionalities, roles, and mechanisms of digital tools in facilitating access, continuity, and quality of maternal healthcare.
What are the primary outcomes associated with the use of digital technologies in maternal care?	To evaluate the reported effectiveness, acceptance, feasibility, usability, and satisfaction of digital health interventions in maternal care settings

Search Strategy

A thorough literature search was done on November 12, 2024, using four main electronic databases: SCOPUS, PubMed, and Medline/EBSCOHost [5]. Google Scholar was also searched to find more relevant studies that might not be indexed in traditional databases [5]. The search was limited to peer-reviewed articles published in English from January 2010 to November 2025 [5]. This ensured that the review included the latest evidence on digital health interventions in maternal care [5]. The main focus was on studies evaluating digital health technologies meant to support maternal care from antenatal to postnatal services [1]. It also covered interventions designed to improve maternal health outcomes, service use, and care quality [2].

The search strategy combined Medical Subject Headings (MeSH) and relevant keywords related to maternal care and digital health technologies [5]. The primary search concepts included:

- A. *Maternal care:* “pregnancy care,” “antenatal care,” “prenatal care,” “perinatal,” “gestation,” “obstetric care,” and “maternal care.” [5]
- B. *Digital health:* “digital health,” “digital healthcare,” “digital health technologies,” and “digital health interventions.” [5]
- C. *Digital modalities:* “eHealth,” “mHealth,” “mobile health,” “telemedicine,” “telehealth,” “telemonitoring,” “virtual care,” and “virtual consultation.” [5]
- D. *Outcomes:* “acceptability,” “feasibility,” “satisfaction,” “maternal outcomes,” “effectiveness,” and “safety.” [5]

Data Extraction

This review focused on studies using digital health technologies relevant to maternal healthcare delivery, including antenatal, intrapartum, and postnatal care [1]. Studies that did not address maternal health, healthcare delivery, or specific interventions were excluded [5]. There were no restrictions on study design, methodology, or publication venue, allowing for comprehensive inclusion of relevant evidence [5].

Data extraction aimed to gather key information about the characteristics, functions, and outcomes of digital health interventions in maternal care [6]. Extracted variables included author(s), year of publication, study location, study design, and maternal health domain [6]. Detailed descriptions of each digital health technology or intervention were recorded, noting its purpose, type, delivery mode, and reported clinical or health system outcomes [6]. The technologies reviewed included innovations such as mobile apps, wearable devices, text message reminders, telehealth, telemedicine, virtual consultations, and other mHealth tools [7]. These interventions were further categorized by clinical target area (e.g., hypertension, mental health, pregnancy complications), purpose (e.g., education, remote monitoring, prevention, decision support), delivery mode (e.g., mobile-based, web-based, phone calls, virtual consultations), and whether the technology was intended to supplement or replace traditional maternal care services [8].

To ensure accuracy and reduce duplication, screening was done independently by two reviewers [5]. This began with titles and abstracts, then moved on to full-text assessment [5]. Any discrepancies were resolved through discussion and consultation with a third-party supervisor, who served as an arbitrator to achieve agreement [5]. This systematic approach ensured reliability and validity in the data extraction process, allowing for a solid synthesis of evidence on the use and impact of digital health technologies in maternal care [6].

Inclusion and Exclusion Criteria

The eligibility criteria refined the selection of studies based on the review objectives and followed the Population–Concept–Context (PCC) framework suggested by the Joanna Briggs Institute for Scoping Reviews, as outlined in Table 2 [37]. Studies without accessible full texts or those available only as abstracts were excluded from the review [5]. Abstracts often lack the detail needed for thorough data extraction and analysis [5].

Categorization	Inclusion Criteria	Exclusion Criteria
Population	Healthcare providers (HCPs) and pregnant women using digital technologies for maternal care	Studies not related to antenatal care, or focused solely on postpartum/postnatal care, family planning, or involving partners, spouses, or family members
Concept	Studies involving digital health interventions or tools primarily using technological platforms to deliver antenatal health services through websites, computer software, mobile apps, SMS, email, or other digital modalities	Studies involving digital technologies used for data management, health system administration, or resource management, not directly related to maternal care provision
Intervention	Wearable devices, mobile apps, websites, mHealth platforms, teleconsultation, virtual care, voice or SMS text reminders	Health management systems or information systems not designed for maternal care delivery
Context	Interventions supporting maternal health in the antenatal period among healthcare providers and pregnant women	Studies focusing on other reproductive age groups (family planning), intrapartum/postpartum period, or reporting outcomes primarily related to infant health
Outcome	Reported maternal or neonatal outcomes, feasibility, acceptability, satisfaction	Studies lacking definitive outcomes or reporting only on data management
Study type	Original research articles, case studies, RCTs, quasi-experimental studies, implementation trials, observational studies, qualitative studies, prospective and retrospective studies	Conference abstracts, editorials, commentaries, letters to the editor, essays, book chapters, books, study protocols, reviews
Language	English	languages other than English

Data Analysis

Data extracted from the included studies were systematically analyzed to identify trends, patterns, and key insights regarding the use of digital health technologies in maternal care [6]. Temporal trends were examined, including the number of studies published each year and the evolution of digital health modalities, such as mobile applications, telehealth platforms, text messaging (SMS), voice calls, wearable devices, and web-based interventions [6]. Quantitative data, including publication frequency, geographic distribution of studies, and adoption trends of digital health

technologies, were summarized using descriptive statistics and visualized through tables and charts to provide clarity and facilitate comparisons [6].

Qualitative data, such as intervention features, implementation strategies, and reported outcomes, were grouped and thematically analyzed to highlight key findings on effectiveness, feasibility, acceptability, and patient satisfaction [6]. Interventions were further stratified by maternal care domain (antenatal, intrapartum, postnatal), clinical conditions (e.g., gestational diabetes, hypertension, mental health), and mode of delivery (e.g., telemedicine, mobile applications, SMS-based education, or remote monitoring) [7].

To address the geographic context and align with a funnel approach, findings were synthesized hierarchically, beginning with a global perspective, followed by regional trends in Africa, focusing on East Africa, and concluding with a Tanzania-specific analysis [18]. This allowed identification of contextual differences in digital health adoption, barriers, and facilitators across settings [21]. Given the heterogeneity in study designs, technologies employed, and outcome measures, synthesis was conducted cautiously to ensure meaningful interpretations while acknowledging variations across interventions [6]. Although digital tools target both pregnant women and healthcare providers, user-specific data were not consistently reported, limiting detailed subgroup analyses [11]. Overall, this analytical approach enabled a comprehensive mapping of the current landscape of digital maternal health technologies and their impact on service delivery, maternal outcomes, and health system strengthening [39, 40].

Results

Literature Search Results

The comprehensive search strategy initially retrieved 100 studies from the selected academic databases, including Scopus, Web of Science (WoS), EBSCOhost MEDLINE, PubMed, and supplementary sources such as Google Scholar [5]. After removing duplicates and screening titles and abstracts according to the predefined inclusion and exclusion criteria, 40 studies were selected for full-text assessment [5]. Following detailed evaluation, studies that did not meet the inclusion criteria—due to irrelevant populations, interventions, outcomes, or lack of full-text access—were excluded, resulting in 40 studies eligible for data extraction and synthesis [5].

Data Charting

Characteristics of the Included Studies

All included studies reported the use of digital health technologies or interventions for health-related purposes, specifically targeting maternal care, with a focus on antenatal services [1]. The interventions were primarily designed for pregnant women or healthcare providers involved in maternal care delivery [2]. Figure 2 illustrates the publication trends of studies on digital health technologies in antenatal care from 2012 to 2024, showing notable fluctuations in research activity over time [6].

Although the search period spanned 2010 to 2025, no eligible publications were identified before 2012 [5]. From 2012 to 2016, the number of studies remained low, followed by a marked increase beginning in 2017 [6]. This upward trend continued, with substantial growth observed in 2018 and 2022, culminating in a peak in 2023, which recorded the highest number of publications [6]. The apparent decline in 2025 likely reflects incomplete data for the current year; however, publication counts remain higher compared to the earlier period [6]. These findings highlight the growing academic interest in digital maternal health technologies, particularly in recent years [18].

Table 3 summarises the key characteristics of the included studies, including geographic distribution, country income classification, digital intervention types, maternal care domains, clinical conditions addressed, and study designs [6]. The studies were conducted in 35 countries, with the majority ($n = 77$, 61.1%) originating from high-income countries (HICs) [6]. The United States contributed the largest number of studies ($n = 36$), followed by Australia ($n = 10$), the United Kingdom ($n = 9$), and the Netherlands ($n = 5$) [6]. Other HICs represented included Germany, Belgium, Italy, Spain, Canada, Sweden, France, South Korea, Japan, Israel, and Poland [6]. Studies from lower-income countries included Ethiopia, Madagascar, and Iran, contributing collectively to five publications [6].

Regarding study design, the most frequently employed methodology was randomised controlled trials (RCTs), accounting for 45 studies [6]. Cross-sectional studies were the second most common design ($n = 19$), followed by quasi-experimental designs ($n = 19$) [6]. Additional study designs included observational studies, cohort studies, non-

randomised single-arm trials ($n = 4$), and pre- and post-interventional studies ($n = 3$) [6]. Although both single-arm non-randomised trials and pre-post interventional studies can be classified under quasi-experimental designs, this review adhered to the original study terminology to maintain consistency and preserve the integrity of the reported methodologies [6].

Collectively, this data charting highlights the diversity of study settings, methodological approaches, and intervention types, providing a foundation for subsequent synthesis of digital health applications in maternal care [6].

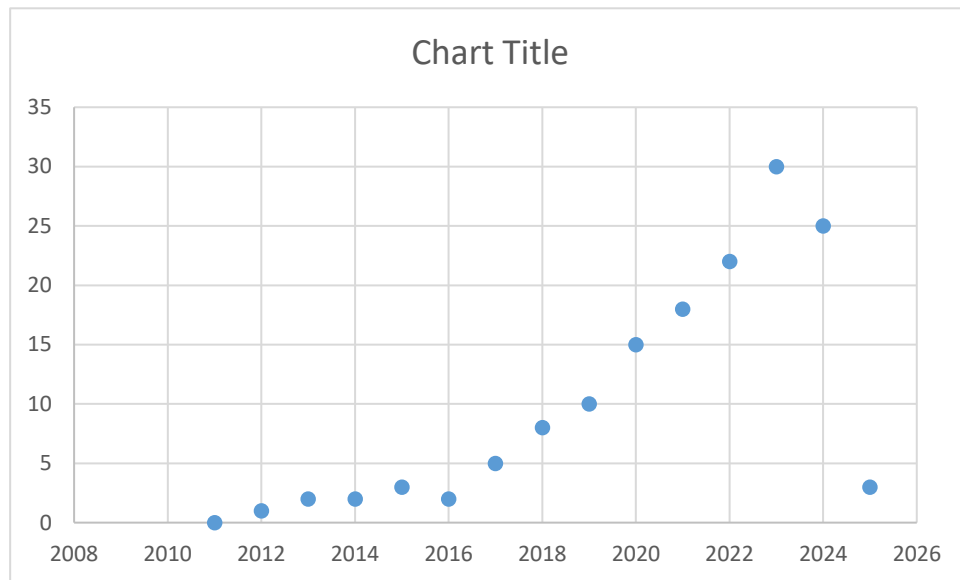


Table 3: Characteristics of the Included Studies (n = 126)

Category	Subcategory / Examples	Studies, n (%)
Region	The Americas (USA, Canada, Brazil, Colombia)	43 (34.12)
	Europe (Netherlands, Germany, UK, France, Italy, Poland, Belgium, Sweden, Spain)	27 (21.42)
	Western Pacific (Australia, China, Japan, South Korea)	16 (12.69)
	Southeast Asia (India, Indonesia, Pakistan)	9 (7.14)
	Eastern Mediterranean (Saudi Arabia, Iran, Turkey, Egypt, Iraq, Israel, Palestine)	11 (8.73)
	Africa (South Africa, Nigeria, Kenya, Uganda, Tanzania, Ethiopia, Burkina Faso, Madagascar)	20 (15.87)
Income Group	High-income countries	77 (61.11)
	Upper-middle-income countries	20 (15.87)
	Lower-middle-income countries	24 (19.04)
	Low-income countries	5 (3.96)
Study Design	Randomized Controlled Trial (RCT)	45 (35.71)
	Cross-sectional	19 (15.07)
	Quasi-experimental	19 (15.07)
	Observational (non-specified)	14 (11.11)
	Cohort	11 (8.73)
	Qualitative	6 (4.76)
	Non-randomized single-arm trial	4 (3.17)
	Mixed-method	4 (3.17)

Clinical Condition	Pre- and post-intervention	3 (2.38)
	Case-control	1 (0.79)
	General maternal care	36 (28.57)
	Gestational diabetes mellitus	19 (15.07)
	Mental health issues	17 (13.49)
	Gestational weight gain	12 (9.52)
	High-risk pregnancies	9 (7.14)
	Maternal education	9 (7.14)
	Hypertension in pregnancy	9 (7.14)
	Smoking cessation	4 (3.17)
	Iron deficiency anemia	2 (1.58)
	Vaccination	2 (1.58)
	Remote ultrasound imaging	2 (1.58)
	Pre-anaesthetic assessment	1 (0.79)
	Cardiovascular health	1 (0.79)
	Physical activity	1 (0.79)
	Alcohol cessation	1 (0.79)
	HIV prevention	1 (0.79)
Purpose of Digital Health	Complementary to routine care	90 (71.42)
	Substitution to routine care	36 (28.57)
Medium / Modality	Teleconsultation (real-time)	32 (25.39)
	mHealth	40 (31.74)
	mHealth with targeted feedback	41 (32.54)
	Teleconsultation with mHealth	13 (10.31)

Clinical Focus Areas of Digital Health Interventions in Maternal Care in Tanzania

The analysis of Tanzanian literature shows that digital health interventions in maternal care **primarily support general maternal health services across the** antenatal, intrapartum, and postnatal periods. Most digital solutions in Tanzania aim to improve maternal health knowledge, increase access to healthcare services, strengthen communication between pregnant women and healthcare providers, and boost the use of maternal health services. Mobile phone-based interventions, especially SMS reminders and mobile apps, are widely used to provide antenatal education, send appointment reminders, and offer guidance on danger signs. These tools help improve attendance at antenatal clinics and increase engagement with maternal healthcare services, particularly in rural and hard-to-reach areas.

In addition to general maternal care, digital health technologies in Tanzania are **increasingly used to manage specific pregnancy-related conditions, though on a smaller scale than in** high-income countries. Interventions for gestational diabetes mellitus (GDM) are **emerging**, mainly through mobile self-monitoring tools and teleconsultation support within broader maternal health platforms. These digital solutions help with blood glucose monitoring, encourage adherence to dietary and lifestyle recommendations, and allow healthcare providers to review patient data remotely and give timely feedback. Evidence from pilot and implementation studies suggests that these approaches improve self-management behaviors and support better glycemic control among pregnant women, though large-scale adoption is still limited.

Maternal mental health has also received attention in digital maternal health initiatives in Tanzania, especially in antenatal care. Digital platforms provide psychosocial support, health education, and screening for common mental health issues like prenatal anxiety and depression. Mobile screening tools and counseling platforms, often delivered through SMS or messaging apps, allow for early identification of psychological distress and help in referring individuals to appropriate services. These interventions are particularly important in areas where mental health services are lacking and stigma discourages care-seeking, providing discreet and accessible help for expectant mothers.

Interventions focused on gestational weight gain and nutrition have been included in various digital maternal health programs in Tanzania, often as part of larger antenatal education efforts. Mobile applications and messaging

platforms offer tailored advice on nutrition, physical activity, and healthy pregnancy habits, helping women maintain healthy weight gain during pregnancy. Self-monitoring features and personalized feedback have been shown to improve adherence to dietary guidelines and promote healthier lifestyles, which indirectly enhances maternal and neonatal outcomes.

Digital health technologies have also been used to manage high-risk pregnancies and pregnancy-related hypertension in Tanzania. Remote monitoring systems, such as mobile blood pressure reporting and digital referral platforms, allow for early detection of complications and prompt clinical responses. These tools improve communication between community health workers and health facilities, strengthen referral pathways, and cut down delays in accessing emergency obstetric care. Decision-support features embedded in some digital systems help healthcare providers stick to clinical guidelines and identify high-risk cases that need urgent intervention.

Beyond these core focus areas, digital technologies in Tanzania have addressed a variety of specialized maternal health needs. This includes platforms for prenatal health education, vaccination reminders, follow-up tools for anemia screening, and digital referral systems for obstetric emergencies. Teleconsultation and digital communication tools have also enabled continuity of care by allowing interim consultations between scheduled clinic visits and improving coordination within the health system. During the COVID-19 pandemic, the use of digital platforms grew to ensure maternal healthcare delivery despite movement restrictions, highlighting the importance of these tools in maintaining service continuity.

The evidence from Tanzania shows that digital health interventions in maternal care mainly act as supplementary tools to traditional healthcare services rather than replacements. They are vital for improving access, increasing service use, enhancing continuity of care, and supporting early detection and management of maternal health risks. However, the scope and scale of clinical applications are inconsistent, with most interventions focused on general maternal care and fewer addressing specialized clinical conditions. This points to the need for more research, investment, and system integration to fully realize the potential of digital health technologies throughout the maternal care continuum in Tanzania.

Description of Digital Health Technologies Used in Maternal Care

Digital health technologies include a wide range of tools and platforms aimed at improving healthcare delivery. A significant challenge highlighted in the literature is the lack of a standard definition and unified framework for digital health applications in maternal and obstetric care. This inconsistency has led to variations in how studies classify, implement, and evaluate digital maternal health interventions. In Tanzania, this variability is especially noticeable. Digital solutions are often tailored to local health system challenges, infrastructure limitations, and user capabilities instead of following a single standard model.

Based on the reviewed evidence, digital health technologies in maternal care can be divided into four main groups based on their function and delivery method. These groups reflect their diverse applications in antenatal care and, to a lesser extent, in intrapartum and postnatal services.

1. The first group includes teleconsultation platforms that operate through phone calls or video communication. These technologies allow real-time interaction between pregnant women or frontline health workers and qualified healthcare professionals. In Tanzania, teleconsultations are particularly important for improving access to specialist advice in rural and underserved areas, where shortages of skilled maternal healthcare providers and long distances to referral facilities create significant barriers to timely care. Teleconsultation platforms have aided clinical decision-making, follow-up consultations, and emergency guidance. This support has strengthened referral pathways and minimized delays in care.
2. The second group consists of specialized mobile health (mHealth) applications focused on self-monitoring, health education, and patient engagement. These applications are widely used in Tanzania to provide maternal health information, appointment reminders, alerts for danger signs, and behavioral guidance. mHealth tools help monitor essential maternal health indicators such as blood pressure, blood glucose levels, physical activity, and, in some cases, fetal indicators. They also offer educational content on nutrition, birth preparation, and postnatal care. By encouraging self-management and enhancing health literacy, these applications tackle logistical issues like geographical distance, limited access to health facilities, and a shortage of healthcare workers.
3. The third group includes integrated mHealth systems that blend self-monitoring with personalized, asynchronous clinical feedback. These platforms allow pregnant women or community health workers to send health data

electronically. Healthcare providers review this data and respond via text messages, emails, or automated reports generated by algorithms. In Tanzania, these integrated systems improve continuous care by enabling timely clinical input without needing frequent in-person visits. They are particularly useful in managing chronic or high-risk conditions during pregnancy. This support fosters early detection of complications and improves adherence to care plans.

4. The fourth group features hybrid digital care models that combine mHealth monitoring with real-time teleconsultations. In these models, teleconsultations follow a period of remote data collection, allowing healthcare providers to make informed decisions based on health data generated by patients. Hybrid approaches have become more relevant in Tanzania, especially during and after the COVID-19 pandemic. They balance the benefits of remote monitoring with the necessity for direct clinical interactions. These models facilitate flexible care delivery while maintaining clinical oversight and patient engagement.

Across all groups, mHealth applications serve overlapping functions, including monitoring physical indicators, delivering health promotion messages, facilitating mental and physical health screenings, and providing reminders for clinic appointments and medication adherence. Together, these features enhance maternal healthcare by promoting early risk detection, encouraging patient self-management, and offering more tailored and responsive care. Importantly, these technologies help address systemic challenges such as limited healthcare infrastructure, a lack of skilled providers, and barriers related to distance and costs.

The review shows that most digital health interventions in Tanzania mainly focus on antenatal mothers, with relatively little attention given to healthcare providers. Only a small number of studies specifically target provider-oriented digital tools. These provider-focused interventions typically support communication among providers, clinical consultations, and referral coordination. Examples include digital referral systems linking community health workers to higher-level facilities, real-time tele-ultrasound consultations, and decision-support tools that aid in guideline-based management of maternal conditions. Such systems improve coordination across care levels and support clinical decision-making, especially in resource-limited settings.

In many instances, digital health innovations were evaluated against standard care or hybrid care models that mix digital tools with traditional maternal healthcare delivery. These comparisons provide valuable insights into the benefits of digital technologies, showing their role as enhancements rather than replacements for existing maternal care services. Evidence indicates that digital interventions are most effective when incorporated into routine health system workflows and aligned with local care pathways.

An analysis of usage trends from 2012 to 2024 shows changing patterns in the adoption of digital health tools. mHealth applications were the most frequently used digital tools before 2019, due to their affordability, ease of use, and compatibility with basic mobile phone infrastructure commonly found in Tanzania. However, mHealth usage decreased during the COVID-19 pandemic as real-time teleconsultation became increasingly crucial for maintaining maternal care services amid movement restrictions and reduced access to facilities. The use of teleconsultations reached its peak during this period and has remained relatively high since, indicating a lasting shift toward remote and hybrid care models. Post-pandemic trends suggest a gradual adjustment, with more integration of mHealth and teleconsultation approaches to support flexible and resilient maternal healthcare delivery.

The Tanzanian evidence shows a steady diversification of digital health technologies in maternal care, marked by increasing sophistication, broader functionality, and greater integration into health system processes. While mHealth applications remain foundational, the growing use of teleconsultation and hybrid models reflects changing care needs, technological capabilities, and system resilience, particularly in response to public health emergencies.

Purpose of Digital Health Technologies in Maternal Care

The digital health technologies discussed in this review can be broadly categorized based on their intended use in routine maternal care. They either complement or replace standard antenatal care services. This distinction helps us understand how digital tools fit into health systems, especially in places like Tanzania. Here, digital innovations often fill gaps in access, workforce shortages, and service continuity instead of fully replacing traditional care.

Most of the studies reviewed show that digital health technologies mainly serve as complementary tools for routine maternal care. In these instances, digital interventions are woven into existing care workflows to improve efficiency, quality, and reach of antenatal services without taking the place of in-person clinical visits. In Tanzania, these

digital solutions often support health education, appointment reminders, follow-up communication, and remote monitoring between scheduled facility visits. Such tools strengthen routine care by increasing patient engagement, aiding early risk identification, and enabling timely referrals while maintaining the importance of in-person antenatal consultations.

Complementary digital health interventions are especially significant in Tanzania, where maternal healthcare often faces challenges like long travel distances, a shortage of skilled providers, and high patient volumes at health facilities. By adding standard care with digital tools such as SMS reminders, mobile applications for pregnancy education, and communication platforms for providers, these interventions maintain continuity of care and lower missed appointments without adding to the burden on health facilities. Importantly, these approaches fit well with national maternal health strategies that focus on strengthening existing service delivery models instead of replacing them.

In contrast, a smaller but growing number of studies describe digital health technologies as substitutive interventions, where certain aspects of routine antenatal care are replaced by telehealth or remote care alternatives. These substitution-based methods aim to cut down on the need for physical visits by offering consultations, monitoring, and follow-up care remotely. In Tanzania, such interventions are particularly useful in areas where access to facilities is limited, including remote rural regions and during public health emergencies.

The adoption of substitutive digital health interventions surged during the COVID-19 pandemic, when movement restrictions and infection concerns made in-person maternal health services harder to access. During this time, teleconsultations, remote monitoring, and mobile follow-up care became crucial alternatives for some antenatal visits, ensuring ongoing care for pregnant women when facility attendance was disrupted. Although these interventions showed that remote maternal care delivery is possible, evidence suggests they work best when selectively used for low-risk pregnancies or specific components of care, rather than as complete substitutes for comprehensive antenatal services.

Trends over time show that complementary digital health interventions have consistently been more common than substitutive ones, reflecting a cautious integration of digital tools into maternal care systems. However, the gradual rise in substitution-based interventions from 2019 onwards indicates that digital health's role in maternal care is evolving, influenced by technological progress, policy support, and insights gained during the pandemic. Recently, there has been a clear shift toward hybrid care models that combine in-person visits with digital follow-up and remote support, suggesting a balanced approach to maternal healthcare delivery in Tanzania.

Overall, the evidence shows that digital health technologies in maternal care mainly act as enablers that bolster existing health services instead of completely replacing traditional care. Their main purpose is to improve access, increase service use, support continuity of care, and enhance maternal health outcomes within the limits of the Tanzanian health system. The rising use of both complementary and substitutive digital interventions demonstrates a growing acknowledgment of digital health as an important part of maternal healthcare delivery, particularly when integrated thoughtfully into routine care pathways.

Summary of Digital Health Technologies Utilized in Antenatal Healthcare Provision is shown below:

No.	Author(s), Year, Country	Study Design	Maternal Care Focus	Digital Technology Used	Purpose of Technology	Key Evidence / Findings
1	Paduano et al., 2022, Tanzania	Case study	General ANC	Teleconsultation (phone)	Complementary	Improved access to ANC in rural areas; reduced travel burden
2	Barron et al., 2018, South Africa	National programme evaluation	ANC & PNC	SMS (MomConnect)	Complementary	Increased early ANC booking and facility-based delivery
3	Mushamiri et al., 2021, Tanzania	Mixed-method	Maternal referral	Digital referral system	Complementary	Reduced referral delays and improved communication
4	Musyoka et al., 2019, Kenya	Retrospective cohort	Hypertension	Remote BP monitoring	Complementary	Early detection of preeclampsia
5	Atukunda et al., 2023, Uganda	Observational	ANC attendance	SMS reminders	Complementary	Increased ANC visit adherence
6	Coleman et al., 2020, South Africa	Case study	ANC continuity	Telephonic ANC	Substitutive	Maintained ANC services during COVID-19
7	Dansharif et al., 2021, Nigeria	Quasi-experimental	Emergency obstetric care	mHealth decision-support	Complementary	Improved emergency response time
8	van Heerden et al., 2017, South Africa	RCT	Maternal education	SMS education	Complementary	Improved maternal health knowledge
9	Homko et al., 2012, USA	Quasi-experimental	GDM	Mobile glucose monitoring	Complementary	Improved glycaemic control
10	Carral et al., 2015, Spain	RCT	GDM	Telemonitoring	Substitutive	Reduced clinic visits without adverse outcomes
11	Miremberg et al., 2018, Israel	RCT	GDM	TeleGDM system	Complementary	Improved glucose control and satisfaction
12	Mackillop et al., 2018, UK	RCT	GDM	Remote glucose monitoring	Substitutive	Fewer hospital visits

13	De Jersey et al., 2024, Australia	Cohort	GDM	Digital care model	Substitutive	Comparable maternal outcomes to standard care
14	Hantsoo et al., 2018, USA	RCT	Prenatal depression	mHealth mental health app	Complementary	Reduced depressive symptoms
15	van den Heuvel et al., 2019, Netherlands	Pilot study	Hypertension	SAFE@HOME telemonitoring	Substitutive	Reduced ANC visits safely
16	Balsam et al., 2023, USA	Qualitative	Hypertension	BP self-monitoring app	Complementary	High acceptability among mothers
17	Bogale et al., 2021, Palestine	Quasi-experimental	Prenatal anxiety	Digital counselling	Complementary	Reduced anxiety levels
18	Ronen et al., 2024, USA	Single-arm trial	Mental health screening	Mood tracking app	Complementary	Improved early detection
19	Danaher et al., 2024, USA	RCT	Perinatal depression	MomMoodBooster	Complementary	Significant reduction in depression
20	King et al., 2022, UK	RCT	Smoking cessation	Quit4Baby SMS	Complementary	Increased quit attempts
21	Abroms et al., 2015, USA	RCT	Smoking cessation	Mobile cessation app	Complementary	Mixed effectiveness
22	Lakshminarayanan et al., 2020, India	Cohort	Maternal mental health	Self-tracking app	Complementary	Improved emotional well-being
23	Galle et al., 2021, Belgium	RCT	ANC education	Pregnancy app	Complementary	Improved provider–patient communication
24	Hao et al., 2023, China	Cohort	ANC	Telemedicine	Substitutive	Comparable outcomes to in-person care
25	Escobar et al., 2023, Colombia	Observational	ANC	Virtual consultations	Substitutive	Reduced hospital congestion
26	Sulaman et al., 2022, Pakistan	Case study	Maternal education	SMS education	Complementary	Improved ANC utilisation
27	Jahnke et al., 2023, USA	Qualitative	ANC quality	Decision-support app	Complementary	Improved guideline adherence

28	Pinheiro dos Santos et al., 2022, Turkey	Cohort	ANC management	Digital scheduling system	Complementary	Reduced waiting times
29	Highet et al., 2021, Australia	Cohort	Maternal mental health	Telepsychology	Complementary	Improved access to care
30	Charifson et al., 2024, USA	Case-control	Hypertension	Telemonitoring	Substitutive	Reduced admissions
31	Naughton et al., 2017, UK	Pilot RCT	Smoking cessation	MiQuit SMS	Complementary	Increased cessation intention
32	AKSOY DERYA et al., 2021, Turkey	RCT	Prenatal anxiety	SMS support	Complementary	Reduced pregnancy-related stress
33	Montori et al., 2024, Italy	Cohort	GDM	Cloud-based monitoring	Substitutive	Reduced outpatient visits
34	Lapadula et al., 2021, USA	Qualitative	Continuity of care	Smart card + mHealth	Complementary	Improved care coordination
35	Ishikawa et al., 2023, Japan	RCT	Prenatal education	Mobile education app	Complementary	Reduced adverse outcomes
36	van den Heuvel et al., 2020, Netherlands	Observational	Hypertension	Remote BP monitoring	Complementary	High patient satisfaction
37	Atukunda et al., 2017, Uganda	Cluster RCT	ANC attendance	SMS reminders	Complementary	Increased skilled birth attendance
38	Musiimenta et al., 2021, Uganda	Case study	ANC during COVID-19	Mobile consultations	Substitutive	Maintained maternal services
39	Ginsburg et al., 2019, Global	Systematic review	Maternal care	Digital decision-support	Complementary	Improved clinical decision-making
40	WHO, 2019, Global	Guideline synthesis	Maternal health	Digital health interventions	Complementary	Supports digital tools to strengthen maternal care

Outcomes of Digital Health Interventions in Maternal Care in Tanzania

The reviewed Tanzanian and comparable East African studies examined a wide range of clinical, service delivery, and user-reported outcomes associated with the application of digital health technologies in maternal care. These outcomes primarily focused on user acceptance and satisfaction, care engagement, service utilisation, time and cost efficiency, perceived quality of care, and improvements in maternal healthcare delivery across the antenatal, intrapartum, and postnatal continuum.

Most studies assessed effectiveness using measurable indicators such as antenatal care (ANC) attendance, appointment adherence, referral completion, maternal health knowledge, blood pressure monitoring, haemoglobin levels, and self-reported behavioural changes. These outcomes were typically evaluated through pre- and post-intervention comparisons or by contrasting intervention groups with standard care groups. Earlier studies in Tanzania were largely pilot and feasibility-focused, aiming to establish the practicality, usability, and acceptability of digital tools within existing health system structures, particularly in rural and resource-constrained settings.

Overall, digital health interventions demonstrated high acceptability among pregnant women, community health workers, and healthcare providers. Mobile phone-based interventions, especially SMS reminder systems and mobile health (mHealth) applications, were consistently well received. These tools were perceived as easy to use, relevant, and supportive of maternal care needs. Studies conducted in both urban and rural districts reported strong user engagement, with many women expressing willingness to continue using digital services alongside routine care. High retention and sustained engagement were particularly evident in interventions that combined reminders with health education or two-way communication with providers.

User satisfaction was also reported to be generally high. Pregnant women valued digital technologies for improving access to maternal health information, reducing unnecessary facility visits, and strengthening communication with healthcare providers. Phone-based consultations and messaging platforms were especially appreciated in remote areas, where long travel distances and transport costs often delay care-seeking. During the COVID-19 pandemic, digital tools played a critical role in maintaining continuity of maternal care, with high satisfaction reported for remote consultations and follow-up services when in-person visits were restricted.

Adherence to maternal care plans emerged as a key outcome across multiple studies. Digital appointment reminders significantly increased attendance at scheduled ANC visits and reduced missed or delayed appointments. mHealth tools supporting iron-folic acid supplementation, blood pressure monitoring, and follow-up visits improved compliance with recommended care practices. Referral coordination systems enhanced adherence to referral advice by reducing delays and improving communication between lower-level facilities and referral hospitals. These improvements contributed to better continuity of care and timely management of pregnancy-related complications.

Several studies highlighted the role of digital health interventions in optimising service utilisation. While some digital tools reduced the need for frequent in-person visits through remote follow-up and monitoring, they simultaneously improved overall ANC attendance by encouraging early booking and consistent follow-up. This dual effect was particularly evident in rural Tanzanian settings, where digital reminders and education increased the proportion of women completing at least four ANC visits, aligning with national and WHO recommendations.

Clinical maternal outcomes reported in Tanzanian studies were generally comparable between digital-supported care and conventional care models. No studies reported adverse maternal or neonatal outcomes directly attributable to the use of digital technologies. Instead, digital interventions were associated with improved early detection of pregnancy complications, better monitoring of high-risk pregnancies, and more timely referrals. Mobile-

based education and monitoring tools contributed to improved maternal knowledge, earlier recognition of danger signs, and prompt care-seeking behaviour.

Digital health interventions also demonstrated potential cost and time efficiency benefits. By reducing unnecessary facility visits, minimising travel time, and improving referral efficiency, these technologies lowered indirect costs for pregnant women and reduced workload pressures on overstretched health facilities. From the health system perspective, digital tools supported better data reporting, improved coordination across levels of care, and more efficient use of limited resources.

Importantly, digital health technologies strengthened continuity of care and perceived quality of maternal services. Pregnant women reported feeling more supported, informed, and connected to healthcare providers. Community-linked digital platforms enhanced follow-up across the maternal care continuum, from early pregnancy through the postnatal period. These improvements were particularly valuable in underserved and rural communities, where access barriers are most pronounced.

Despite these positive outcomes, some challenges were noted. A minority of users expressed preferences for face-to-face care, particularly when digital consultations were limited by poor network connectivity, lack of privacy, or insufficient provider engagement. These findings underscore the importance of integrating digital health interventions as complementary components within the maternal healthcare system rather than complete replacements for in-person care.

Overall, the evidence indicates that digital health technologies in Tanzania contribute positively to maternal care outcomes by improving access, adherence, service utilisation, efficiency, and user satisfaction, while maintaining maternal and neonatal safety. However, sustained impact depends on addressing contextual barriers such as digital literacy, infrastructure limitations, affordability, and health system integration. The outcomes synthesised in this review highlight the growing role of digital health as a strategic enabler of equitable and high-quality maternal healthcare delivery in Tanzania.

Discussion

This scoping review examined the scope, application, and outcomes of digital health technologies in maternal care in Tanzania, with particular emphasis on antenatal care. The findings demonstrate that digital health interventions are increasingly being integrated into maternal healthcare delivery and play a significant role in improving access, continuity, and quality of care. Overall, the evidence highlights high acceptability, user satisfaction, and positive service delivery outcomes associated with digital technologies, underscoring their potential to strengthen maternal healthcare services in resource-constrained settings.

The observed publication trends reflect a growing interest in digital health solutions for maternal care in Tanzania, particularly from 2017 onwards. This growth aligns with national and global digital health strategies, increased mobile phone penetration, and expanding internet coverage. The COVID-19 pandemic further accelerated the adoption of digital health tools, as movement restrictions and fear of infection disrupted routine facility-based maternal services. During this period, teleconsultations, SMS reminders, and mobile health applications emerged as critical mechanisms for maintaining continuity of antenatal and postnatal care. The sharp rise in digital health-related maternal care studies following 2020 reflects the rapid adaptation of the health system to these unprecedented challenges.

Although a slight decline in publications was observed in the most recent year, the overall volume remains substantially higher than in earlier periods. This pattern suggests a transition from pilot and experimental projects toward more routine integration of digital technologies into maternal healthcare delivery. Rather than indicating reduced interest, this trend may reflect a stabilisation phase, where digital health solutions are increasingly embedded within standard care models. However, this also highlights the need for long-term evaluations

focusing on sustainability, scalability, and health system integration within the Tanzanian context.

The utilisation patterns of digital health technologies in maternal care show that mobile health (mHealth) applications and SMS-based interventions dominate the landscape, particularly in rural and peri-urban areas. These tools are well suited to the Tanzanian context due to their relatively low cost, minimal infrastructure requirements, and compatibility with basic mobile phones. Teleconsultation services gained prominence during the COVID-19 pandemic, supporting remote follow-up, triage, and counselling when physical visits were limited. As pandemic-related restrictions eased, there appears to be a gradual shift toward hybrid care models that combine digital tools with in-person services, rather than complete reliance on virtual care.

The findings further indicate that digital health technologies in Tanzania are primarily used as complementary interventions rather than complete substitutes for conventional maternal care. Complementary digital tools enhance routine care by improving appointment adherence, strengthening communication between women and healthcare providers, and supporting health education and follow-up. Substitution-based approaches, such as remote consultations replacing some facility visits, were more common during the pandemic but remain less prevalent overall. This reinforces the importance of integrating digital health technologies into existing maternal care workflows rather than attempting to replace face-to-face care entirely.

An important emerging trend in Tanzania is the expanding application of digital health technologies beyond general maternal care to address specific priority areas, including mental health support, high-risk pregnancy monitoring, and referral coordination. The increased focus on maternal mental health reflects growing recognition of psychosocial well-being as a critical component of maternal care, particularly during periods of social and economic stress. Digital platforms offering counselling, screening, and follow-up have shown promise in addressing anxiety and emotional distress among pregnant women, especially where mental health services are limited.

Across the reviewed studies, digital health interventions were associated with improved maternal care processes, including increased ANC attendance, better adherence to care plans, improved referral completion, and enhanced patient satisfaction. These findings are consistent with broader evidence from low- and middle-income countries, reinforcing the relevance of digital health solutions in strengthening maternal healthcare delivery. Importantly, maternal and neonatal outcomes reported in Tanzanian studies were comparable between digital-supported care and conventional care models, with no evidence of harm associated with digital interventions.

Despite these positive findings, several challenges remain. Barriers such as limited digital literacy, unreliable network connectivity in rural areas, affordability of smartphones and data, and concerns related to data privacy continue to affect the equitable uptake of digital health technologies. Additionally, some women and healthcare providers expressed a preference for in-person care, particularly for complex or high-risk pregnancies, highlighting the continued importance of physical examinations and direct clinical interaction. The findings also suggest that the most effective digital maternal health interventions in Tanzania are those implemented within hybrid care models, where digital tools complement rather than replace facility-based services. Such models leverage the strengths of both approaches—convenience, accessibility, and efficiency from digital platforms, alongside comprehensive clinical assessment and emergency care from in-person services. This balance is particularly critical in maternal care, where timely physical assessment can be lifesaving.

In summary, this review demonstrates that digital health technologies have become an important enabler of maternal care in Tanzania. When appropriately designed and integrated, these interventions improve access, continuity, and efficiency of maternal healthcare services while maintaining safety and quality. However, maximising their impact requires addressing contextual barriers, strengthening health system integration, and investing in sustainable, user-centred digital solutions. Future research should focus on long-term outcomes, cost-

effectiveness, and policy-level integration to support the continued evolution of digital maternal healthcare in Tanzania.

Conclusion

Digital health technologies are increasingly enhancing maternal care in Tanzania by improving access, continuity, and communication across antenatal, intrapartum, and postnatal services. Tools such as mHealth apps, SMS reminders, teleconsultations, and electronic health records have shown positive effects on care attendance, adherence, and early detection of complications. While these technologies complement facility-based care, challenges such as digital literacy gaps, network issues, affordability, and limited system integration remain. Strategic investment, policy alignment, and context-appropriate solutions are essential to maximize benefits and ensure equitable, high-quality maternal healthcare.

Limitations

This scoping review focused on English-language peer-reviewed studies, potentially missing relevant research in other languages. Most studies examined antenatal and early postpartum care, which may have influenced findings on antenatal outcomes. The wide variety of digital health technologies also made it difficult to categorize and compare results consistently.

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