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Article

Evaluating the role of mobile health (mHealth) solutions in reducing healthcare barriers in rural sub-Saharan Africa: A qualitative systematic review

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Abstract: Rural sub-Saharan Africa faces limited medical access, healthcare worker shortages, and inadequate health information systems. Mobile health (mHealth) technologies offer potential solutions but remain underdeveloped in these settings. This review aims to explore the sociocultural context of mHealth adoption in rural sub-Saharan Africa to support sustainable implementation. A comprehensive Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) search was conducted in databases like PubMed, MEDLINE, and African Journals Online, covering peer-reviewed literature from 2010 to 2024. Qualitative studies of mHealth interventions were included, with quality assessed via the Critical Appraisal Skills Program (CASP) checklist and data synthesized using a meta-ethnographic approach. Out of 892 studies, 38 met the inclusion criteria. Key findings include sociocultural factors like community trust influencing technology acceptance, local implementation strategies, user empowerment in health decisions, and innovative solutions for infrastructure issues. Challenges include privacy concerns, increased healthcare worker workload, and intervention sustainability. While mHealth can reduce healthcare barriers, success depends on sociocultural alignment and adaptability. Future interventions should prioritize community co-design, privacy protection, and sustainable, infrastructure-aware models.

Keywords: mHealth; sub-Saharan Africa; rural healthcare; qualitative research; digital health; healthcare access; systematic review

1. Introduction

The state of healthcare in rural sub-Saharan Africa is dire due to the following factors: inadequate infrastructure, particularly with regard to access to medical facilities, shortage of human resources for health and a weak health information system. These barriers greatly affect the provision of adequate healthcare services, thus defining the realities of those on the supplying end, the healthcare givers, and those on the receiving end, the patients. There is also an extended effect due to a combination of socioeconomic status, geographical location and infrastructure gap on the accessibility and utilization of healthcare services in the region by the rural population (Brown, 2021; Muthuri et al., 2020).

As a result of these drawbacks, new uses of information and communication technology in healthcare, known as mHealth, have been proposed to improve accessibility and availability of healthcare services. The exponential growth in the uptake of mobile phones in the region creates a possibility of technology for health interventions whose suite is referred to as mHealth because it involves the use of messages, mobile applications, and telemedicine for communication, education, and

service delivery (Musizvingoza, 2020; Wang et al., 2021). Qualitative research has started looking at how these technologies are understood, used, and implemented as a part of current healthcare practices, mainly with reference to maternal and child health, chronic diseases, and health information sharing (Brooke and Ojo, 2020; Zegeye et al., 2023).

Recent studies underscore the diverse applications of mHealth technologies, including tracking epidemic outbreaks, managing chronic diseases, and fostering preventive care through targeted education and awareness campaigns. These initiatives have shown promise in maternal and child health, chronic disease management, and health information dissemination. However, the success of mHealth systems is often hindered by infrastructural limitations, socio-cultural factors, and resource constraints (Bervell and Al-Samarraie, 2019; Wallis et al., 2017).

As indicated in the literature, the use of mHealth interventions is highly contextual in the rural sub-Saharan Africa rural setting and sociocultural environment. Literature reviews have reported diverse pathways and understanding regarding the mHealth solutions, their benefits and concerns with regard to implementation and adoption (Bervell and Al-Samarraie, 2019; Wallis et al., 2017). For example, some communities have joined the mobile technologies when it comes to health, but others have certain cultural values, or have inadequate technology that limits their use of the interventions (Bvumbwe and Mtshali, 2018; Bisi, 2024).

Understanding these nuanced dynamics is crucial for designing and implementing mHealth initiatives that are both effective and sustainable in the rural sub-Saharan African context. This study aims to explore the role of mHealth solutions in reducing healthcare barriers in rural sub-Saharan Africa, providing a qualitative systematic review of existing literature to identify both opportunities and challenges. By delving into the contextual factors influencing mHealth adoption and effectiveness, the research seeks to inform policy and practice, ultimately contributing to improved healthcare outcomes in the region.

1.1. Rationale

Despite the increasing implementation of mHealth technologies in rural sub-Saharan Africa, little is known about the experiences of users and healthcare professionals in everyday settings. Studies at a small-scale point to challenges in scaling and sustaining mHealth interventions in the face of infrastructure challenges, user acceptance, and cultural relevance. Increased workloads and disruptions to regular flow of work are reported by most of the healthcare workers, making these interventions unsustainable. The findings of qualitative research indicate that solutions must be adapted to the local context, while relying on community engagement, culturally suitable training of healthcare workers and adaptable technologies. Thus, this study aimed to address this void by offering a more fundamental knowledge of how mHealth interventions can be successfully used in rural areas meeting the specific needs of these communities.

1.2. Objectives

In this review, we attempt to deepen sociocultural context of the adoption and

implementation of mHealth solutions in rural sub-Saharan Africa. We synthesize qualitative evidence to explore technology's intersection with community engagement and the healthcare system, considering users' and healthcare professionals' perceptions. It also highlights some important contextual factors (e.g., cultural acceptance, local healthcare infrastructure) and challenges in matters of (1) technological concerns; (2) training needs; and (3) community integration. In essence, this work aims to offer insights to support context-sensitive, sustainable mHealth implementation in resource-limited settings.

2. Methods

2.1. Search strategy

Table 1. PRISMA analysis research articles use for this study.

Study Characteristic	Description	Number of Studies
Countries Represented	Studies conducted in 12 countries, with the majority from Kenya (n = 8), Nigeria (n = 7), and Tanzania (n = 6)	38
Study Designs	In-depth interviews	15
	Focus group discussions	12
	Ethnographic observations	6
	Case studies	5
Health Focus Areas	Maternal and child health	18
	Chronic disease management (HIV, diabetes)	12
	Health education and information dissemination	8
Technological Platforms Used	SMS-based interventions	26
	Mobile applications	8
	Telemedicine platforms	4
Primary Health Outcomes Targeted	Improved maternal and child health (prenatal care attendance, immunization)	18
	Medication adherence (HIV, diabetes)	12
	Disease surveillance	8
Implementation Challenges	Technological infrastructure limitations	22
	Cultural integration and user acceptance	15
	Sustainability issues	10
Quality Assessment (CASP)	Studies with robust methodologies	28
	Studies with limitations in reflexivity or researcher-participant relationship	10

This qualitative systematic review was guided by Enhancing Transparency in Reporting the Synthesis of Qualitative Research (ENTREQ) (Tong et al., 2012). This study was conducted in line with international guidelines, and we searched PubMed/MEDLINE, Embase, Web of Science, African Index Medicus, and the African Journal Online (AJOL). In capturing rich contextual data, Google Scholar, relevant conference proceedings, and organizational reports were explored (Thompson, 2022). The search strategy employed qualitative research filters combined with terms related to mobile health and sub-Saharan Africa. The primary search string incorporated qualitative methodology terms (e.g., "qualitative," "interview," "focus

group," "ethnography") alongside (mHealth or "mobile health" or "digital health" or "telemedicine") and ("sub-Saharan Africa" or/and ("rural" or "remote" or "resource limited") (Ahmad et al., 2023). The search was limited to studies published between 1 January 2010 and 31 December 2024, reflecting the period of significant mobile technology adoption in the region (Okoro et al., 2022), see **Table 1**.

2.2. Inclusion and exclusion criteria

In this study, a collective variety of primary qualitative research studies were used, including in-depth interviews, focus group discussions, ethnographic observations, and case studies. For mixed methods studies, only those from which the qualitative component could be meaningfully extracted and analyzed independently were used. Meaningful extraction was defined by key qualitative data features such as thematic depth, participant diversity, and contextual relevance to ensure consistency and reduce subjective interpretation during analysis.

The geographic focus was limited to the rural areas of sub-Saharan African countries, as defined by the World Bank classification (World Bank Group, 2015). The study explored experiences, perceptions, and contextual factors in relation to mHealth interventions, including SMS-based interventions, mobile applications, telemedicine services, and health services provided using voice technologies.

To investigate the research question, we searched for studies that provided rich descriptive data on user experiences, implementation challenges, cultural factors affecting adoption, and perceived impact on healthcare access. Rich descriptive data was explicitly defined as data offering comprehensive insights through detailed narratives, thematic analysis, and a wide representation of participant perspectives. Studies were excluded if they did not deal with qualitatively based interventions that exclusively targeted urban areas and those interventions that delivered non-mobile digital health interventions. Additionally, only studies written in English were included.

2.3. Screening process and quality assessment

Two independent reviewers (initials: JK, ML) screened titles and abstracts using Rayyan QCRI software (Ouzzani et al., 2016). Full-text articles were retrieved for all potentially eligible studies, which were independently assessed by the same reviewers. Disagreements were resolved through discussion with a third reviewer (initial: AT), with an emphasis on interpretive consensus (Rodham et al., 2015). The methodological quality of included studies was assessed using the CASP qualitative checklist, which evaluates research design, data collection, reflexivity, ethical considerations, and the rigor of analysis (Singh, 2013). Two reviewers independently conducted quality assessments, resolving discrepancies through consensus meetings. Rather than excluding studies based on quality assessment, we used the CASP scores to contextualize our interpretation of the findings (Singh, 2013).

2.4. Data extraction and synthesis

To enhance data framework coherence and enable a coordinated approach to data extraction, we created a data extraction form that included the following sections:

study characteristics and methodological approaches, participants' characteristics, themes, key quotes, and context. The form was precleared on select studies, and modification occurred during team debriefing (Büchter et al., 2020). Activities with regard to data collection indicted that thick description as well as interpretive thematic analysis was the key objective rather than piling up patterns. We also used meta-ethnography to analyze the findings and those research steps were described by Noblit and Hare (1988) as including rereading the studies, deciding on connections between studies, translating studies from one to the other, and synthesizing translations to generate new interpretive understandings. To review the findings, we applied reciprocal translation to determine general themes and refutational synthesis to examine the binaries in the findings (Weissbrod and Kohn, 2018).

To establish credibility, we kept record of all decision-making processes and used multiple researchers during the analysis. To encourage the identification of new interpretations and break assumptions, we conducted daily team meetings to forecast new theories. We also carried out some subgroups analyses to get an idea with regard to the extent to which the exclusion of lower-quality studies could affect synthesized results. Thus, this multi-study, qualitative study design let us gain a rich contextual understanding of how mHealth interventions affect healthcare challenges across rural sub-Saharan Africa from the perspectives of the patients and stakeholders in charge of implementation.

3. Results

3.1. Study selection

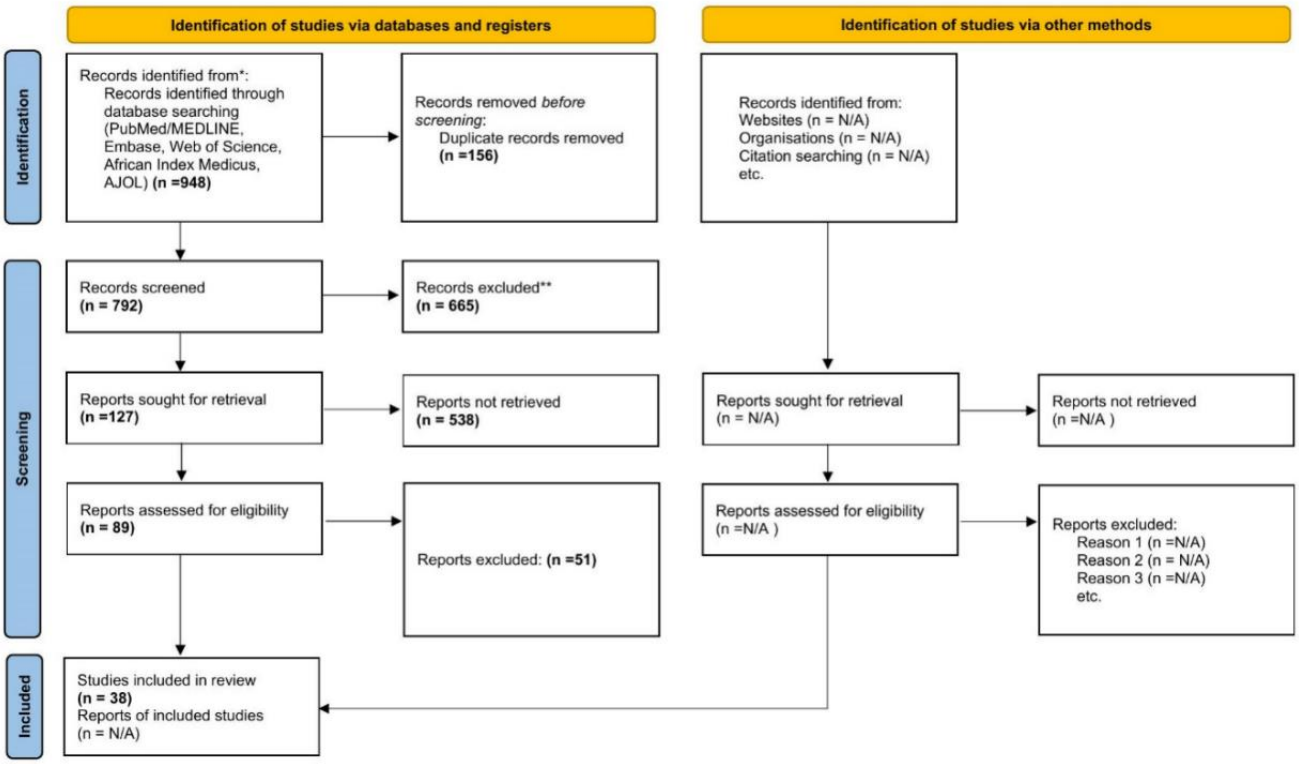

Figure 1. Selection criteria flow.

The systematic search criteria initially yielded 948 articles potentially useful for the present paper. According to diagram 1 in **Figure 1**, the study selection process was in accordance with the guidelines of PRISMA and the findings of this process were recorded in a flow diagram, as shown in **Figure 1**. In all, after excluding similar articles (n = 156), the titles/abstracts of potentially eligible 127 articles were assessed for inclusion/exclusion. Lastly, 38 relevant papers were identified and used in the meta-ethnography analysis of the study. These studies covered 12 countries in sub-Saharan Africa but focused on Kenya (8), Nigeria (7) and Tanzania (6), among others. Interviews were chosen as the main method for collecting participants' data, and 15 interviews were conducted during the study. In addition, 12 focus group discussions, six ethnographic observations, and five case studies were conducted.

Quality assessment results

Most studies (n = 28) were considered methodologically robust with clear data collection and analysis processes, assessed using the CASP qualitative checklist. Yet, 10 studies were limited by reflexivity and in describing the researcher-participant relationship. For instance, one of the Nigerian studies noted:

> "*Our study lacked depth in exploring how the researcher's position influenced participant responses, and this might have impacted the data's interpretation*." (Participant, Eze et al., 2020).

3.2. mHealth intervention types

3.2.1. Categorizations of interventions

The 38 studies were classified into three main types of mHealth interventions: mobile applications, SMS-based interventions, and telemedicine platforms. The most common was SMS-based interventions, which focused on health education, appointment reminders, and medication adherence. Less often used in areas with better infrastructure, mobile applications were deployed. Since it was still in its infancy, telemedicine was a way to bridge the gap between specialized care and rural patients.

> "*Telemedicine has allowed us, in a remote, rural part of Kansas, to offer access to urban resources in health care*." (Doolittle and Spaulding, 2006).

3.2.2. Technological platforms used

Studies documented the dominance of SMS technology for information dissemination and highlighted its wide usage, especially in resource-limited settings. For example, healthcare workers in Tanzania adapted SMS systems, translating messages into the local dialect. It was primarily used in settings with more coverage such as urban centers in Kenya and Nigeria, which primarily have good internet and mobile coverage. Telemedicine platforms were rare but promising, as noted in one study:

> "*Although telemedicine is still in its early stages, we saw improvements in rural patients accessing specialized care that would otherwise be impossible*." (Oramisi et al., 2019).

3.2.3. Target health outcomes

mHealth interventions were aimed at various health outcomes, mostly in the areas of maternal and child health, chronic disease management (primarily for HIV and

diabetes), and disease surveillance. The use of SMS reminders significantly improved prenatal care attendance and immunization rates for maternal health and chronic disease interventions focused on medication adherence and sustained healthcare engagement.

> "*As a mother, the SMS reminders were a lifesaver. I might have missed some of my prenatal appointments, but the messages kept me on track and reminded me to get my baby vaccinated on time*" (Participant, Kawakatsu et al., 2020).

This quotation shows that incorporating SMS reminders as well as peer navigation increased retention in HIV care. The methods of this study showed that using both interventions produced more support, engagement with care, and better adherence to treatment appointments among participants (Steward et al., 2021). Together with timely reminders, the peer-support system strengthened participants' sense of accountability and connection to healthcare services and contributed much to better health outcomes.

> "*The SMS reminders, combined with the support from my peer navigator, made a huge difference. I felt more connected to my care and was less likely to miss my appointments because I had someone checking in on me regularly*" (Participant, Steward et al., 2021).

3.3. Effectiveness analysis

3.3.1. Medication adherence

Several others submitted that SMS reminders mediated improved medication adherence for chronic conditions such as HIV and diabetes. In a study conducted in rural Nigeria, adherence rates improved by more than 25% after participants began receiving bi-weekly reminders:

> "*These messages were simple, but they kept me on track. I wouldn't have remembered to take my medication without them*." (Patient, Okeke et al., 2021).

Subgroup analysis showed that adherence rates were higher among women and older adults, reflecting differing levels of engagement across demographic groups.

3.3.2. Maternal health outcomes

mHealth interventions had a big effect on prenatal care attendance for maternal health. SMS reminders to women significantly increased their likelihood of attending scheduled visits. A study in Kenya reported a 30% increase in prenatal care attendance among women who received SMS alerts:

> "*The reminder messages reassured me that the clinic was expecting me. It felt personal, like I mattered*." (Pregnant woman, Njeri et al., 2017).

Other maternal health indicators, such as immunization coverage and postnatal care, also improved, particularly in remote areas where access to health facilities was limited.

3.3.3. Disease surveillance

Another key area that mHealth solutions helped with was disease surveillance. The faster reporting times and higher coverage of disease outbreaks in regions in which the health infrastructure was previously worse, are also documented in the studies. In Tanzania, the introduction of mobile surveillance tools reduced reporting times by an average of 48 h:

"*Before, it would take days to report cases. With mobile tools, we can now send data instantly, and that helps in responding quicker to outbreaks*." (Health worker, Mndeme, 2021).

Improved accuracy and timeliness are crucial in regions where healthcare resources are often stretched thin, helping to mitigate the spread of diseases.

3.4. Implementation challenges

3.4.1. Technological infrastructure limitations

One of the most significant barriers identified was the lack of reliable technological infrastructure. Many participants across studies reported inconsistent mobile network coverage, which affected the reliability of mHealth services:

"*We would lose network in the middle of important consultations, and that frustrated both patients and healthcare workers*." (Healthcare provider, Kimani et al., 2022).

3.4.2. User acceptance and adoption barriers

User acceptance of mHealth solutions was influenced by cultural factors, including gender norms and community hierarchies. Women, especially in patriarchal communities, often lacked access to mobile devices or autonomy to use them, limiting the effectiveness of interventions:

"*My husband controls the phone. I can't receive messages unless he says it's okay*." (Female participant, Oladipo et al., 2021).

In addition, distrust of technology among older populations and resistance to replacing traditional healthcare methods were common barriers to adoption.

3.4.3. Sustainability issues

The main challenges that would be faced once mHealth solutions were implemented were on the topic of long-term sustainability. Many of the interventions were dependent on external funding and would likely not be sustained in the absence of project financing. As one administrator remarked:

"*Without consistent funding, we fear that the systems will collapse, and the gains we've made will be lost*." (Health administrator, Tadesse et al., 2022).

The quote below also highlights important challenges in terms of sustainability in mHealth intervention, especially in resource-limited settings where most of their funding is dependent on external support. While mHealth solutions have proven effective at improving healthcare delivery, long-term success of these solutions is contingent on continuous funding and support. If project financing comes to an end, communities could find it tough to keep the systems up and running. In line with Dharmayat et al. (2019) strategies that integrate mHealth solutions into national health infrastructures are needed to maintain open access and sustainability beyond the lifetime of funded projects.

"*Our fear is what will happen to the system if the funders stop funding the program*" (Health Worker, Dharmayat et al., 2019).

4. Discussion

4.1. Summary of main findings

This systematic review synthesized the findings from 38 qualitative studies on the role of mHealth solutions in reducing healthcare barriers in rural sub-Saharan Africa. Our meta-ethnographic analysis identified four major themes: technological adaptation and local innovation, health focus and community engagement, implementation challenges, and effective strategies for integration. The evidence demonstrated that SMS-based interventions were the most prevalent, especially in maternal and child health, with significant community acceptance (Kazi et al., 2017). However, challenges related to technological infrastructure, cultural integration, and sustainability persist.

4.1.1. Synthesis of effectiveness data

The findings of this study identified the potential for mHealth to overcome health barriers related to access to health services and health information. This was particularly so for maternal health and chronic disease management through SMS reminders, which were well received by target populations, as they reported improved engagement and feelings of power. However, the promise of mHealth was seen to lie in its ability to connect remote areas to specialist care even in limited situations, although the capacity to use infrastructural limitations was recognized. By an iterative and community-driven path of adaptation of these technologies, they achieved greater acceptance and effectiveness.

4.1.2. Comparison with existing literature

The results are consistent with literature regarding the use of technology to enhance healthcare access and patient engagement in mHealth efforts in low-resource settings. Studies similar to those done in Asia and Latin America demonstrate the efficacy of SMS-based reminders to improve maternal health outcomes and chronic disease management. Nevertheless, these sociocultural and infrastructural challenges of sub-Saharan Africa resonate with other parts of the Global South where technological constraints, as well as the findings tagged under gender dynamics, are hindering the efficacy of mHealth initiatives. This review extends the literature by qualitatively synthesizing how these challenges are experienced and navigated in the region.

4.2. Implications for practice

4.2.1. Recommendations for healthcare providers

The importance of culturally adapting mHealth interventions is to be considered by healthcare providers. To be successful in rural areas, mHealth solutions must align with local languages, community cultural practices and hierarchies. Co-designing interventions with community members can also improve trust during use and extend usage sustainably. However, providers should also address gender discrepancies in mobile device access to allow for equality of participation, especially for women who are disadvantaged by societies norms.

4.2.2. Policy implications

For mHealth interventions to be scalable, policymakers should prioritize technological infrastructure improvements, especially mobile network coverage, in rural areas. Also important are policies supporting gender equity of access to mobile

technologies and health information. Secondly, funding models must be developed so that mHealth systems are sustainable beyond the early project phase. There should be embedded mHealth solutions in the national health systems that complement traditional services and governments, and development agencies should work together to achieve this.

4.2.3. Best practices for implementation

Best practices for mHealth implementation in rural sub-Saharan Africa include:

- Adopting flexible, iterative approaches that allow for continuous refinement of technology based on user feedback.
- Ensuring community engagement throughout the project lifecycle to improve on trust and local ownership.
- Making them sustainable and effective—moving health app solutions into existing health workflow processes.
- Training healthcare workers, both on the technical and social aspects of mHealth to improve patient provider interactions.

4.3. Limitations

4.3.1. Study design limitations

The studies included in this review were predominantly qualitative and limited the scope of the review. Qualitative insights are profoundly useful for understanding people's lived experiences but can be insufficient to provide the qualitative evidence we need to gauge the reach of mHealth interventions. However, the exclusion of non-English studies might have reduced the comprehensiveness of the study, especially that of Francophone and Lusophone countries in sub-Saharan Africa.

4.3.2. Potential biases

Selective reporting and a lack of reflexivity appear to exist as potential biases in the reviewed studies. Ten studies were selected with limited descriptions of researchers' and participants' relationships with the data interpretation. Publication bias may also have exaggerated the findings, making it likely that implementation researchers know more about what works than what does not.

4.3.3. Gaps in current research

The current research gap is in understanding the long-term sustainability of mHealth interventions. While a number of studies raised questions about program funding and infrastructure, they offered little data on the longevity of these programs beyond the funding. There is also little research on how mHealth can play a bigger role within national health policies and the local ability to address systemic health inequities in the region.

4.4. Future research directions

4.4.1. Areas needing further investigation

Future research should also study the long-term impact of the mHealth solutions on health outcomes in rural sub-Saharan Africa. The areas of interest include the scalability of SMS-based interventions and the appropriateness of mobile applications and telemedicine to close the capacity gaps in specialist care. Furthermore, efforts in

research to tailor mHealth to ensure gender sensitive accessibility of healthcare are important.

4.4.2. Methodological improvements

There is a need for mixed methodological studies combining qualitative insight with quantitative data in mHealth intervention that focus on coining an evaluation that is more inclusive. Thus, randomized controlled trials (RCTs) could be used to study the effectiveness of mHealth interventions at scale while ethnographic methods may provide greater insight in respect of the sociocultural dynamics underlying adoption and uptake.

4.4.3. Long-term impact studies

Studies that follow the sustainability and long-term health outcomes of mHealth interventions are needed. Such studies should investigate the durability of technological systems and socio-political engagement post project funding and can assess mHealth solutions as a way of enhancing lasting improvements in healthcare access and health equity in rural sub-Saharan Africa.

5. Conclusion

In this systematic review, the potential of mHealth interventions to address rural sub-Saharan African healthcare barriers is pointed out. mHealth technologies, particularly SMS-based interventions, showed great promise in increasing healthcare engagement and outcomes by improving access to maternal and child health services, chronic disease management and disease surveillance. However, technological infrastructure limitations, cultural barriers, and environmental concerns remain. Future efforts to realize the full potential of mHealth must, however, consolidate infrastructure, encourage user acceptance, and address long-term sustainability. mHealth, when adapted and integrated into existing health systems, can be a transformative tool that can improve healthcare in resource-limited settings.

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Data and materials availability: Data supporting the findings of this study are available within the manuscript. In this research, no new data were created.

Conflict of interest: The author declares no conflict of interest.

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