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# Use of mobile devices (mhealth) to promote health in Africa.

## A Scoping Review

Metropolia University of Applied Sciences

Bachelor of Health Care

Degree Programme in Nursing

Bachelor's Thesis
29th February 2024

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| **Title** | Use of Mobile Devices (mHealth) to Promote Health in Africa: A Scoping Review |
| **Number of Pages & Date** | 36 pages 29 February 2024 |
| **Degree** | Bachelor of Health Care |
| **Degree Programme** | Nursing and Health Care |
| **Specialisation** | Nursing |
| **Instructor(s)** | Pirjo Vesa, Principal Lecturer |
| **Abstract** | Among the many difficulties in Africa's Healthcare system has been inadequate infrastructure, labor shortages, and obstacles to obtaining good treatment, particularly in rural areas. Mobile health (mHealth) technology has thus appeared as a revolutionary way to close healthcare disparities all throughout the continent. This scoping study sought to outline the advantages of mHealth in enhancing African healthcare systems and provide a summary of the present research on the subject. The primary study topic was: How can mHealth assist the African healthcare system? Scientific databases including CINAHL, PubMed, and MEDLINE were systematically searched to gather data. A total of 1,336 relevant papers were found and examined using specified inclusion and exclusion criteria. Results were mapped using thematic content analysis. By means of remote maternity and postnatal care, palliative treatments, and higher kid immunization rates, the research found mHealth increases access to healthcare. It also improves |

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| | public health education, helps disease surveillance and emergency responses, and offers training and diagnostic assistance to healthcare professionals. These developments were mostly driven by real-time data tools, teleconsultations, and mobile messaging. Ultimately, by improving access, efficiency, and involvement, mHealth has shown great promise in changing healthcare delivery in Africa. Still major subjects needing further research, however, are those connected to infrastructure, digital literacy, and policy integration. |
| **Keywords** | mHealth, mobile health, healthcare in Africa, digital health, health technology, maternal care, disease surveillance, health promotion, healthcare access, healthcare workers |

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# 1. Introduction

For a long time, Africa's healthcare systems faced numerous challenges that often-hindered effective service delivery. The continent's vast and diverse geography and limited infrastructure created significant barriers to healthcare access, particularly in rural and remote areas. Healthcare facilities were often concentrated in urban centers, leaving many populations without regular access to essential medical services (Manamela & Choung, 2024). In many parts of Africa, health education and disease prevention efforts have been hampered by inadequate communication channels, and a lack of trust in healthcare professionals (Østergaard, 2015).

This makes it difficult to disseminate critical health information to communities. Traditional paper-based health record systems were common in many African countries, leading to inefficiencies in data management and decision-making, public health surveillance, disease monitoring, and responses to outbreaks were often slow and ineffective due to the lack of real-time data collection and communication tools (Odekunle et al., 2017). Technology in health has been changing over time, and new applications have been adopted to offer efficient care, Among the many digital technologies integrated in the African healthcare systems is mhealth. mHealth (mobile health) involves various types of mobile and wireless technologies designed to enhance healthcare delivery (Ibeneme et al., 2022).

The World Health Organization defines mhealth as "The use of mobile and wireless technologies to support the achievement of health goals". Over the past decade, mHealth has evolved into a powerful tool that improves the efficiency and accessibility of healthcare services worldwide, in healthcare, mobile health(mHealth) is a very important tool that offers creative methods to raise, the efficiency, effectiveness, and accessibility of healthcare services provided globally. mhealth has the potential to completely transform the way that healthcare is delivered by enabling remote monitoring, improving the interaction between patients and healthcare professionals, and making health information and services more easily accessible with the increasing use of smartphones and other mobile devices.

mHealth includes a variety of technologies and applications aimed at improving healthcare delivery and outcomes through mobile devices. It includes mobile health apps for fitness, chronic disease management, and mental health, along with

telemedicine platforms that enable remote consultations. Wearable devices, like fitness trackers, monitor vital signs and physical activity (Charlton et al., 2023). SMS-based health services provide accessible health information, while remote monitoring devices enable the ongoing management of chronic conditions. mHealth also supports health education, disease outbreak tracking, and health information systems for real-time patient data management. These innovations have particularly improved healthcare access and outcomes in regions with limited traditional healthcare infrastructure (Rathbone & Prescott, 2017).

The purpose of this thesis is to describe how mHealth has improved the healthcare system in Africa. The thesis aims to gain knowledge about mHealth in the African healthcare system.

# 2. Background and Key terms

## 1.1. Mhealth in Africa

In Africa, mHealth is becoming more popular as a means to overcome obstacles to healthcare delivery and access. According to Gilano et al. (2024), these technologies are particularly impactful for maternal health, providing mothers with access to crucial health information and supporting informed decisions on childhood vaccination. Access to medical treatments in rural and underserved areas has greatly improved because of mHealth. Patients and healthcare providers may communicate more easily because of mobile phones, which can make remote consultations and advice possible. This is especially advantageous in areas with inadequate healthcare facilities (Istepanian, 2022). Projects focused on mobile health have been crucial in educating and informing the public about health issues, Communities are educated about illness prevention, maternity and child health, and good lifestyle choices through the use of mobile platforms.

Monitoring and responding to health emergencies have become easier with mobile phones used for disease surveillance, enabling quicker epidemic detection and more efficient management of infectious diseases through real-time data gathering and reporting. Applications for mobile health (mHealth) also simplify many back-end healthcare operations, such as follow-up treatment, patient information management, and appointment scheduling, which contribute to better patient management and more economical use of resources. Additionally, mobile technology provides health workers

with access to medical information, training materials, and decision-making tools, which raises the standard of care in resource-limited areas (Istepanian, 2022).

Sub-Saharan Africa has benefited greatly from the deployment of mobile health (mHealth) technologies in public health surveillance. The improvement of data gathering procedures, which become quicker and more efficient, is one of the main benefits. This innovation is essential in areas where traditional methods could be labor-intensive or slow. Moreover, mHealth tools speed up reaction times to public health emergencies by improving illness monitoring and outbreak detection, the extensive adoption of mHealth applications is made possible by the accessibility of mobile phones in sub-Saharan Africa. These methods ensure that vital health information is efficiently communicated and bridge gaps in healthcare delivery by reaching underserved and remote communities. mHealth solutions also help healthcare professionals by giving them access to real-time data and instruments for making decisions, which eventually raises the standard of care given (Brinkel et al., 2014).

### 1.2. Healthcare system in Africa

According to Masiye et al. (2023), colonial legacies and after-independence changes contributed to the evolution of Africa's healthcare system from informal to more structured systems. Initially, basic medical care and public health programmes got less focus than threatening acute illness, and healthcare delivery was frequently uneven (Masiye et al.,2023).

The African healthcare system faces numerous obstacles in becoming both accessible and effective. Over the years, it has suffered from a range of man-made issues spanning institutional, human resources, financial, technical, and political developments (Oleribe et al., 2019). These challenges are compounded by inadequate medical infrastructure in many areas, including underdeveloped transportation systems, shortages of medical supplies, and insufficient healthcare facilities, particularly in rural and isolated locations, which significantly limits access to essential health services (Istepanian, 2022).

In many African countries, individuals bear a significant portion of healthcare costs out of pocket. This can lead to financial hardship and reduced access to care, especially for low-income households. Most African countries have public healthcare systems funded by the government. However, public healthcare facilities often face challenges

such as underfunding, inadequate infrastructure, and shortages of medical staff and supplies. These facilities typically serve the majority of the population, especially in rural and low-income areas.

Across Africa, there is a high demand for healthcare professionals such as physicians, nurses, and community health workers. However, this demand is unmet due to a significant 'brain drain,' where highly qualified individuals migrate to other nations seeking better opportunities, which leads to inadequate staffing levels and, consequently, overworked facilities and substandard patient care. This shortage is particularly severe in rural areas, where poor working conditions and a lack of infrastructure discourage healthcare workers from staying. Ultimately, the migration of healthcare professionals to higher-income countries exacerbates the shortage, impacting the healthcare system's capacity to deliver adequate care across the continent (Istepanian, 2022).

The governments of many African nations face financial difficulties that make it difficult for them to sufficiently fund their healthcare systems. Insufficient funds for healthcare provision, facility maintenance, and medical supply purchases are the outcome of low healthcare budgets. As a result, consumers frequently have to pay high private expenses for medical care (Istepanian, 2022). Some countries in Africa, such as Rwanda, Ghana, Nigeria, Kenya, Tanzania and Ethiopia have started implementing social health insurance schemes as part of efforts to remedy the lack of financial risk protection mechanisms (Oleribe et al., 2019). Therefore, the poor bear the highest burden of diseases and experience high levels of financially crippling healthcare expenditure in many sub-Saharan African countries.

The burden of infectious and non-communicable diseases is particularly high in Africa. The healthcare system is under strain due to the high prevalence rates of infectious diseases like HIV/AIDS, malaria, and tuberculosis, as well as the increased frequency of chronic disorders like diabetes and hypertension. Health policies must be comprehensive and integrated due to the dual burden of disease (Istepanian, 2022). African governments are working to develop and implement national health policies and strategies that align with global health goals, such as Universal Health Coverage (UHC) and the Sustainable Development Goals (SDGs). However, weak governance, corruption, and limited resources often hinder the effective implementation of these policies (Oleribe et al., 2019).

There are notable differences in healthcare availability between rural and urban regions, as well as between various socioeconomic categories. While people living in rural areas may have limited access to healthcare, urban areas frequently have better healthcare facilities and services. Furthermore, there are more obstacles for underprivileged and marginalized communities to obtain healthcare (Istepanian, 2022). Some African governments are working to decentralize healthcare services by expanding access to primary care in rural and underserved areas. This includes the establishment of rural health posts, community health centers, and mobile clinics to reach remote populations. Investments in infrastructure, such as improved transportation networks and telecommunications, are also critical to enhancing healthcare accessibility.

In order to fund their health initiatives, many African healthcare systems rely significantly on foreign donors and external help. This assistance is vital, but it can also cause problems with sustainability and dependency, as well as a lack of connection with the needs and objectives of local health (Istepanian, 2022). Various international donors, non-governmental organizations (NGOs), and multilateral organizations provide essential funding, technical assistance, and resources. International aid is often subject to the political and economic conditions of donor countries. Changes in government policies, economic downturns, or global crises can lead to reductions in aid, leaving African healthcare systems vulnerable. For example, during the COVID-19 pandemic, some international donors redirected funds toward their domestic healthcare systems, leading to cuts in funding for ongoing health programs in Africa.

Women and girls, particularly in rural and low-income areas, face unique healthcare challenges. Gender-based disparities in education, income, and social status often result in limited access to healthcare services for women. Cultural norms and practices may restrict women's mobility, making it difficult for them to seek care, especially for reproductive health issues. Additionally, maternal mortality rates are particularly high in many African countries, especially in rural and underserved areas. Access to skilled birth attendants, emergency obstetric care, and postnatal services is often limited for women in these regions. The lack of maternal healthcare services contributes to preventable deaths from complications such as hemorrhage, infections, and hypertensive disorders. Furthermore, the HIV/AIDS pandemic, in addition to other infectious diseases and new healthcare risks highlighted the necessity of strong

healthcare systems that can address complicated medical issues (UNAIDS, 2021). The HIV/AIDS pandemic remains one of the most significant public health challenges in Africa. Sub-Saharan Africa, in particular, bears the brunt of the epidemic, with the region accounting for more than two-thirds of the global HIV burden. The widespread prevalence of HIV has strained healthcare systems, leading to high mortality rates and placing immense pressure on healthcare providers.

### 1.3. Mhealth Statistics

The mHealth market's projected growth reflects a significant shift in healthcare towards digital solutions, driven by an increase in chronic diseases, consumer engagement with digital tools, and technological advancements such as wearable devices (Grand View Research, Inc., 2024). With the global market expected to exceed $111.5 billion in 2022 and continue growing at over 22% CAGR through 2032, this expansion highlights the rising demand for real-time health monitoring and the critical role of mHealth in addressing chronic conditions like diabetes, cardiovascular diseases, and neurological disorders (Insights, 2024).

Key factors driving this market include:

1. Wearable Devices: This segment is projected to exceed $171 billion by 2032, fueled by the need for better access to clinical information. The COVID-19 pandemic accelerated the adoption of wearable technology, emphasizing the importance of monitoring vital health parameters such as heart health and blood glucose levels (Grand View Research, Inc., 2024).
2. Diagnostics and Treatment Applications: Expected to grow at over 21% CAGR through 2032, this segment reflects the demand for real-time monitoring tools for patients with chronic diseases. Innovations like the Peerbridge Cor System for portable ECG diagnostics represent how companies are meeting this need with advanced technology (Grand View Research, Inc., 2024).
3. Patient Segment: Projected to reach $190.5 billion by 2032, this segment underscores the growing awareness and emphasis on monitoring vital health parameters. The accessibility of mHealth apps and the internet further drive product adoption, contributing to this sector's rapid growth (Grand View Research, Inc., 2024).

The mhealth market in Middle East & Africa is expected to reach a projected revenue of US$ 6,260.4 million by 2030. A compound annual growth rate of 14.7% is expected of Middle East & Africa mhealth market from 2024 to 2030 (Grand View Research, Inc., 2024). These developments illustrate mHealth's critical role in enhancing patient care and expanding healthcare access, especially in developed regions of North America and Europe. As digital health continues to evolve, the market's expansion is poised to impact healthcare delivery on a global scale, especially in Africa.

To build upon the initial analysis of the mHealth market's projected growth, it is crucial to recognize the broader implications of this digital health transformation. Beyond the statistics and technological advancements, mHealth is reshaping healthcare systems by fostering more personalized care and empowering patients to take an active role in managing their health. This paradigm shift signifies a movement from traditional, reactive healthcare models towards preventive, patient-centered care, where continuous monitoring and timely interventions are key to improving outcomes.

In Africa, where healthcare infrastructure often struggles to meet the needs of a rapidly growing population with limited resources, mHealth presents a valuable solution. In many countries across the continent, the burden of managing chronic diseases is exacerbated by a shortage of healthcare professionals and insufficient access to traditional healthcare services. Mobile technology, with its wide accessibility, offers a way to bridge this gap, empowering patients in rural and underserved areas to access crucial health services. Through mHealth, patients can consult with healthcare providers via telemedicine, receive automated reminders to take medication, and access educational resources on managing chronic conditions.

Also, wearable devices are showing promise in improving maternal and child health outcomes. Devices equipped with GPS and heart rate monitors can provide data on maternal health conditions in remote areas, alerting healthcare providers when urgent care is needed. This enables a more proactive approach to healthcare, ensuring that medical interventions are provided before complications arise. Additionally, mobile diagnostics have been particularly impactful in infectious disease management. During outbreaks of diseases such as malaria or tuberculosis, mobile health solutions can assist in quick diagnosis and treatment, which is crucial for containing the spread of infectious diseases. mHealth applications can also store patient data securely,

allowing for more accurate epidemiological tracking and the identification of disease hotspots, thereby enabling targeted healthcare interventions.

# 2. Purpose, Aim and Research Question

The purpose of this thesis is to describe the impact of mHealth on improving healthcare systems in Africa. Additionally, this thesis aims to gain insights into the role of mHealth within the African healthcare system.

The Research Questions is:

What are the benefits of mhealth in the healthcare system in Africa?

# 3. Methodology and Methods

## 3.1. Data Collection Method

A scoping review method is used in this thesis to provide an overview of the main conclusions, research methods, and developments in the literature by summarizing and mapping the breadth of knowledge already available on the subject. Scoping reviews are particularly valuable for gaining a broad understanding of a research area without necessarily narrowing it down to specific research questions, as they examine what is known, highlight emerging developments, and identify areas requiring further investigation (Johnson & Christensen, 2017). This approach is especially useful for researchers seeking a comprehensive overview of a topic, as it assists in identifying gaps, limitations, and potential areas for future research (Johnson & Christensen, 2017).

CINAHL, PubMed, and Medline are the databases used in searching for articles.

## 3.2. Data Search and Selection

Keywords, Boolean operators, and advanced search filters will be used to retrieve articles through Databases like CINAHL, PubMed and Medline,

The search terms that will be used are *mhealth in Africa*. Boolean operators that will be used are “AND” and “OR” and truncation to search databases.

The inclusion and exclusion criteria (Table 1) will be used to enhance the retrieved studies and directly address the research questions. To ensure appropriate results in establishing more relevant data for the research question.

Table 1: Inclusion and Exclusion Criteria

| **Inclusion Criteria** | **Exclusion Criteria** |
|---|---|
| Articles relevant to using mobile devices(mhealth) to promote health in Africa. | Articles irrelevant to using mobile devices(mhealth) to promote health in Africa. |
| Studies published in English Language. | Studies that are not published in English Language. |
| Articles that are Peer-reviewed | Non-peer-reviewed articles |
| Articles published from 2014 to 2024 | Articles published before 2014 |

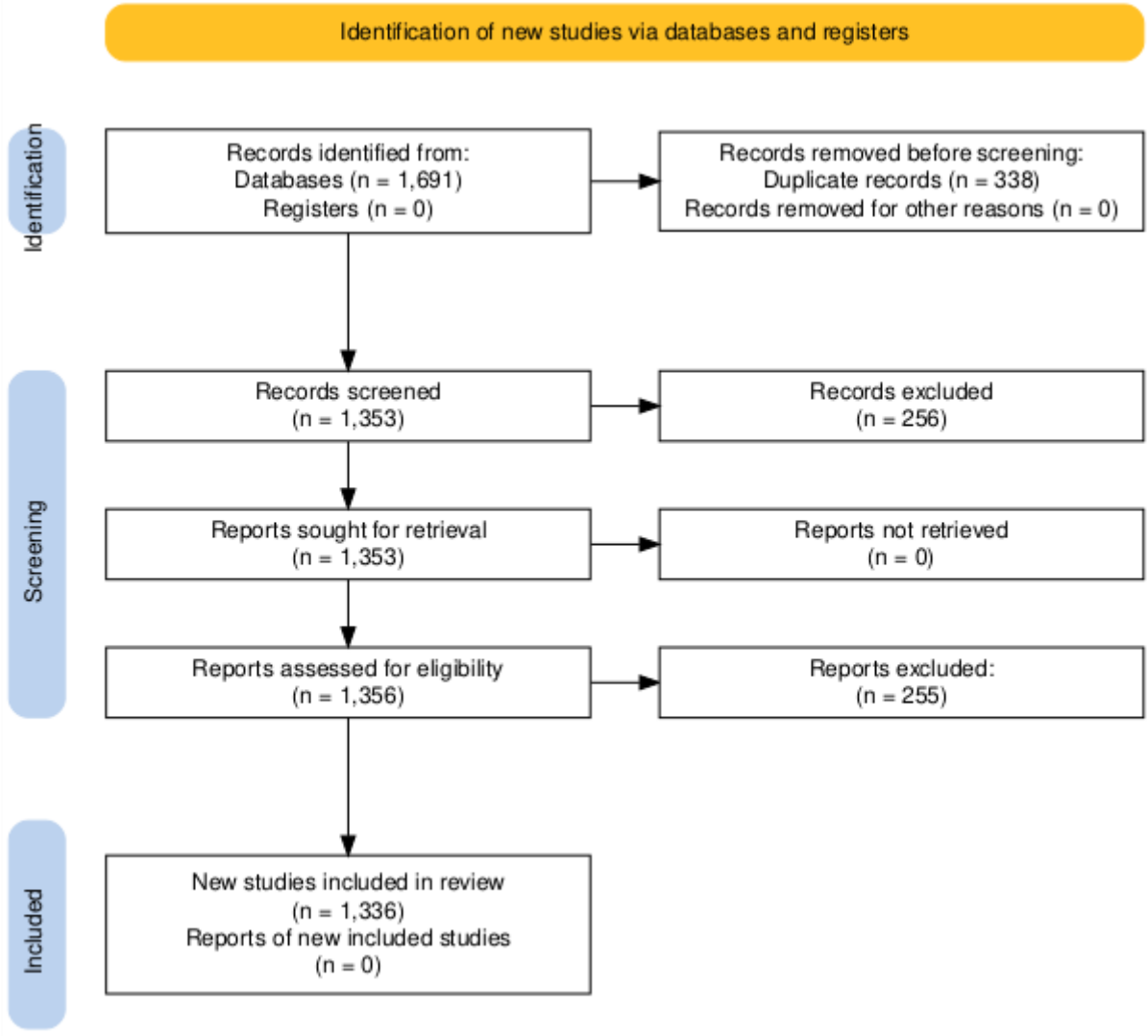
Table 2: Database Search Results

The Prisma flow diagram will be used to report the data search results.

| Database | Search sentence | Total Number of Hints | Papers/records included based on the title | Papers/records included based on the abstract | Papers/records included based on the full text |
|---|---|---|---|---|---|
| CINAHL | Mhealth in Africa | 51 | 51 | 50 | 47 |
| MEDLINE | Mhealth in Africa | 21 | 21 | 16 | 19 |
| PUBMED | Mhealth in Africa | 1,619 | 1,619 | 1,525 | 1,270 |

| | | | | | |
|---|---|---|---|---|---|
| Limiters | Years 2014-2024 | - | - | - | - |
| Records in Total | | 1,691 | 1,691 | 1,591 | 1,336 |

Figure 1: Prisma Flow Diagram




### 3.3. Data Analysis Method

In a scoping review, data analysis involves mapping and categorizing themes, concepts, and arguments to provide a broad understanding of the research landscape. This approach is essential for summarizing available evidence, identifying gaps, and

offering insights into emerging areas. Data in this thesis will be analyzed through content analysis, focusing on the themes, concepts, and evidence presented in the literature, along with the inclusion and exclusion criteria to ensure a comprehensive exploration of the topic (May & Perry, 2022).

# 4. Findings

## 4.1. Improved Access to Healthcare

Access to healthcare remains a significant challenge across much of Africa, where rural and remote areas are often underserved due to inadequate infrastructure, limited health resources, and a shortage of healthcare workers. The adoption of mobile health (mHealth) technologies has emerged as a transformative approach to address these challenges by improving healthcare access, especially for vulnerable populations in geographically isolated locations.

### 4.1.1. Maternal Health and Antenatal Care

Maliwichi et al. (2021) found that mHealth interventions focused on maternal healthcare have significantly expanded access to vital health information for expectant mothers in rural Africa. Through mobile health platforms, pregnant women can now receive timely information on antenatal care, vaccination schedules, and emergency services, which is particularly beneficial in areas with scarce healthcare facilities. This real-time, accessible information has improved maternal health outcomes by ensuring that pregnant women in underserved areas are educated and empowered to make informed health decisions. The Maliwichi et al. study highlights that by reducing physical barriers to healthcare, mHealth offers a critical solution to improving maternal health and decreasing the maternal mortality rate.

### 4.1.2. Mobile Messaging for Pregnancy and Postnatal Care

Sibuyi et al. (2022) examined the MomConnect initiative in South Africa, which provides pregnant women with tailored health information and reminders through mobile messaging services. MomConnect has been especially successful in reaching women who may otherwise lack access to conventional healthcare due to distance, financial limitations, or limited knowledge of available resources. The program not only increases healthcare engagement during pregnancy but also empowers women by providing knowledge about childcare practices. Sibuyi et al. (2022) note that this increased engagement with healthcare systems leads to improved maternal and infant

health outcomes, as women become more likely to seek timely medical assistance and adhere to healthcare recommendations.

#### 4.1.3. Palliative Care in Remote Regions

Access to palliative care has also been expanded through mHealth initiatives. According to Allsop et al. (2018), mHealth applications have significantly extended the reach of palliative care services to patients in remote areas who would otherwise face significant challenges in receiving end-of-life care. Their study found that mobile platforms enable healthcare providers to offer continuous support and monitoring for patients with life-limiting illnesses, thereby overcoming the geographic and logistical barriers that commonly obstruct access to palliative services. mHealth enables providers to deliver care, offer guidance, and monitor patient well-being, ensuring a higher quality of life for those in remote regions.

#### 4.1.4. Childhood Vaccination Rates

Vaccination, a cornerstone of preventive healthcare, has benefited substantially from mHealth applications. Gilano et al. (2024) conducted a systematic review and meta-analysis demonstrating that mHealth interventions have contributed to significantly higher vaccination rates across Africa. These mobile health tools provide caregivers with timely reminders about vaccination schedules, access to educational materials, and location-based information on vaccination sites. By facilitating access to these essential services, mHealth reduces missed vaccinations, especially among children in remote and resource-limited settings. Gilano et al. (2024) highlight that the ease of access to vaccination information via mobile technology has become a crucial factor in reducing disease incidence rates in children, making mHealth an invaluable asset to public health efforts.

#### 4.1.5. Diagnostic and Treatment Support for Healthcare Workers

Finally, mHealth technologies play an essential role in improving healthcare access by supporting healthcare workers in diagnostics and treatment. Osei et al. (2020) examined the availability and utility of mHealth tools for diagnostic support across Sub-Saharan Africa and found that mobile technologies enable healthcare workers to perform diagnostic and treatment support tasks more effectively, even in regions with minimal infrastructure. mHealth applications facilitate communication between healthcare providers and patients, enabling timely intervention and care. Furthermore,

diagnostic support tools allow healthcare providers to accurately diagnose conditions, recommend treatments, and ensure that patients are following medical guidance, all of which are essential in areas where in-person medical visits are limited.

## 4.2. Public Health Education and Awareness

Public health education is crucial in preventing diseases, promoting wellness, and fostering healthier communities. However, in many African countries, health literacy remains low due to limited access to reliable information, especially in rural and underserved regions. Mobile health (mHealth) has become an essential tool for disseminating health information and raising awareness, providing communities with accessible, timely, and tailored health education. The use of mHealth for public health education is particularly effective because it capitalizes on mobile technology, which is widely accessible across the continent, even in remote areas with limited healthcare facilities.

### 4.2.1. Barriers and Enablers in mHealth for Health Education

Aboye et al. (2024) conducted a qualitative study in Ethiopia that explores the barriers and enablers of mHealth in promoting public health education. The study highlights the positive impact of mHealth platforms in enhancing health awareness among patients, healthcare professionals, and the general population. mHealth platforms have been particularly effective in reaching populations in remote areas where conventional health education resources are scarce. However, Aboye et al. (2024) also identified several challenges that limit the effectiveness of mHealth, such as limited internet access, low health literacy, and technical issues with mobile devices. These challenges suggest that while mHealth has great potential, its effectiveness is often contingent on the availability of supporting infrastructure and user training. By addressing these barriers, mHealth initiatives could become even more impactful in bridging the health information gap across diverse African populations.

### 4.2.2. mHealth and COVID-19 Information Dissemination

Chitungo et al. (2021) examined the role of mHealth during the COVID-19 pandemic in Sub-Saharan Africa, a period when accurate and rapid dissemination of health information was critical. mHealth platforms were instrumental in spreading reliable information about COVID-19 prevention, symptoms, and vaccination, which helped counter the high levels of misinformation circulating on social media. These platforms

provided users with real-time updates on COVID-19 cases, quarantine protocols, and vaccine availability, helping to educate the public and promote preventative behaviors. This study emphasizes how mHealth served as a bridge between healthcare systems and the public, ensuring that people could access verified health information during a global health crisis. Chitungo et al. (2021) argue that mHealth's role in combating misinformation has positioned it as a valuable tool for future public health crises, not only as a means of communication but also as an active participant in managing health education.

#### 4.2.3. Supporting Community Health Workers (CHWs) with Educational Resources

Kansiime et al. (2024) explored how mHealth has enhanced the capacity of community health workers (CHWs) to deliver health education in Uganda. CHWs play a critical role in promoting public health education, especially in rural areas where access to professional healthcare is limited. mHealth platforms provide CHWs with real-time access to educational resources, allowing them to educate caregivers and communities about disease prevention, hygiene practices, maternal health, and child healthcare. The study found that mHealth empowers CHWs by improving their health knowledge and enabling them to provide more accurate and comprehensive health education to their communities. Despite these advantages, Kansiime et al. (2024) noted several challenges, such as limited training for CHWs on how to use mobile devices and inadequate access to reliable internet. The study concludes that while mHealth holds considerable promises for supporting CHWs in health education, addressing these barriers is crucial for maximizing its effectiveness.

### 4.3. Enhanced Disease Surveillance and Emergency Response

The role of mobile health (mHealth) in enhancing disease surveillance and emergency response capabilities is critical for addressing public health challenges across Africa. Given the region's limited healthcare infrastructure and logistical constraints, traditional methods of disease tracking and outbreak management have often fallen short. mHealth technologies have emerged as a transformative solution, providing real-time data collection, rapid communication, and enhanced coordination among healthcare workers, all of which are essential for effective disease surveillance and timely emergency responses.

4.3.1. The Integrated Disease Surveillance and Response (IDSR) strategy has been a cornerstone in improving disease monitoring in African countries. Wu et al. (2018) examined the implementation of IDSR in Malawi, identifying both its successes and the challenges it faces. Their findings highlight how mHealth platforms support IDSR by providing a structure for real-time disease reporting, which helps in quickly identifying and responding to disease outbreaks. Wu et al. (2018) noted, however, that several implementation gaps still hinder the effectiveness of IDSR, such as delays in reporting, issues with data accuracy, and challenges in alert systems. mHealth has proven instrumental in bridging these gaps by automating data entry processes, reducing reporting delays, and improving data accuracy, all of which are essential for effective disease tracking. This use of mobile applications for disease reporting aligns well with the needs of low-resource settings, enabling healthcare providers to relay timely and precise information to national health authorities, which enhances preparedness and response capabilities.

4.3.2. Ebola Contact Tracing and Monitoring

The effectiveness of mHealth in managing emergency responses has been particularly notable during disease outbreaks, such as the Ebola epidemic in West Africa. Danquah et al. (2019) conducted a proof-of-concept study in Sierra Leone, which used mobile applications to trace contacts and monitor cases during the Ebola outbreak. The study revealed that mHealth applications enabled healthcare workers to trace contacts more efficiently, monitor the health of those exposed to the virus, and quickly identify potential new cases. This was vital in controlling the spread of Ebola, as the ability to track individuals who had been in contact with infected people allowed health officials to isolate and monitor these individuals before the virus could spread further. Danquah et al. (2019) highlighted those mobile applications provided real-time data, which facilitated faster decision-making and increased the agility of response efforts. This study underscores how mHealth technologies can be critical in emergency response scenarios, where timely information is essential to prevent the spread of highly contagious diseases.

4.3.3. COVID-19 Surveillance through GIS and Mobile Technology

In the face of the COVID-19 pandemic, mHealth technologies played a crucial role in managing disease spread and response efforts across Africa. Akpan et al. (2022) explored the use of Geographic Information Systems (GIS) in conjunction with

mHealth for contact tracing and surveillance of COVID-19 cases. Their study demonstrated that GIS platforms originally designed for polio surveillance could be repurposed effectively to track COVID-19, showcasing the adaptability and versatility of mHealth solutions. The integration of GIS allowed health authorities to visualize data on infection hotspots, enabling targeted interventions and resource allocation. This approach significantly improved the efficiency of COVID-19 monitoring and response, as it provided health workers with a geographical overview of infection patterns, helping them to prioritize testing, contact tracing, and vaccination efforts. Akpan et al. (2022) argue that such adaptability in mHealth tools is invaluable, as it allows existing technologies to be re-engineered to address new public health challenges, enhancing resilience and response preparedness in the healthcare system.

### 4.4. Support for Healthcare Workers

mHealth has proven to be a valuable resource for healthcare workers across Africa, providing crucial support in real-time communication, decision-making, training, and access to medical information. This is particularly important in remote and resource-limited settings, where healthcare workers often operate with minimal resources and limited access to professional support. The integration of mHealth into healthcare delivery systems has not only improved the quality of care but has also alleviated the workload of healthcare workers, allowing them to make more informed decisions and deliver timely care.

#### 4.4.1. Real-Time Communication and Decision-Making Support

Gonçalves-Bradley et al. (2020) highlighted the role of mHealth in facilitating real-time communication between healthcare providers, enabling them to share patient data, treatment plans, and updates instantaneously. This level of connectivity is especially beneficial in areas where in-person consultations with specialists may not be feasible. Real-time communication allows healthcare workers to quickly consult with specialists or colleagues, improving the quality of diagnosis and treatment in remote settings. Gonçalves-Bradley et al. (2020) found that this immediate access to support also enhances healthcare providers' confidence and reduces delays in patient care. With mHealth, healthcare workers are able to avoid many time-consuming and resource-intensive tasks, instead focusing on direct patient care. By facilitating swift collaboration across distances, mHealth has effectively brought a network of

healthcare expertise to even the most isolated areas, creating a support system that elevates healthcare standards.

4.4.2. Integration of mHealth Technologies for Better Patient Management

Addotey-Delove et al. (2020) underscore the importance of mHealth in integrating various technology-driven solutions into healthcare practices, which allows healthcare workers to streamline patient management. mHealth applications designed to support clinical workflows have helped healthcare workers track patient progress, manage appointments, and document patient data more efficiently. This integration of digital tools ensures that patient records are accurately maintained, accessible, and can be shared easily among professionals when necessary. Addotey-Delove et al. (2020) also noted that mHealth technologies reduce the burden of paperwork and administrative tasks on healthcare workers, allowing them to focus more on patient interactions and care quality. This is particularly relevant in settings with high patient-to-provider ratios, as mHealth enables healthcare workers to manage a larger caseload more effectively. By simplifying documentation and improving data accessibility, mHealth applications contribute to more cohesive and coordinated patient care.

4.4.3. Training and Capacity Building through Telehealth

The role of mHealth in training and capacity building is especially crucial in regions where access to medical education and ongoing professional development is limited. Kok et al. (2023) examined how telehealth has been used to support the training of community health workers (CHWs) in Uganda during the COVID-19 pandemic, providing them with remote access to training, supervision, and consultations with healthcare professionals. This telehealth-based approach to training not only equips CHWs with updated medical knowledge and skills but also allows them to consult with experts in real time when encountering complex cases. According to Kok et al. (2023), telehealth has increased the reach of training programs, enabling CHWs in remote areas to receive the same quality of training as those in urban centers. This is critical for addressing healthcare inequalities, as CHWs play a vital role in delivering primary healthcare services in underserved communities. The ability to receive training and guidance remotely empowers healthcare workers, giving them greater confidence and competence in delivering healthcare.

# 5. Discussions

## 5.1. Improved Access to Healthcare

The findings from these studies underscore the transformative potential of mHealth to bridge healthcare access gaps across Africa. By directly addressing the unique challenges of healthcare delivery in rural and underserved areas, mHealth enables both patients and providers to overcome logistical and geographic barriers. For instance, mobile messaging platforms, such as MomConnect, not only improve maternal health by providing accessible health information but also foster a more engaged and informed patient population. Similarly, the use of mHealth in palliative care allows patients with limited mobility to receive consistent care, minimizing their need to travel to healthcare facilities.

A key feature of mHealth's impact on healthcare access is its ability to deliver preventive care effectively. Tools designed to improve vaccination rates demonstrate that mHealth can help achieve large-scale health improvements by reducing the incidence of preventable diseases, especially among vulnerable populations. Moreover, these mHealth platforms cater specifically to the needs of remote communities, creating an inclusive healthcare environment that is responsive to population-specific challenges.

The utility of mHealth in enhancing diagnostic and treatment support also illustrates its role in empowering healthcare workers, who may be the only healthcare providers available in underserved regions. These tools allow healthcare providers to access crucial information, make timely decisions, and deliver care remotely, effectively expanding the healthcare system’s reach. As such, mHealth provides a sustainable model for improving healthcare delivery in regions that lack substantial physical healthcare infrastructure. The studies reviewed demonstrate that mHealth is not merely a technological solution but a strategic intervention capable of addressing structural healthcare challenges in Africa.

mHealth’s role in expanding healthcare access reflects its capacity to mitigate longstanding healthcare challenges and provide a more equitable healthcare system. However, while mHealth demonstrates substantial benefits, challenges such as ensuring consistent mobile network coverage, improving digital literacy, and

addressing data privacy concerns remain important considerations for future development and implementation efforts.

### 5.2. Public Health Education and Awareness

The findings from these studies demonstrate that mHealth has a powerful role in advancing public health education and awareness, especially in areas that face healthcare access barriers. By providing platforms for widespread and rapid health education, mHealth bridges the gap between healthcare providers and remote populations, bringing reliable information to those who would otherwise lack access to it. This capacity is particularly evident in crisis situations like the COVID-19 pandemic, where timely and accurate information dissemination was essential. Chitungo et al. (2021) underscore mHealth's ability to respond swiftly to emerging health threats, filling an urgent need for verified health information during times of widespread misinformation. This responsiveness has proven to be invaluable for healthcare systems, enabling them to manage public health risks more effectively.

Moreover, mHealth's effectiveness in supporting CHWs illustrates its potential to strengthen the public health workforce in Africa. Community health workers, often the primary link between rural communities and the healthcare system, benefit greatly from mHealth platforms that enhance their knowledge and enable them to educate others. The ability of CHWs to access updated, evidence-based health information through mHealth is crucial for empowering them in their roles and enabling them to make a greater impact in the communities they serve. This not only improves health literacy but also increases trust in healthcare practices and professionals, as CHWs are often the most trusted health figures within their communities. However, as Kansiime et al. (2024) noted, for CHWs to use mHealth effectively, they require adequate training and resources. This indicates that while mHealth can significantly support CHWs, complementary investments in training and infrastructure are essential for sustained impact.

Addressing the challenges identified by Aboye et al. (2024) and Kansiime et al. (2024), such as limited internet access and low health literacy, is also critical for mHealth's future effectiveness. These barriers highlight the need for adaptive solutions, such as offline capabilities for mHealth applications or simplified interfaces for low-literacy populations. Additionally, partnerships with telecommunications companies could

enhance connectivity in rural areas, further extending mHealth's reach. The studies reviewed indicate that while mHealth has made considerable progress in advancing health education, fully realizing its potential will require systemic support and strategic infrastructure investments.

mHealth has shown significant potential in advancing public health education and awareness across Africa, especially in underserved regions. Its ability to disseminate information rapidly and support CHWs makes it a valuable tool in efforts to improve health literacy and empower communities. Future efforts to address infrastructure and training limitations will enhance mHealth's efficacy, ensuring it remains a powerful resource for public health education in Africa.

### 5.3. Enhanced Disease Surveillance and Emergency Response

The studies reviewed illustrate the critical role of mHealth in transforming disease surveillance and emergency response across Africa. By enabling real-time data gathering, rapid contact tracing, and geographic tracking, mHealth has equipped healthcare systems with more effective tools for managing disease outbreaks. The implementation of mHealth tools in the IDSR framework, as explored by Wu et al. (2018), demonstrates how mobile technologies can support centralized data systems to improve communication and timeliness in disease monitoring. Despite challenges like reporting delays and data accuracy issues, mHealth tools offer solutions that address these limitations, creating more efficient and effective surveillance systems. The automation and digitalization of data entry in mHealth applications help reduce human errors and allow for streamlined communication between healthcare workers and authorities, which is especially important in rural and underserved areas.

The impact of mHealth on emergency response is further highlighted by its success during the Ebola and COVID-19 outbreaks. In Danquah et al. (2019), the use of mobile technology for Ebola contact tracing revealed how crucial mHealth can be in managing highly infectious diseases, providing tools for quick containment and reducing the risk of widespread transmission. The case of COVID-19, as described by Akpan et al. (2022), also exemplifies the adaptability of mHealth tools, especially when combined with GIS technologies. This combination has provided health authorities with a powerful tool for visualizing infection patterns and making data-driven decisions on resource allocation. By tracking COVID-19 in real time and understanding where

clusters of cases emerge, mHealth enables more proactive responses, preventing health systems from becoming overwhelmed.

Another crucial aspect is the scalability and adaptability of mHealth technologies, which make them well-suited for public health crises. Akpan et al. (2022) highlighted the ease with which GIS platforms could be adapted from polio monitoring to COVID19 tracking, demonstrating the long-term benefits of investing in flexible mHealth infrastructure. This adaptability suggests that with the right support, mHealth tools can serve as a backbone for responding to future public health crises, providing resilience against a wide array of diseases.

While mHealth has proven invaluable in surveillance and response, challenges remain, such as securing sustainable funding, training healthcare workers, and addressing issues related to data privacy and cybersecurity. These challenges highlight the need for ongoing support from governments, international organizations, and technology developers to ensure that mHealth infrastructure is resilient, reliable, and secure. Future investments in mHealth should focus on improving connectivity in remote areas, training healthcare staff on mHealth applications, and enhancing data security protocols to safeguard sensitive health information.

mHealth has shown extraordinary promise in enhancing disease surveillance and emergency response across Africa, positioning it as a crucial component of the continent's healthcare strategy. The ability to adapt existing mHealth tools for new challenges, such as the shift from polio GIS monitoring to COVID-19 tracking, demonstrates its utility in addressing emergent and unexpected public health crises. With continued investment and support, mHealth can serve as a powerful asset in strengthening Africa's healthcare resilience, enabling faster, more coordinated, and more effective responses to future health threats.

### 5.4. Support for Healthcare Workers

The findings from these studies emphasize the indispensable role of mHealth in supporting healthcare workers in low-resource settings, helping them to deliver quality care despite limitations in infrastructure and human resources. mHealth tools provide healthcare workers with the resources, communication networks, and training opportunities necessary to perform their duties more effectively. Real-time communication, as highlighted by Gonçalves-Bradley et al. (2020), is particularly

valuable in remote areas where isolation from specialists and colleagues can create significant barriers to high-quality care. mHealth's ability to bridge these gaps by enabling instant consultations helps healthcare workers make faster, more accurate decisions, thus improving patient outcomes. This connectivity fosters a collaborative environment that enhances the quality of care available to patients in rural and underserved areas.

The integration of mHealth applications for patient management also demonstrates how technology can ease the workload of healthcare workers, as shown by AddoteyDelove et al. (2020). By reducing administrative burdens and simplifying documentation processes, mHealth frees up healthcare workers to dedicate more time to patient interactions, which is particularly critical in overcrowded clinics or health posts. Additionally, mHealth's role in creating accessible, well-maintained patient records ensures that healthcare workers can deliver continuous, coordinated care even in cases where patients must see different providers. This improves continuity of care, which is essential for managing chronic conditions and ensuring positive health outcomes in the long term.

Training and capacity building through telehealth are also transformative aspects of mHealth that directly benefit healthcare workers. The study by Kok et al. (2023) shows that telehealth can be an effective way to expand access to training for CHWs, who are essential to delivering primary healthcare in rural areas. By making training resources available remotely, mHealth ensures that CHWs stay informed about best practices and evolving healthcare standards, which is crucial for maintaining high care standards across various healthcare settings. Access to telehealth training also reduces the isolation that many CHWs may experience, providing them with a support network and access to expert guidance, which boosts their competence and confidence in managing patient care.

However, while mHealth has been successful in supporting healthcare workers, challenges remain. These include the need for reliable internet connectivity, adequate training on the use of mHealth tools, and sustainable funding to support the adoption and maintenance of these technologies. In many parts of Africa, inconsistent mobile network coverage and low digital literacy among healthcare workers can hinder the full utilization of mHealth. Therefore, further investments in digital infrastructure and training programs are essential to maximizing the benefits of mHealth for healthcare

workers. Additionally, as the dependency on digital platforms grows, the importance of data privacy and security increases, necessitating robust policies to protect sensitive patient information.

mHealth has shown tremendous potential in supporting healthcare workers across Africa, from enhancing real-time communication and data sharing to providing training and facilitating better patient management. By addressing the challenges that remain, mHealth can continue to strengthen healthcare systems and empower healthcare workers to deliver quality care in even the most resource-limited settings. The ongoing integration of mHealth into healthcare practices promises not only to improve the well-being of healthcare workers but also to contribute to better health outcomes for communities across Africa.

## 5.5. Ethics and validity

The Finnish Advisory Board on Research and Integrity (TENK) defines responsible research conduct as focusing on ethics, accuracy, and attention to detail at all stages of research, including thesis work, respecting ethical standards preserving the integrity of the research process and building confidence among researchers and the public. (Finnish National Board on research and integrity Tenk). In upholding these values, researchers ensure that their work maintains integrity, which is vital for building trust and confidence among both the research community and the public. Ethical conduct is not limited to the research results themselves but also extends to the methods and practices used to gather and analyze data.

Thesis ethics cover a wide range of factors, such as obtaining the required research licenses, conducting ethical reviews for study areas, and maintaining transparency in funding sources and conflicts of interest. It is expected of researchers to respect other people's work by properly crediting their contributions and respecting their intellectual property rights. Researchers should also abstain from any actions that might harm the integrity of their work, such as misrepresenting their accomplishments, creating, or manipulating data, or copying the work of others (Finnish National Board on research and integrity Tenk).

All the information in this thesis will be obtained from approved databases and confidently shall be considered. I will make a careful commitment to follow ethical guidelines to guarantee that my thesis is recognized as genuine, preventing harm,

maintaining the study subject's right to self-determination, and protecting privacy and data (Arene 2018). This commitment will guarantee that my thesis is recognized as genuine and reliable, preventing harm to individuals and communities involved.

## 5.6. Recommendations

Improving the uptake and execution of mobile health (mHealth) technologies in Africa necessitates a comprehensive strategy.

1. Strengthening Infrastructure and Connectivity

Insufficient internet coverage and inadequate network connectivity pose considerable obstacles to the adoption of mHealth in Africa. Investments in telecommunication infrastructure, especially in rural and underserved regions, are crucial for enabling effective mHealth implementation (Aboye, Simegn, and Aerts, 2024).

2. Capacity Building for Healthcare Workers

The effective implementation of mHealth technologies is contingent upon the digital literacy and technical proficiency of healthcare professionals. Significant training expenses and a lack of skills have been recognized as major barriers. Comprehensive training programs can improve the usability and sustainability of mHealth interventions (Kansiime et al., 2024).

3. Enhancing Data Privacy and Security Measures

Issues related to data protection and the privacy of individuals impede the acceptance of mobile health solutions. Establishing strong policies and frameworks to safeguard user information is essential for fostering trust between users and healthcare professionals (Ndayizigamiye, 2022).

4. Public-Private Partnerships

Partnerships among governmental bodies, private tech firms, and non-profit organizations can deliver the essential resources and knowledge required to expand mobile health initiatives. These collaborations promote the exchange of effective strategies and advancements, thus improving the impact of mobile health initiatives (Health Systems Trust, 2015).

5. Targeted Community Awareness Campaigns

Community awareness gaps have been recognized as obstacles to the acceptance of mHealth solutions. Implementing focused initiatives to inform communities about the advantages and application of mobile health solutions can enhance user participation and diminish opposition to emerging technologies (Kansiime et al., 2024).

6. Continuous Monitoring and Evaluation

Creating structures for overseeing and assessing mobile health initiatives is crucial for determining their efficacy and long-term viability. Consistent evaluations aid in recognizing obstacles and directing enhancements, guaranteeing that digital health initiatives achieve their desired goals (Ndayizigamiye, 2022).

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