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Hypertension management in sub-Saharan Africa: an overview of challenges and opportunities for telemedicine

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Abstract

Hypertension is the leading contributor to cardiovascular disease (CVD)-related deaths globally, with Africa being one of the World Health Organization regions with the highest prevalence of elevated blood pressure (BP). In sub-Saharan Africa (SSA), awareness, treatment, and control levels of hypertension remain low in both men and women and in different settings, including rural and urban areas. Important barriers to the management of hypertension in SSA are within health systems, usually overburdened by communicable and non-communicable diseases, acute medical conditions, and child and maternal healthcare. Health system-related challenges include the availability and cost of essential medicines and healthcare workforce constraints. At the patient level, individual barriers such as sociodemographic, economic, and psychosocial factors contribute significantly to the poor control of hypertension. Telemedicine presents a promising approach to improve the delivery of optimal care for individuals living with hypertension by serving as a connection between healthcare providers and patients. This may enhance access to isolated people living with hypertension, such as in rural areas. However, there is a concern that telemedicine may exacerbate some of the barriers to the management of hypertension in disadvantaged groups, such as those with limited access to digital technology, low education and literacy levels, and the ageing population. Therefore, the objective of this review is to summarize the current state of telemedicine use in the management of hypertension in SSA and discuss the challenges and opportunities to provide cost-effective, equitable, and sustainable access to digital health technology for people living with hypertension in SSA.

Keywords: Hypertension management, sub-Saharan Africa, telemedicine, health equity, digital health

INTRODUCTION

A recent World Health Organization (WHO) report indicated that life expectancy in the WHO Africa region increased by an average of 10 years between 2000 and 2019[1]. This percentage increase was reported to be higher than that in any of the WHO regions worldwide and was mainly attributed to the prevention and treatment of infectious diseases. However, this milestone is evidently counterbalanced by the striking increase in non-communicable diseases (NCDs), such as hypertension and type 2 diabetes[1-3]. Hypertension remains the leading cause of cardiovascular disease (CVD) globally, with low- and middle-income countries (LMICs) disproportionately affected by the burden of hypertension and CVD[4]. In sub-Saharan Africa (SSA), almost half of the adult population (46%) was estimated to be living with hypertension in 2015, with the prevalence continuing to increase[2,5,6]. During the same period, using a cut-off of 140/90 mmHg, a systematic review reported a prevalence of 30% (95%CI: 27%-34%) in SSA[7]. The high prevalence of hypertension is associated with factors such as urbanization and unhealthy lifestyle behavior[8-10]. Various studies have visualized the burden of hypertension in SSA using the care cascade model and showed that awareness, treatment, and control levels remain low in the region, across sex groups and different localities[11-13], highlighting the challenge of adequate management of hypertension. The cascade of care is a model used to represent the percentage of people with a specific disease at different stages, starting with screening as the first stage and ending control to establish which stages present with the largest proportion of loss and therefore require interventions[14]. Contextualized interventions, such as task shifting, have proven to be beneficial in improving blood pressure (BP) control in individuals with hypertension, particularly the use of community health workers (CHWs)[15,16].

Although there seems to be some progress in efforts to reduce BP in hypertensive individuals in SSA, suboptimal management of hypertension in the region remains a public health concern[5,17]. This could be due to, among others, non-compliance with existing guidelines and best practices; lack of evidence-based guidelines, finances, resources, and practical management policies; and poor access to healthcare[5,17,18]. Considering these challenges, the need for cost-effective and innovative strategies to achieve optimal BP control in hypertensive individuals remains critical, with telemedicine showing the potential to improve access to care for hypertensive individuals, particularly those in underserved and resource-limited settings[18,19]. The use of telemedicine may improve the management of hypertension by increasing the accessibility, quality, and affordability of healthcare[19-21]. However, its implementation remains limited worldwide, possibly due to challenges associated with the low level of acceptance among patients and healthcare providers, lack of technologies, funding, training of healthcare providers and policies, and quality of infrastructure in healthcare systems in various countries[21,22]. Despite these challenges, in SSA, telemedicine may be a promising approach to enhance the connection between healthcare providers and patients, especially those in remote areas where physical access to health services remains a challenge[23].

The objective of the present paper is to demonstrate the current state of telemedicine use and discuss challenges and opportunities for the implementation of telemedicine in managing hypertension in SSA countries.

Relevant definitions

Telemedicine (telehealth) (synchronous, asynchronous) - a virtual mode of communication between the patient and healthcare provider using telecommunications that may be synchronous, that is, real-time communications such as telephone calls and video conferencing, or asynchronous, such as the use of text

messages or emails or recorded information shared between the two parties[24,25].

Telemonitoring - the use of telecommunication technology to continuously monitor the health parameters of patients for early detection of symptoms and timely treatment[26].

eHealth - healthcare practice is used to mediate communication between healthcare practitioners and patients by means of electronic information and communication technologies, and may include text messaging, emails, push notifications, and mobile applications[27].

Mobile Health (mHealth) - the use of mobile communication technologies to deliver healthcare services and wellness support for patients[28].

TELEMEDICINE IN MANAGEMENT OF HYPERTENSION IN SUB-SAHARAN AFRICA

Current evidence from sub-Saharan Africa

Among the various interventions to adequately control BP in people living with hypertension in LMICs, telemedicine seems to be the frontrunner owing to the potential added benefit of improving access to underserved populations and reducing the cost associated with the use of primary health care (PHC) services[15,29,30]. In 2014, it was estimated that chronic conditions would be managed with the application of telemedicine solutions in approximately 7 million patients globally by 2018; however, these figures may have been underestimated[22,31]. Although telemedicine is considered a promising tool to improve patient behavior and care, its implementation worldwide is yet to reach a peak[32]. Various modes of telecommunication are used in telemedicine worldwide, but the use of mobile phone health applications is fast-moving and expected to improve the ongoing implementation of telemedicine[22]. Precise global estimates of the implementation of telemedicine to manage hypertension are not well documented[22]; however, the need to intensify implementation has risen due to regulations aimed at controlling the coronavirus disease 2019 (COVID-19) pandemic[33,34].

Despite the constraints of the health system in Africa, telemedicine has been recommended as a potential solution to some of the barriers to the provision of adequate care, such as increasing access to health services to isolated individuals in rural areas. However, few successful telemedicine programs have been implemented[21]. Currently, there are no known estimates of patients managed using telemedicine in SSA. However, some significant improvements in healthcare provision through the implementation of telemedicine have been evident in various medical disciplines, such as mental health, pediatrics, obstetrics, and gynecology[35,36]. The use of telemedicine was mostly distributed in rural and semi-rural areas of SSA[35].

Therefore, we conducted a literature review to assess the current state of telemedicine use in the management of hypertension in SSA, and identify challenges and opportunities.

The following approach was adhered to for identifying studies that specifically investigated the use of telemedicine for the management of hypertension in SSA:

Relevant articles were obtained by using Pubmed to find articles published in English until June 2022 using the combination of key words and phrases “telemedicine”, “hypertension management”, “Africa”, “sub-Saharan Africa”, and “telehealth”. Four studies were selected based on relevance: one study used telephone calls and text messages, another study used text messages only, and the other two studies used mobile phone health applications. Data on telemedicine approaches used for the management of hypertension in SSA are scant, as only four out of 46 countries in SSA were reported, as shown in Table 1[37-40].

Table 1. Characteristics of published articles over the past decade addressing the use of telemedicine to control hypertension in sub-Saharan Africa

Study (Country)	Inclusion criteria	Sample size	Study design and follow-up	Description of telecommunication used	Outcomes
Kingue *et al.*, 2013 (Cameroon)[37]	Age ≥ 15 years ● Hypertension (SBP ≥ 140 mmHg or DBP ≥ 90 mmHg) ● Hypertension for patients with diabetes or nephropathy (SBP ≥ 130 mmHg or DBP ≥ 80 mmHg)	268 participants: Intervention (n = 165) Control (n = 103)	● Prospective interventional study ● Follow-up after 24 weeks	Telephone calls and text messages from nurses to specialist clinicians for decision making	● SBP and DBP ↓ over time (33.3% *vs.* 27.5%) ● Improved BP control in stage 3 hypertensive group compared with control group (50% *vs.* 39.1%)
Nelissen *et al.*, 2018 (Nigeria)[38]	● Age ≥ 18 years ● Confirmed new or previous diagnosis of hypertension	336 participants	● Prospective study ● Follow-up after 6 months	Communication between pharmacists and cardiologists using a mobile health phone application for remote patient management	● SBP and DBP ↓ by 9.9 mmHg and 5.9 mmHg, respectively ● Improved BP control from 24% (baseline) to 56% (endline)
Bobrow *et al.*, 2016 (South Africa)[39]	● Age ≥ 21 years ● Diagnosed with hypertension by a clinician ● Prescribed BP-lowering medication ● SBP < 220 mmHg and DBP < 120 mmHg at enrolment	1372 participants: Information-only SMS text messages (n = 457) Interactive SMS text messages (n = 458) Standard care (n = 457)	● Parallel three-arm randomized controlled trial ● Follow-up at 6 and 12 months	Communication with patients via: ● SMS text messaging for the information-only group (information on collection and taking medication) ● Interactive text messaging (same information as information-only group, but could cancel or change appointment dates and times)	● SBP ↓ by 2.2 mmHg in Information-only group at endline ● No significant ↓ in SBP in interactive text messaging group at endline ● BP control in information-only and interactive text messaging groups improved by 1.4 odds compared to standard care group ● Adherence to medication ↑ by 62.8%, 59.7% and 49.4% in the information-only, interactive text messaging and standard care groups, respectively
Sarfo *et al.*, 2019 (Ghana)[40]	● Age ≥ 18 years ● Recent CT scan confirmed stroke of less than one month ● Uncontrolled hypertension (SBP ≥ 140 mmHg) at screen and/or enrollment visit	60 participants Intervention (n = 30) Control (n = 30)	● Two-arm randomized control trial ● Monthly follow-up for the first three months of the study and afterwards at 6 and 9 months	A mobile phone health application was used to record home blood pressure readings and daily medication adherence of patients under supervision of nurses and physicians	● No significant difference in medication adherence between the intervention and control groups ● Improved SBP control in the intervention group compared to the control group (73.3% *vs.* 43.3%)

BP: Blood pressure; DBP: diastolic blood pressure; SBP: systolic blood pressure; SMS: short message service.

A randomized control trial conducted in rural Cameroon evaluated the effectiveness of using telemedicine to support healthcare providers in the management of hypertension with the use of telephone calls and text messages. Only the healthcare providers involved in the intervention group were trained in and implemented telemedicine. Participants in the intervention group had higher baseline BP than those in the control group. At the end of the observation period, only those in the intervention group had a reduced mean BP compared to the control group (P = 0.04)[37].

In Nigeria, the use of mobile health applications has made it possible for patients to connect with healthcare providers (cardiologists and pharmacists). Through this application, information on patients regarding pharmacy and doctor consultations, BP measurements, and prescribed and dispensed medication

was recorded. This information enabled the cardiologists involved in the study to access patient data and review it for appropriate interventions. With the use of mobile application, mean SBP and DBP of patients decreased by 9.9 mmHg (SD:18.0) and 5.9 mmHg (SD:11.4), respectively, with an overall increase in the proportion of patients achieving BP control ($P < 0.001$)[38].

In South Africa, a randomized control trial determined whether a short message service (SMS)-based intervention was better than standard care in supporting hypertensive patients to adhere to treatment and achieve BP control. This three-arm trial included patients in standard care (no telemedicine intervention), information-only text messaging, and interactive text messaging. Patients in the information-only text messaging group received information regarding collecting and taking medicines and reminders when medicines were ready for collection or for their scheduled clinic appointments. In the interactive text messaging group, in addition to the above-mentioned information given in the text-only group, there was an option to respond to the text messages and to cancel or change appointments and timing. The text-only messaging intervention demonstrated a reduction in SBP ($P = 0.046$), and all groups in the study had improved medication adherence at the end of the trial (all $P \leq 0.002$)[39].

A randomized control trial conducted in Ghana aimed to determine whether using a mobile phone health application can improve BP control among stroke patients within one month of symptom onset compared with standard care. Patients in the control group received standard care and SMS messages regarding healthy lifestyle behaviors. Those in the intervention group were provided with a BP monitor linked to the mobile phone application to record and report their BP readings and medication intake under the supervision of a nurse. Based on the level of adherence, patients were also sent motivational messages to adhere to treatment. The application generated a daily report, and patients were followed up monthly to evaluate their BP readings and adherence to treatment. At the end of the trial, the SBP of patients that were included in the intervention group was significantly reduced compared to the control group ($P = 0.035$)[40].

The scarcity of data on the use of telemedicine for the management of hypertension is among the current gaps and challenges in healthcare service delivery in SSA. Challenges and potential obstacles to the implementation of telemedicine programs in SSA are discussed in the next section.

Current challenges for telemedicine in the management of hypertension in sub-Saharan Africa

In 2019, a pooled analysis of population-representative studies showed that BP control rates in treated individuals with hypertension were 23% in women and 18% in men globally, and were much lower in SSA, at 13% in women and 9% in men[3]. Different control rates have been reported in individual studies throughout the SSA region. The H3Africa AWI-Gen study reported even higher rates of uncontrolled hypertension in four African countries (Burkina Faso, Ghana, Kenya, and South Africa)[11]. In this study, 22% of the women and 12% of the men in the treated group had controlled BP. A trend of poor control was also observed in Nigeria (12.4%)[12] and Sierra Leone (5%)[41], with a narrowing of the previously observed rural-urban gap in the prevalence of hypertension, a similar observation made in a South African rural area[42]. Generally, barriers to the management of hypertension in SSA include a combination of individual and system-related barriers [Figure 1], some of which may be alleviated or exacerbated by telemedicine interventions. The individual barriers include adherence to medication, comorbidity, cultural beliefs, socioeconomic status, literacy, and education levels[43]. System barriers include accessible and functional PHC facilities, availability of essential medicines, staff shortages, and digital technology skills in the current health workforce[44]. Challenges that may negatively impact the implementation and access to telemedicine as an approach for the management of hypertension in SSA will be discussed in the context of the current barriers.

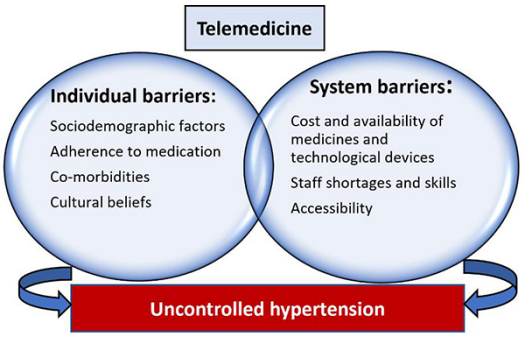

Figure 1. Factors contributing to the poor management of hypertension in sub-Saharan Africa.

Availability of data

Perhaps the most important challenge is the availability of high-quality large randomized controlled trials proving the clinical efficacy of telemedicine interventions in different SSA contexts. Although there has been some progress in telemedicine interventions for the delivery of healthcare services in Africa for the past four decades[21], interventions with a specific focus on hypertension management remain scant. This is not unique to SSA, as indicated by the limited studies in LMICs. Key limitations in the existing data include relatively small sample sizes, short duration/follow-up periods, and types of interventions that vary widely between contexts[19].

Most studies in LMICs, including SSA, usually included one-directional text messaging (SMS) or patient reminders and not the application of telemedicine, which incorporates real-time communication between the patient and healthcare provider or between healthcare providers[21,37,39,45]. Indeed, there are barriers to more advanced models of telemedicine, such as devices to capture health parameters, including but not limited to BP monitors and communication devices (such as microphones, electronic devices, and video). More barriers in the sub-Saharan African context are lack of infrastructure, including availability of stable electricity, cellular network coverage, and broadband internet coverage[46,47], with Africa having one of the slowest internet speeds in the world[48]. Hence, studies should be representative of diverse sub-Saharan African populations and contexts, and evidence of the clinical efficacy generated needs to be tested for feasibility in different settings, particularly resource-constrained environments.

Urban-rural gap

Data collected between 1960 and 2021 show that more than half (approximately 52%) of the African population resides in rural areas, while the number is even higher (58%) in SSA[49,50]. Although the current trend indicates that the population is shifting towards urbanization, individuals living in rural areas usually lack access to affordable, quality, and comprehensive healthcare globally[51], which is evident in some countries in SSA, including but not limited to South Africa[52,53], Mozambique[54,55] and Nigeria[56]. The growing burden of hypertension is rapidly closing the rural-urban gap that was previously reported, with the prevalence of hypertension and associated risk factors increasing in rural areas[12,42]. Treatment and control remain low and at times even lower than those in urban areas[12,55]. Although remote provision of care may be beneficial in people living with hypertension in rural areas, the availability of digital devices, mobile networks and internet connections, mobile data affordability, and digital literacy levels pose another challenge within the context of telemedicine. According to World Bank data on access to technology, many Africans are currently unable to access the technology needed to access school, financial, and health services[57].

A qualitative study investigating the use of mHealth for NCD services in rural Tanzania found that healthcare professionals and CHWs were familiar with the use of mobile devices for the provision of health services, specifically for reaching individuals in remote areas. However, the results were different when looking at the patients. Of the interviewed NCD patients, only three out of 17 were aware of the use of mobile devices to deliver healthcare[45]. This study suggests that suitability and acceptability may be obstacles to the implementation of telemedicine for hypertension management in rural areas. Recently, in the Ebonyi state of Nigeria[56], an assessment of the availability of essential medicines and technology in PHC facilities (71.1% rural) found a significant gap in the provision of hypertension control services, an observation previously made in other studies in SSA, including but not limited to Mozambique and Rwanda[54,58]. This raises a concern regarding the feasibility of implementing telemedicine programs in rural areas with existing challenges in the delivery of basic services for hypertension management. Although telemedicine may overcome barriers related to distance and access to PHCs, the consistent availability of antihypertensive medication and accompanying resources, such as validated digital BP monitors, should be prioritized to address the unmet need for adequate diagnosis and treatment in many regions of SSA.

Cost and affordability

The economic burden of treating hypertension and its resultant health outcomes have a negative impact on individuals, overwhelm health systems, and society. A recent systematic review and meta-analysis on the economic burden of hypertension in SSA showed that the cost of treating hypertension for individuals and providers was higher relative to income[29]. Major drivers include comorbidities, in-hospital treatment, use of private health insurance, and high socioeconomic status[29,30]. The development and implementation of telemedicine programs in the management of hypertension requires infrastructure, re-training, and re-skilling of the current workforce[32]. This will likely be accompanied by costs to governments and patients, who are currently overburdened with out-of-pocket costs for antihypertensive medication. A significant portion of untreated and treated uncontrolled patients have indicated cost and affordability as barriers to the management of hypertension[30,56].

The cost of telemedicine depends on the model of care being used, including required devices, mode of communication and transmission, and whether the interactions are synchronous or asynchronous. The use of mobile devices, such as telephone and text messaging (SMS) and emails, present some of the simplest and most affordable modes of communication, with smartphone applications becoming more common[32]. In this setting, both the healthcare provider(s) and patient must have the necessary tools, skills, and/or literacy for information and communication technology for the desired benefit to be achieved. One of the challenges identified for NCD patients on the use of mHealth in rural Tanzania was the cost of airtime for CHWs, and it was suggested that the cost be subsidized to support usage[45]. At the national and regional levels, the political will to invest in NCDs in Africa is essential to mobilize resources, including funding for technological advances in the delivery of healthcare services. Interventions should be cost-effective, contextualized, and co-designed with multiple stakeholders, including representatives from people living with hypertension. This will ensure the implementation of telemedicine programs that are sustainable and equitable across different population groups.

Use of personal information, data management and regulation

The collection and processing of patient information and overall data management are significant concerns in the application of telemedicine for both health practitioners and patients. When applying telemedicine, patient data are collected remotely and exchanged within the health facility system[23,32]. In most parts of SSA, healthcare facilities have CHWs that are responsible for following up with patients and ensuring the continuous delivery of healthcare services, particularly medicines[56,59,60]. It is for this reason that gaining

community trust, especially in rural areas, may influence the acceptability of telemedicine interventions. When interviewed regarding the use of mHealth for delivering NCDs care, patients in Tanzania indicated concerns regarding the sharing of their personal information and medical data with an unknown person responsible for sending out text messages[45]. Indeed, connection over the Internet and sharing of information using online or cloud-based platforms increases the risk of data breaches and access to personal information, which should otherwise be protected. These are some of the regulatory and ethical aspects of confidentiality and privacy in the application of telemedicine, which have become a barrier in most regions in Africa[46], including Southern African[61,62] and East African communities[63,64] as well as the community of West African states[65,66].

Opportunities for telemedicine use in hypertension management in sub-Saharan Africa

Despite the challenges discussed, collaboration between multiple stakeholders can result in tailored interventions centered around telemedicine to improve healthcare delivery for individuals living with hypertension in SSA. With political will, investment in infrastructure and skills development, impactful strides can be made in testing and implementing telemedicine in the management of hypertension in different settings across SSA. Some of these opportunities are discussed below.

Research consortia and industry partnerships

Multi-stakeholder collaborations, as indicated in Figure 2 provide useful opportunities for both research and implementation of interventions that provide sustainable improvement in health outcomes. This also applies to hypertension management. It is clear from previous work that large consortia such as the Africa Wits-INDEPTH partnership for Genomic Studies (AWI-Gen)[67], a collaborative center of the Human Heredity and Health in Africa[67] consortium, contribute significantly to the characterization of the burden of hypertension. With this consortium, data were collected on the prevalence of hypertension in SSA from rural and urban areas of Burkina Faso, Ghana, Kenya, and South Africa[67,68]. Multi-site and multi-country clinical trials, such as the CREOLE trial[69], which included Cameroon, Kenya, Mozambique, Nigeria, South Africa, and Uganda, have a greater potential to contribute to establishing the clinical efficacy of telemedicine interventions in the broader SSA context. This trial compared the efficacy of different antihypertensive medications at selected sites.

With such approaches, the chance of securing large amounts of funding for sustainable interventions is high. The funding usually contributes significantly towards infrastructure and capacity building in terms of training early career researchers, health professionals, and CHWs involved in the studies. The consortia may achieve greater impact when there are local and international partnerships including industry, research, and academic institutions. Working with governmental and non-governmental organizations and other members of the communities within which the research is carried out is essential, as seen with the Ndlovu research consortium in South Africa[70,71]. Some stakeholders in the Ndlovu consortium, for example, Aidsfonds, are currently supporting the implementation of digital health in South Africa, Malawi, and Kenya for peer educators, CHWs, and communities involved in stakeholder-led initiatives[72]. Most recently, the Urinary Proteomics Combined with Home Blood Pressure Telemonitoring for Health Care Reform (UPRIGHT-HTM) study[73], a randomized clinical trial, was initiated globally, including in Nigeria and South Africa. UPRIGHT-HTM is investigating the use of urinary proteomics and home BP telemonitoring to improve the individualized treatment of asymptomatic patients. The anticipated outcome is prevention of the onset of primary endpoints and adverse outcomes, thereby increasing quality of life and reducing health care expenditure.

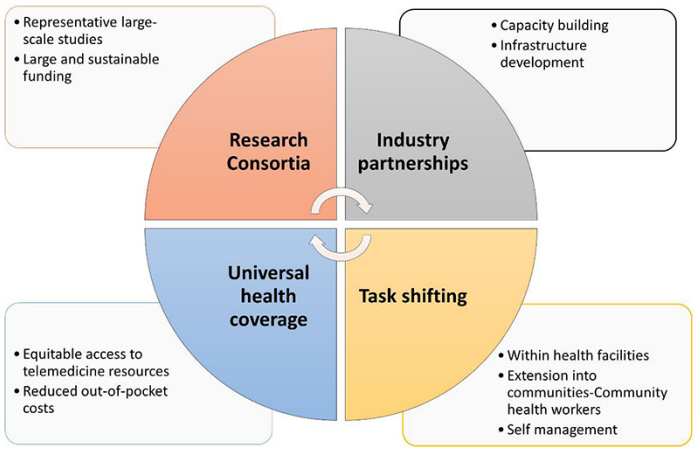

Figure 2. Areas and opportunities to facilitate and enhance implementation of telemedicine for hypertension management in sub-Saharan Africa.

In terms of access to technology, various stakeholders are making increasing efforts to improve access to technology for isolated communities in Africa. The World Bank is currently implementing a multitude of projects aimed at improving access to digital tools by 2030, which is in line with the *Digital Transformation Strategy for Africa (2020-2030)* which also includes digital health[74,75]. Leveraging telemedicine programs and platforms deployed as part of the COVID-19 response, such as contact tracing and real-time data sharing within health systems, may reduce the cost of implementing telemedicine for NCDs management[76], especially hypertension.

Task shifting

It is well-known that task shifting in the form of CHWs is a valuable extension of the PHC system that improves the reaching of remote and marginalized individuals in need of healthcare[60]. The inclusion of CHWs in healthcare delivery contributes to the efficiency of approaches, including the integrated care model for chronic diseases and self-management [77]. Tracking and ensuring that patients are retained within the health system[78-80] is among the major benefits of CHWs, which was recently confirmed with the decentralization of NCD management in Eswatini[59]. In some areas, particularly rural areas with shortages of medical doctors and professional nurses, CHWs are assigned leading roles in healthcare facilities[54], underscoring the importance of this arm of healthcare service delivery in SSA. Several studies in LMICs including SSA[81-83], have confirmed the need to include CHWs in the management of hypertension. The effectiveness of such interventions suggests that CHWs have the potential to benefit from the adoption of telemedicine in hypertension management. The potential benefits of including CHWs are the ability to build community trust, communicate with patients, and train patients to use and access the tools and resources within the program. It was shown that CHWs are aware of telemedicine as an approach to healthcare provision and improve the chances of acceptance in the communities in which they work[45]. With support, this resource can result in increased reach, cost-effectiveness, and sustainability.

Universal health coverage

According to the most recent report on tracking universal health coverage (UHC) in the WHO Africa region[1], in the past two decades, many countries in the WHO Africa region have improved the UHC service coverage index (SCI). Recent developments include equipping integrated health centers with diagnostics and healthcare services dedicated to NCDs and implementing WHO packages. Incorporation of telemedicine is essential for reaching the 2030 sustainable development goal 3.4 target, which encompasses

the reduction by one third of premature mortality due to NCDs through prevention, treatment and promotion of mental health and well-being[84]. Control of hypertension is key[15] in reducing CVD-related mortality. Of particular concern is the fact that although the provision of essential services for communicable diseases has improved, there is a sharp increase in hypertension and other NCDs that are currently not receiving the much-needed health services in a manner proportional to the disease burden[1,29]. Telemedicine has the potential to improve healthcare and patient outcomes, especially in resource-constrained settings, where distance and overwhelmed PHC facilities are the main barriers to achieving adequate care for hypertension[15,32]. One of the proposed policy shifts towards people-centered care for UHC includes leveraging technology for proper arrangement of health services and real-time data generation and sharing for timely actions and decisions by specialists and management in the health systems[1,76].

FUTURE PERSPECTIVES

As summarized in Figure 3, implementation of telemedicine to improve BP control in individuals living with hypertension in SSA, especially in underserved and remote areas, must be supported by evidence of clinical efficacy. High-quality randomized trials conducted in various regions, countries, and multiple sites within countries are urgently needed to tackle the burden of uncontrolled hypertension[19]. It is essential that the adoption of telemedicine and potential policy changes be based on evidence representative of the unique context of the sub-Saharan African region. Implementation research has the potential to determine the feasibility of adopting telemedicine and identify barriers and means to overcome such obstacles so that patients may indeed benefit from the interventions. Funding and government subsidies form the cornerstone of developing the required infrastructure, capacity building, and monitoring of telemedicine interventions as part of health systems and community-based initiatives. Despite improvements in life expectancy owing to better management and treatment of infectious diseases in Africa, NCDs such as hypertension and type 2 diabetes mellitus are rising public health concerns, with limited resources dedicated to addressing the growing burden[1]. This calls for mobilization of resources in hypertension management, with telemedicine as a promising approach to enhance the connection between healthcare providers and patients and benefit, especially those in rural areas where physical access to health services is a barrier[15,32].

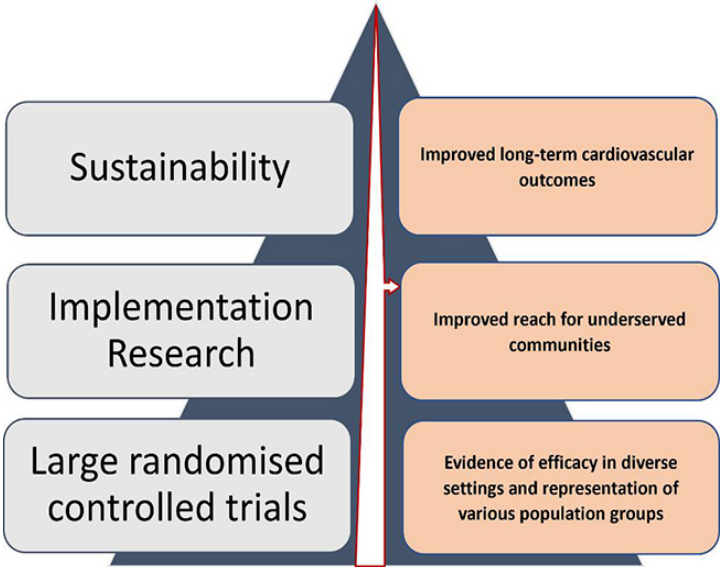

Figure 3. Requirements for implementation of telemedicine programs for management of hypertension in sub-Saharan Africa.

CONCLUSION

Although large representative clinical trials are limited, available evidence suggests that telemedicine may improve hypertension management in different settings in SSA. Challenges and potential obstacles include lack of infrastructure, digital literacy, and financial constraints. Alongside these barriers, opportunities exist that can be maximized to ensure that SSA, one of the regions with the highest rates of uncontrolled hypertension, is not left behind as the world moves towards improvement of hypertension control through telemedicine. The design and implementation of telemedicine programs to enhance the provision of healthcare for people living with hypertension in SSA should be contextualized, cost-effective, sustainable, and equitable.

DECLARATIONS

Authors' contributions

Conceptualized the article, performed literature search, wrote sections: Gafane-Matemane LF
Performed literature search, wrote sections: Mokwatsi GG
Provided critical input on the conceptualization and written sections, reviewed sections: Boateng D

Availability of data and materials

Not applicable.

Financial support and sponsorship

None.

Conflicts of interest

All authors declared that there are no conflicts of interest.

Ethical approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

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