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Opportunities to leverage telehealth approaches along the hypertension control cascade in sub-Saharan Africa.

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Abstract

Purpose of Review: To review current literature on the use of telehealth at different stages of the hypertension control cascade in sub-Saharan Africa (SSA) and to discuss opportunities to harness information and communication technology infrastructure to improve population level hypertension control.

Recent findings: There are a limited number of telehealth studies at the different stages of the hypertension control cascade. The small body of evidence suggests several promising innovations. These innovations include the use of interactive text messaging, smartphone applications, and telephone calls demonstrated significant reduction in mean systolic blood pressure and increase in the proportion of hypertensives with blood pressure control. Interventions that included text messaging with educational content had the potential to improve hypertension knowledge and also influence behavioral modification and health-seeking behavior.

Summary: There is a need for studies on feasibility, acceptability, and scaling up of telehealth interventions with rigorous study designs.

Keywords

Hypertension; Hypertension control cascade; sub-Saharan Africa; telehealth

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Introduction

There has been a dramatic increase in the prevalence of noncommunicable diseases – especially hypertension – in Sub-Saharan Africa (SSA) in the past two decades.(1–3) Reasons for this shift include increased life expectancy, urbanization, and lifestyle changes (e.g., dietary habits, physical activity, smoking/tobacco use).(4–8) Approximately 46% of African adults (≥ 25 years of age) have hypertension, a prevalence rate that now surpasses high-income countries (35%) and other nations (40%) throughout the world.(1, 2, 9, 10) Hypertension is the primary risk factor for myocardial infarction, chronic kidney disease, stroke, heart failure, and cardiovascular related deaths.(11)

Despite this burgeoning epidemic, efforts focused on the prevention and control of hypertension in SSA have been limited.(12) For example, in a recent meta-analysis 27% of hypertensive adults in SSA were aware of their diagnosis, only 18% of those with a diagnosis were receiving treatment, and only 7% of those receiving treatment had achieved blood pressure control.(13) In response to these alarming rates, the Pan-African Society of Cardiology (PASCAR) released their “roadmap to achieving 25% hypertension control in Africa by 2025.”(10) In this ten-point action plan, PASCAR identified structural interventions to achieve this goal, including the allocation of adequate funding and resources to improve detection, diagnosis, treatment, and control of hypertension – the four components of the hypertension control cascade.(10)

Hypertension Control Cascade (HCC)

The hypertension control cascade is comprised of sequential steps that describe how hypertensives access healthcare services and treatment, and acknowledges lapses that may occur at each stage, leading patients to “fall off” the cascade and, ultimately, prevent blood pressure control.(14) These steps include: (1) hypertension screening, (2) hypertension diagnosis, (3) appropriate and effective hypertension management, and (4) achievement of blood pressure control.(14)

The first stage of the cascade focuses on increasing patients’ awareness of the risks of hypertension to encourage health-seeking behaviors and screening.(15) Additionally, routine and standardized screening is a critical step in making timely diagnosis of hypertension.(16) Individuals who are diagnosed with hypertension should promptly receive appropriate treatment (e.g., pharmacologic agents and/or lifestyle modifications) to manage their condition.(17) Clinical guidelines recommend treatment initiation when blood pressure is 130/80 mmHg among adults.(17–19) Finally, if treatment is successful and maintained over time, then patients should achieve blood pressure control (i.e., blood pressure < 130/80 mmHg).

To advance people on the HCC to ultimately achieve blood pressure control, interventions in SSA have focused on community engagement, provider education, building capacity within healthcare systems (including task-shifting), and promoting patient behavior modifications such as salt reduction or substitution, smoking cessation, and promotion of physical activity.(20) However, in SSA, barriers to achieving and maintaining blood pressure control continue to exist, including lack of established policies or political willingness to implement policies

to address the burden of hypertension; dearth of healthcare resources (e.g., screening programs, antihypertensive medications, healthcare providers); lack of evidence-based guidelines; limitations in healthcare providers education; noncompliance with existing guidelines and best practices; and high out-of-pocket expenditures associated with necessary healthcare services.(21) Therefore, there is a critical need for innovative, cost-effective approaches to achieve meaningful gains toward hypertension control. (Figure 1)

Telehealth Strategies in SSA

Telehealth approaches, “the use of telecommunications and virtual technology to deliver health care outside of traditional health-care facilities,” may represent a promising opportunity to overcome barriers to access, cost, and quality of care for hypertension in SSA.(22, 23) Telehealth is a broad term that encompasses telemedicine, telecommunication, and mHealth that is provided via computers, mobile phones, or other handheld devices that have internet access.(24) Telehealth has been used in high-income settings to increase patient access to high quality care at a reduced cost.(25) Interventions that incorporate telehealth strategies have been shown to be effective in raising awareness, improving screening and diagnosis, and sustaining blood pressure control in high-income countries.(24) For example, use of web-based platforms and electronic messaging have been widely used for raising hypertension awareness and eliciting behavior change;(26) while short message service (SMS), or text messages, and telemonitoring (the use of information technology to monitor patients’ blood pressure at a distance) have been associated with improved blood pressure control.(27–29)

In contrast to high-income countries, where the use of computers with broadband internet access as mode of telehealth delivery interventions may be viable, few people in SSA own computers or tablets. A more accessible telehealth modality in SSA is mobile phones. According to 2012 World Bank estimates, less than 10% of households in SSA had computers, while approximately 70% of adults had mobile phone subscriptions in South Africa. Smartphone adoption is rapidly increasing in SSA as well, with a median of 37% smartphone ownership in 2015.(3) Furthermore, data plans are often inexpensive, wireless internet access is rapidly expanding, and SMS messaging and video call applications are widespread regardless of socioeconomic status, thus creating multiple opportunities for easy-to-access, free, or low-cost communication.(30) The availability of mobile technology to a majority of the population provides a great opportunity to address the burden of hypertension and associated cardiovascular morbidity and mortality. Telehealth interventions have the potential to improve outcomes along the HCC and support the goals of PASCAR to dramatically increase the number of patients in SSA who have achieved effective, long-term hypertension control.

Literature review

We conducted a narrative literature review to: 1) examine the current landscape and success of telehealth interventions occurring at each step of the HCC; and 2) identify opportunities to expand current or develop new telehealth strategies to achieve blood pressure control in SSA. In order to evaluate the current landscape of telehealth interventions in hypertension,

we searched PubMed including MEDLINE to identify articles published in English until May 1, 2019 using the combination of key words and phrases: 'hypertension', 'high blood pressure', 'sub Saharan Africa', 'Africa', 'mHealth', and 'telehealth'. Our search yielded 28 articles, of which 20 were excluded for the reasons specified in Figure 2 (see Figure 2). Most of the excluded articles were systematic reviews, whereas others specified outcomes that were not related to stages of the HCC.

Overall, 8 studies from 5 countries in SSA were included; 2 studies used telehealth strategies to address hypertension awareness and screening, 2 studies addressed hypertension diagnosis, and 4 studies used telehealth interventions to assess hypertension management and control (Table 1).

Six studies used telehealth approaches aimed at providers while 4 used strategies focused on patients. Four studies utilized SMS text messaging and phone calls and 5 studies used mHealth and smart phone application tools as the method of telehealth delivery. Studies assessed a variety of patient populations: 1 study focused on pregnant women attending an antenatal clinic; 1 study evaluated deaf adults; 1 study targeted hypertensive adults with a prior history of stroke; 4 studies assessed hypertensive adults; and 2 studies included adults from the general population.

Hypertension awareness to increase screening

We identified two studies that focused on awareness with the aim of increasing hypertension screening rates. In Cape Town, South Africa, researchers tested an intervention whereby patients received 90 SMS text messages with hypertension facts and lifestyle education over a period of 17 weeks. While this content did not improve hypertension knowledge, it was associated with motivating positive self-reported behavior change, including smoking cessation, reduced alcohol consumption, weight loss, decreased salt intake, eating a healthier diet, and increasing exercise.(31)

A second study sought to assess the acceptability and effectiveness of SMS messages at improving hypertension knowledge among deaf adults in Cape Town. SMS messages included medical information on hypertension, such as symptoms and possible consequences of hypertension, as well as information on how high blood pressure could be avoided or managed through healthy lifestyle changes. Haricharan and colleagues found that this approach increased awareness and improved overall knowledge of hypertension.(32)

Hypertension diagnosis

We found two studies that focused on diagnosis of hypertension using telehealth approaches. In Western Kenya, a cloud-based electronic medical record (EMR) tool was implemented for providers in antenatal care clinics and was found to improve documentation of hypertension care for pregnant women. Despite increased completeness in documentation, there was no increase in the number of women screened for hypertension – only five patients were screened during the entire study period.(33) Additionally, community health workers in rural Kenya utilized an mHealth screening tool that estimated cardiovascular disease profiles in a sample of adults living in the community and found that the point prevalence of hypertension was 23%.(34)

Hypertension management and control

We identified five studies that used telehealth to improve hypertension management and supporting hypertension control. In a study in Lagos, Nigeria linking hypertensive adults to healthcare providers through an mHealth app that allowed cardiologists to review blood pressure data, patient complaints, and prescriptions, as well as communicate directly with pharmacists, led to a significant reduction in mean systolic blood pressure of 9.9 mmHg (SD: 18) and an increase in the proportion of patients achieving blood pressure control.(35) In Ghana, the use of a nurse-driven smart phone application, comprised of a blue-toothed blood pressure monitor and tool for a patient's self-monitoring of blood pressure measurements and medication intake, demonstrated a trend towards increased blood pressure control among hypertensive, stroke participants; however, no difference in antihypertensive medication adherence was observed between the intervention and control groups.(36) In study in South Africa, information only text messaging (e.g., hypertension education, medication and appointment scheduling reminders) or interactive text messaging (e.g., modify clinic appointments) that addressed a range of common issues with antihypertensive medication adherence and persistence were associated with both a modest reduction in blood pressure and an improvement in medication adherence. (37) Similarly, healthcare providers in rural Cameroon who received telephone calls and text messages with patient-specific blood pressure and treatment data from a large referral hospital, contributed to improvements in their patients' blood pressure control. (38)

Discussion

We identified a small number of studies (n=8) addressing telehealth-delivered interventions in SSA. Among the articles that we reviewed, evidence largely suggests that telehealth innovations addressing hypertension outcomes are promising, but future research is required to confirm the potential of these interventions. Specifically, studies that focused on management and control stages of the HCC produced positive results, whereas studies that assessed the first two stages had mixed results. SMS messages that include educational content had the potential to not only improve a patient's knowledge of hypertension, but also influence health behaviors, including discussions with providers about hypertension screenings. However, areas of future inquiry should include the evaluation of whether message type impacts study outcomes (e.g., facts about hypertension vs. motivation for lifestyle modification vs. patient-centered messaging), assessing outcomes when SMS are delivered at different times of the day or day of the week, and strengthening of study designs with the inclusion of a comparator group, among other approaches.

Provider reminders and mobile screening tools were found to have the potential to improve screening and diagnosis of hypertension. Introducing automated algorithms to assist community health workers and non-physician healthcare providers with timely screening and appropriate diagnosis were found to increase access to care. Expanding the use of automated guidelines may support implementation of innovative approaches, such as task-shifting, to address the shortage of physicians and other health care workers in SSA.(39)

Given the dearth of evidence on the use of telehealth in the different stages of the HCC, we offer our reflections on the opportunities to expand telehealth in order to improve

hypertension control in SSA. First, we examine lessons learned from telehealth interventions in SSA that have largely focused on communicable diseases (i.e., HIV and malaria) and maternal and child health.(40) In recent systematic reviews, mHealth interventions targeting pregnant women were found to increase antenatal care attendance, skilled attendance at birth and vaccination rates.(41) In HIV, telehealth studies have increased HIV risks awareness and retention into care.(42, 43) Telehealth innovations targeting communicable diseases and maternal-child health have been found to be highly acceptable, feasible, and have significantly improved medication adherence, engagement in care, and use of health services.(40) Therefore, it is important to use the already established precedence in these disease areas to increase the use of telehealth along the HCC. For example, since there is a growing number of older people living with HIV (44), embedding interventions at different stages of HCC in ongoing HIV focused telehealth interventions may improve overall health of people living with HIV and may be cost effective. This will also support the 5th PASCAR action plan- “integrate hypertension detection, treatment and control within existing health services such as vertical programs (e.g. HIV, TB).” Researchers can also adapt key components of telehealth interventions that have been established in the communicable diseases whose goals are to raise awareness and encourage screening into the first stages of the HCC. Telehealth interventions that have been successful in improving adherence to antiretroviral therapy and achievement of viral suppression may also be adapted to support the later stages of HCC.(45)

Another area to explore in the use of telehealth for hypertension control is to reflect on the already existing infrastructure that supports other sectors of governments in SSA. For example, as of February 2014, at least 49 countries in Africa required or were in the process of requiring, the registration of personally identifiable data in order to activate a prepaid subscriber identification module (SIM) card for national security purposes.(46) Although the mandatory registration of SIM cards been met with controversies over privacy, access to population-based mobile phone ownership has provided the ability of the governments to send alerts to their citizens when there are threats to security, including terrorism. With this capability, member countries of PASCAR may utilize this platform to disseminate health education and support goals associated with different stages of the HCC. For example, one plan proposed by PASCAR sought to prevent hypertension by reducing high levels of salt intake and obesity, increasing fruit and vegetable intake, and promoting physical activity. Member countries could use the national mobile phone registry to send out information on the risk factors of hypertension and behavioral modification strategies. Given the privacy concerns, study designs using these platforms would need to undergo careful evaluation for legality, ethical approval, feasibility and acceptability prior to implementation.

Conclusions

The recent development of technology in SSA provides great potential to incorporate telehealth strategies in the different stages of the HCC. In the context of SSA, these interventions are potentially scalable given the accessibility and lower cost associated with mobile phone ownership. Given the paucity of published work in telehealth interventions in hypertension, some of the key questions for researchers and policy makers in SSA include the following;

- In adaptation of telehealth approaches used in communicable diseases interventions, what are the active components of the intervention that should be adapted?
- On the current infrastructure where governments have access to individual data through SIM registration, to what extent can the different telehealth approaches be successfully delivered to the intended sub-populations? Which stages of the HCC would be more likely to produce significant results?
- How can telehealth approaches be integrated into the existing healthcare systems in SSA?
- Are telehealth interventions for hypertension control cost-effective in SSA?

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* of importance

** of major importance

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Figure 1:
The Hypertension Control Cascade

Figure 2.

Reasons for exclusion of studies: Diagram of the number of studies identified by literature search and reasons for exclusion to arrive at 8 studies that were included in the review.

Table 1:
Published articles addressing telehealth interventions along the hypertension control cascade.

Stage(s) of Hypertension Control Cascade	Setting	Author	Year	Mode of Telehealth Delivery	Study Design	Sample Size	Outcomes
Awareness to increase screening	Cape Town, SA	Hacking D et al.(31)	2016	SMS text messages with hypertension knowledge sent to patients	RCT	76 adults in intervention; 70 adults in control	No improvement in hypertension knowledge score between intervention and control (17.5 v. 17.7, p=0.69) Increased positive self-reported behavioral change for intervention participants
Awareness to increase screening	Cape Town, SA	Haricharan HJ et al.(32)	2017	SMS text messages with hypertension knowledge sent to patients	C-S with pre and post-test analysis	41 deaf adults	Increased knowledge of hypertension in overall test score between baseline and follow up (p=0.0033)
Diagnosis	Western Kenya	Haskew J et al. (33)	2015	Cloud based EMR tool for hypertension documentation and screening used by providers	Prospective cohort with pre and post-test analysis	946 pregnant women	Significant difference in the amount of missing documentation for screening of hypertension pre and post-implementation (25.1%, 95%, CI 20.5 – 29.7, p <0.001) No increase in hypertension screening. Only 5 (0.5%) patients screened for hypertension during study period
Diagnosis	Rural Kenya	Mamnik J et al. (34)	2018	Two-way mHealth SMS based hypertension screening tool used by CHWs	C-S	2865 adults	Screened 2865 adults for hypertension and found a point prevalence of hypertension of 23%
Management and Control	Lagos, Nigeria	Nelissen HE et al. (35)	2018	mHealth application used by cardiologists and pharmacists	Prospective cohort	165 hypertensive adults	Reduction in mean BP with an average change in SBP –9.9mmHg (SD: 18.0) and in DBP –5.9mmHg (SD: 11.4) among baseline and endline No difference observed in average change in SBP among newly diagnosed (–9.6 mmHg, SD: 14.3) previously diagnosed (–10.0 mmHg, SD: 18.8, p=0.907), those not on antihypertensive medication (–12.8 mmHg, SD: 17.8) and those using antihypertensive medications at baseline (–8.5 mmHg, SD: 18, p = 0.083) Increased BP control from 24% at baseline to 56% at endline, p <0.001
Management and Control	Kumasi, Ghana	Sarfo FS et al. (36)	2018	Smart phone application driven by nurses and used by patients	RCT	30 hypertensive, stroke adults in intervention; 30 hypertensive, stroke adults in control	Trend towards BP control in intervention arm compared to control arm (46.7% v. 40.0%, p = 0.79) Increase in SBP control in intervention arm compared to control arm (73.3% ff. 43.3%, p = 0.035) No difference in medication adherence between arms (0.95 +/- 0.16 v 0.98 +/- 0.24, p = 0.56)
Management and Control	Cape Town, SA	Bobrow K et al. (37)	2016	Information only SMS text messaging and interactive text messaging sent to patients	Multi-arm RCT	457 hypertensive adults in information only text messaging intervention; 458 hypertensive adults in interactive text messaging intervention; 457	Reduction in mean SBP from baseline to 12 months for information-only message group compared to usual care –2.2 mmHg (95% CI –4.4 – –0.04, p =0.046) Reduction in mean SBP from baseline to 12 months for interactive message group compared to usual care –1.6 mmHg (95% CI –3.7 – 0.6, p =0.16) Blood pressure control for information only messages and interactive message compared to usual care with adjusted odds

Stage(s) of Hypertension Control Cascade	Setting	Author	Year	Mode of Telehealth Delivery	Study Design	Sample Size	Outcomes
						hypertensive adults in control	ratio of 1.4 (95% CI 1.0 – 1.9, $p=0.04$) and 1.4 (95% CI 1.0 – 1.9, $p=0.04$) respectively Increased medication adherence with 62.8% of information only message participants, 59.7% of interactive message participants and 49.4% of usual care ($p<0.001$) meeting goal of 80% medication coverage over 12 month period
Management and Control	Yaounde, Cameroon	Kingue S et al. (38)	2013	Telephone calls and text messages from nurses to cardiologists and nephrologists	RCT	165 hypertensive adults intervention; 103 hypertensive adults control	Increased BP control among intervention participants with stage 3 hypertension compared to usual care group (50% v. 39.1%, $p=0.04$) No change in BP control among intervention participants with stage 1 and stage 2 hypertension compared to usual care group (65.2% v. 70%, $p=0.20$) Reduced mean BP among intervention participants compared to usual care group between baseline and final visits, (33.3% v. 27.5% $p=0.04$)

Abbreviations: RCT, randomized control trial; C-S, cross-sectional study; CHW, community health worker; BP, blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; EMR, electronic medical record