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From Digital Messages To Integrated Hypertension Care: A Critical Integrated Literature Review Of Technology-Enabled Framework For Africa

OGUNYEMI Suraj Adefabi

Department of Medicine, Obafemi Awolowo University, Ile-Ife, Nigeria

Abstract: ***Hypertension is one of the most important and increasingly complex non-communicable disease challenges confronting African health systems. Although effective antihypertensive medicines, diagnostic procedures and clinical guidelines are available, hypertension awareness, treatment and blood-pressure control remain inadequate across many African countries. The rapid expansion of mobile telecommunications, digital health infrastructure, remote monitoring, electronic health records, telemedicine, wearable devices and artificial intelligence (AI) has created new opportunities for improving hypertension prevention, screening, diagnosis, treatment, adherence and long-term monitoring. This review therefore examines the current state of evidence concerning technologies for hypertension management in Africa, assesses their potential benefits and limitations, and identifies priorities for future research, practice and policy. Evidence indicates that mobile health (mHealth), short message service (SMS), smartphone applications and home blood-pressure monitoring are currently the most extensively studied technologies. This review shows that mHealth/eHealth and SMS were the dominant technologies, supporting medication adherence, lifestyle counselling and home blood-pressure monitoring. However, limited digital literacy, inadequate internet infrastructure, privacy concerns, high data costs, unreliable electricity and poor integration with clinical workflows remain important barriers, thus making evidence concerning clinical effectiveness to be mixed. Emerging technologies—including Internet of Things (IoT)-enabled blood-pressure monitors, telemedicine, electronic health records, clinical decision-support systems, wearables and AI—could further strengthen hypertension care, but evidence from Africa remains comparatively limited. This review thus argues that technology should be integrated into primary healthcare rather than implemented as isolated digital projects. Therefore, a sustainable African hypertension management model should combine affordable mobile communication, validated home BP monitoring, community health workers, electronic records, clinical decision support and telemedicine, supported by strong data governance and digital-equity principles. Future research should prioritize multicountry randomized trials, cost-effectiveness, implementation science, interoperability, cyber security, sustainability and locally developed AI models.***

Keywords: ***hypertension; Africa; digital health; mobile health; mHealth; SMS; telemedicine; home blood-pressure monitoring; Internet of Things; artificial intelligence; primary healthcare.***

I. INTRODUCTION

Hypertension is a major global public-health problem and one of the most important preventable causes of cardiovascular morbidity and mortality. Persistent elevation of blood pressure increases the risk of stroke, ischemic heart disease, heart failure, chronic kidney disease and premature death. Its public-health importance is amplified by the fact that hypertension is frequently asymptomatic and can remain undiagnosed for prolonged periods (Hamrahian and Falkner, 2017; Fuchs and Whelton, 2020; Goorani *et al*., 2024).

The problem is particularly important in Africa, where demographic transition, urbanization, ageing, changing dietary patterns, obesity, physical inactivity and socioeconomic

transformation are contributing to increasing cardiovascular risk. At the same time, many African health systems face shortages of healthcare professionals and facilities such as inadequate diagnostic equipment, poor continuity of care, limited access to medicines and insufficient resources for long-term management of chronic diseases (Sanni, 2025; Sheffel *et al*., 2024).

The World Health Organization's 2025 *Global Report on Hypertension* emphasizes that hypertension control requires systematic improvement in detection, treatment and control and provides updated regional and country-level information on the burden and response to hypertension (World Health Organization, 2025). Thus, the challenge is therefore not simply to identify people with hypertension, but to create a sustainable system capable of ensuring that patients are diagnosed, treated, monitored and maintained at recommended blood-pressure levels.

Digital technologies have increasingly been proposed as one component of this response. Mobile phones can deliver health information and medication reminders. Smartphone applications can support self-management. Digital blood-pressure monitors can facilitate home monitoring. Telemedicine can connect patients with clinicians. Electronic health records can improve continuity of care, while artificial intelligence may eventually support risk prediction and individualized clinical decision-making.

Nevertheless, technological innovation does not automatically produce better health outcomes. Technologies must be affordable, acceptable, culturally appropriate, interoperable and integrated into existing health systems (Thokala *et al*., 2023; Ezeh *et al*., 2023). This consideration is particularly important in Africa, where digital infrastructure and health-system capacity vary substantially between and within countries.

This review therefore examines the current state of evidence concerning technologies for hypertension management in Africa, assesses their potential benefits and limitations, and identifies priorities for future research, practice and policy.

II. REVIEW METHOD AND SCOPE

This study adopts a *critical integrative literature-review approach*. It focuses on technologies that support one or more components of hypertension management:

- ✓ prevention and health education;
- ✓ screening and detection;
- ✓ diagnosis;
- ✓ medication adherence;
- ✓ lifestyle modification;
- ✓ home BP monitoring;
- ✓ clinical decision-making;
- ✓ remote consultation;
- ✓ patient follow-up;
- ✓ population surveillance; and
- ✓ risk prediction.

Emphasis is placed on evidence from African countries and on literature published during the recent period, while selected earlier landmark studies are retained where they provide important conceptual or empirical foundations.

III. TECHNOLOGIES FOR HYPERTENSION MANAGEMENT IN THE AFRICAN CONTEXT

As seen in Table 1, hypertension management in Africa is characterized by substantial gaps across healthcare. Other challenges include low awareness, inadequate screening, delayed diagnosis, limited treatment initiation, medication non-adherence and inadequate follow-up (Jobe et al., 2025; Egekeze, 2024).

Authors	Challenges in the hypertension treatment
Ottaru *et al*., 2024	- Limited availability of hypertension screening services - Lack of antihypertensive medications - Perceived complexity of managing hypertension - Lack of appropriate patient education to address care - High cost of hypertension medications makes them unaffordable - High consultation costs at hypertension clinics - Fear of side effects from hypertension medications - Perception that hypertension medications are ineffective - High transportation costs to healthcare facilities - Use of herbal remedies, perceived as a cheaper alternative for controlling hypertension - Self-monitoring of symptoms at home, eliminating the need to visit health facilities - Irregular use of medications
Gooden *et al*., 2023	- Organizational and health system factors: (No protocols for screening; lack of access to diagnostic equipment; lack of continuity of care) - Individual factors: (Health professionals' knowledge; self-monitoring) - Syndemic factors: (Poverty and mental health issues)
Hing *et al*., 2021	- Obstacles related to the financial aspects of hypertension medications - Shame of having to ask loved ones for financial support - Transportation costs to access hypertension treatment clinics - The high cost of hypertension exams - Lack of a national policy for managing non-communicable diseases (NCDs) - The burden of taking multiple medications daily - Side effects of medications - Changes in lifestyle, including the adoption of a new diet. - Low knowledge, prevention strategies and associated complications
Kagaruki *et al*., 2018	- Low knowledge of hygiene and dietary measures for prevention. - Low knowledge of dietary measures. - Patients claim that ARVs increase the occurrence of HBP. - Lack of health education - An incorrect perception
Manavalan *et al*., 2020	- Lack of awareness
Manavalan *et al*., 2020	- Limited knowledge of hypertension, including what it is, its causes, progression, symptoms, complications, and treatment

	- Participants believe that controlling stress is a better way to control hypertension - Delayed linkage to care after their initial hypertension diagnosis or were not linked to care at all - Difficulties with communication and counseling with providers - Reluctance to take antihypertensive medications - Additional structural barriers to hypertension care
Hoffman *et al*., 2021	- Barriers to taking antihypertensive medications (not having enough money to buy antihypertensive medications; difficulty remembering to take medications every day ; Lack of funds for transportation to the clinic for refills; Feeling that medications were no longer needed due to good health - Factors associated with uncontrolled blood pressure (self-reported non-adherence to antihypertensive medications)
Manavalan *et al*., 2021	- Patient-level barriers: Stress, depression, lack of knowledge and awareness about hypertension - Provider-level barriers: Inadequate hypertension training and knowledge gaps; ineffective antihypertensive prescribing practices; challenges with hypertension counseling - System-level barriers: Limitations in clinic capacity for hypertension care; high costs of hypertension care; lack of routine hypertension screening and monitoring; challenges with hypertension data, guidelines, and protocols.

Classification of patient-level, provider-level and health system-level barriers to hypertension prevention by included study consolidated framework for future reproducibility and comparative analysis (Mixed systematic review and meta-analysis, sub-Saharan Africa, 2017–2024) Adapted from Nang et al., 2025 .

Table 1: Major challenges in hypertension management in Africa

The health-system context is critical. Many patients have to travel considerable distances to healthcare facilities, while specialist services are concentrated in major urban centres. Healthcare workers may also have limited time to provide repeated counselling and monitoring for chronic disease.

Some of the technologies for hypertension management in the African context are discussed as follow:

A. MOBILE HEALTH TECHNOLOGIES

a. SMS-BASED INTERVENTIONS

SMS is arguably the most accessible digital-health technology for hypertension management in Africa because it can operate on basic mobile phones and does not require smartphones or broadband internet (Hinneh *et al*., 2025; Dlamini *et al*., 2023). SMS interventions may provide:

- ✓ medication reminders;
- ✓ appointment reminders;
- ✓ lifestyle advice;
- ✓ BP-monitoring reminders;
- ✓ motivational messages;
- ✓ health education;
- ✓ follow-up prompts; and
- ✓ communication between patients and healthcare workers.

Several researchers (such as Cao et al., 2022; Rahman and Bhuiyan, 2024; Boima *et al*., 2024) found that SMS was among the dominant technologies used for hypertension management. The reviewed interventions commonly addressed medication adherence, lifestyle modification and home BP monitoring. This is because an important advantage of SMS is scalability. Mobile-phone penetration is substantially greater than access to specialist healthcare services in many African communities. Consequently, SMS can provide a relatively inexpensive mechanism for maintaining contact with patients.

However, SMS interventions are not universally effective. Messages that are repetitive, culturally inappropriate, overly technical or insufficiently personalized may fail to change behaviour.

b. SMARTPHONE SOFTWARE APPLICATIONS

Smartphone applications can provide substantially greater functionality than SMS. This is because a hypertension-management application may allow patients to:

1. record BP measurements;
2. visualize BP trends;
3. receive medication reminders;
4. obtain lifestyle recommendations;
5. communicate with healthcare workers;
6. receive appointment reminders;
7. monitor physical activity;
8. record medication use; and
9. receive alerts when measurements are abnormal.

Software applications can also facilitate two-way communication rather than simply transmitting information from providers to patients.

However, smartphone-based interventions may produce digital inequalities. Older adults, low-income households and populations in areas with poor connectivity may be excluded.

Therefore, an African digital-health ecosystem should not rely exclusively on smartphone applications. SMS and voice-based technologies still remain important alternatives.

Evidence for mHealth Effectiveness

Although inconsistent, the evidence concerning the effectiveness of mHealth for hypertension in Africa is promising as seen in Table 2.

For example, the 2026 scoping review by Osei *et al*. which aimed at mapping evidence on the use of digital health interventions for managing medication and healthcare service delivery by health professionals in Sub Saharan Africa. After screening 2,104 potentially eligible articles across the different electronic databases, the study found that there is limited evidence on the use of digital health interventions for managing medications of hypertension and improving healthcare service delivery in Sub Saharan Africa (Osei *et al*., 2026). This is because in African settings, addressing technological and contextual barriers while reinforcing training and support systems is critical to successful implementation and scale-up. Therefore, simply introducing a

mobile intervention is insufficient to guarantee improved BP control.

However, individual African trials have reported stronger effects. For example, Hinnel *et al*. (2025) conducted a scoping review with sixteen studies across three African regions included. Common digital health tools assessed were mobile Health (mHealth) or electronic Health applications and short message service (SMS)-based interventions. Supported self-management functions included medication adherence, lifestyle counselling and home blood pressure monitoring. Implementation strategies included prior training, continuous digital support and provision of resources including BP devices and data credit. The findings suggest that Digital health tools, particularly mHealth apps and SMS, support key hypertension self-management.

Author	Country	Digital Health Intervention
Barsky *et al*., 2019	Tanzania	Mobile application to send biweekly tailored short SMS text messages.
Cremers *et al*., 2019	Nigeria	mHealth app to facilitate communication between pharmacists and cardiologists
Haricharan *et al*.,2017	South Africa	eHealth intervention involved an SMS campaign designed for hearing disabilities
Leon *et al*., 2015	South Africa	Mobile phone SMS messages for patients with hypertension
Maar *et al*., 2016	Tanzania	Mobile phones to deliver SMS-based health intervention messages.
Nelissen *et al*., 2018	Nigeria	eHealth intervention for remote patient monitoring
Nichols *et al*., 2019	Ghana	mHealth technology for self- blood pressure monitoring and SMS
Vedanthan *et al*., 2015	Kenya	Tablet- based integrated record- keeping and decision support system for hypertension Management
Mannick *et al*., 2018	Kenya	Mobile phones to deliver SMS- based health intervention messages
Aw *et al*., 2020	Kenya	mHealth platform for risk assessment and sending SMS to patients.
Sarfo *et al*., 2018	Ghana	mHealth platform BP monitoring and sending SMS to patients
Bobrow *et al*., 2016	South Africa	SMS platform for delivering hypertension- related information
Mugabirwe *et al*., 2021	Uganda	mHealth platform for HBPM, virtual community messaging, medication adherence
Dele- Ojo *et al*., 2023	Nigeria	mHealth application, dietary advice, medication use reminders, clinic appointment reminder, advice on lifestyle modification
Liashiedzi *et al*., 2024	Ghana	mHealth application healthcare reminders, referral
Lyles *et al*., 2023	Kenya	mHealth specialised NCD mHealth app

Source: Hinneh et al., 2025

Table 2: Selected evidence concerning digital hypertension interventions in Africa

c. HOME BLOOD-PRESSURE MONITORING

Home blood-pressure monitoring (HBPM) is one of the most clinically relevant technologies for hypertension management. Traditional clinic-based measurements provide information only at particular points in time, while HBPM allows patients to obtain repeated measurements under everyday conditions (Hansell *et al*., 2024).

In addition to the advantages of Home Blood-Pressure Monitoring in Table 3, the technology can also improve:

- ✓ identification of uncontrolled hypertension;
- ✓ treatment monitoring;
- ✓ patient engagement;
- ✓ clinician decision-making;
- ✓ detection of BP trends; and
- ✓ continuity of care.

HBPM becomes even more powerful when combined with digital communication.

Advantages	Limitations
• Can take multiple readings over an extended period of time • Avoids white-coat reaction to BP measurement • Reproducible • Predicts CV morbidity and mortality better than office BP • Can diagnose white-coat and masked hypertension • Allows patients to better understand hypertension management • Telemonitoring allows remote monitoring by healthcare professionals • Detects increased BP variability	• Some devices have been found to be inaccurate • Cuff placement can affect accuracy • May induce anxiety and excessive monitoring • Risk of treatment change by patients based on casual home measurements without doctors' guidance • Lack of nocturnal recording • Not yet reimbursed by insurance companies in many countries

Source: George and MacDonald, 2015.

Table 3: Advantages and limitations of Home Blood-Pressure Monitoring

However, an important lesson from the literature is that providing patients with BP devices without establishing a

system for interpreting and responding to measurements may produce limited clinical benefit, as also confirmed in Table 3.

The optimal model therefore involves:

Validated BP device → patient measurement → digital transmission → healthcare-worker review → clinical action

d. MHEALTH COMBINED WITH HOME MONITORING AND TASK-SHIFTING

One particularly promising approach is the combination of technology with task-sharing.

The study by Sarfo *et al*. (2026) in Ghana, a Phone-based Intervention under Nurse Guidance after Stroke (PINGS) trial, compared the efficacy and safety of usual care versus a 12-month intervention, comprising home blood pressure self-monitoring with nurse case management for elevated home BP recordings, use of phone alarms as medication reminders, and once-weekly education about cardiovascular risk reduction, delivered via regular telephonic audio messages in selected Ghanaian dialects. The study showed that leveraging mhealth with minimal sophistication and task shifting to nurses on top of usual care could safely improve blood pressure control in low-resource settings. This model is highly relevant to African health systems because of the shortage of physicians, which makes physician-only hypertension management difficult to scale.

A nurse or community health worker can:

- ✓ measure BP;
- ✓ educate the patient;
- ✓ monitor adherence;
- ✓ review digital alerts; and
- ✓ refer complex cases.

Physicians can then focus on patients requiring more advanced assessment.

Technology therefore becomes an instrument for *health-workforce optimization* rather than merely a communication tool.

e. TELEMEDICINE

Telemedicine enables healthcare providers to assess and manage patients remotely (Vudathaneni *et al*., 2024). In addition to the benefits of Telemedicine in Table 4, potential hypertension applications also include:

- ✓ remote BP review;
- ✓ medication review;
- ✓ specialist consultation;
- ✓ follow-up appointments;
- ✓ treatment adjustment;
- ✓ referral;
- ✓ patient counselling; and
- ✓ clinical supervision of community health workers.

This has considerable potential in rural Africa. For instance, a patient in a remote community may have BP measured locally by a nurse or community health worker, while a physician in an urban hospital reviews the data remotely.

Benefits	Barriers
Improved health outcomes (including enhanced blood pressure control and improved medication adherence), optimization of medication management, and enhanced quality of care	Limited evidence of long-term efficacy and sustainability (trend to a reduction of adherence to the intervention over time)
Accelerated delivery of care with potential for real-time evaluation of critical patients	Lack of guidelines, protocols, and standards
Increased access to medical services or diagnostic procedures not available otherwise	Poor interoperability between the different solutions and limited compatibility with electronic health records
Management of distant patients and particularly of those residing in underserved areas	Limited integration with traditional healthcare services
Possibility to provide care through remote evaluation where face-to-face consultation is not possible	Usability (tools and solutions not always user-friendly)
Increased number of patients served	Technological and infrastructural barriers
Time-saving (if properly used), with a reduction in travel time, frequency of office visits, and laboratory tests	Lack of health reimbursement plans
Cost efficiency: long-term reduction of social and healthcare expenditure	Regulatory (legal and ethical), security, and privacy issues
Facilitation of interprofessional cooperation (teleconsultation)	Lack of validation and certification of most solutions and interventions
Reinforcement of patients physician relationship	Limited accessibility and affordability, with potential health inequity, particularly due to economic, social, and cultural issues (digital divide)
Patients empowerment	Poor physician adoption (inertia)

(Source: Omboni, 2023).

Table 4: Telemedicine benefits and barriers in hypertension management

The major constraints of this technology include connectivity, electricity, privacy, digital literacy and healthcare-worker availability.

f. INTERNET OF THINGS AND CONNECTED BP DEVICES

The Internet of Things provides an opportunity to connect BP-monitoring devices directly to digital platforms. An IoT-enabled system can automatically transmit BP readings from a digital BP monitor to a smartphone or cloud-based platform (Kale *et al*., 2024; Kumar *et al*., 2026). This IoT system could automatically identify patients with persistently uncontrolled BP, as illustrated in Figure 1.

Nevertheless, IoT hypertension research in Africa remains relatively immature. There are fewer IoT studies than SMS or

conventional mHealth interventions. Therefore, this represents an important research opportunity, but also a warning against premature technological complexity.

g. ELECTRONIC HEALTH RECORDS

Electronic health records can provide a longitudinal picture of a patient's hypertension trajectory.

Relevant information may include:

- ✓ BP measurements;
- ✓ medications;
- ✓ treatment changes;
- ✓ laboratory results;
- ✓ comorbidities;
- ✓ cardiovascular risk;
- ✓ appointments;
- ✓ adherence; and
- ✓ referrals.

EHRs can improve continuity of care when patients move between facilities. For hypertension management, EHRs are particularly valuable when combined with clinical decision support (Alexiuk et al., 2024).

h. CLINICAL DECISION-SUPPORT SYSTEMS

Clinical decision-support systems can help healthcare workers apply standardized hypertension protocols (Song *et al*., 2024). For example, an electronic system could generate an alert when:

- BP remains above target;
- the patient has missed follow-up;
- medication intensification should be considered;
- a high cardiovascular-risk profile is identified; or
- referral is required.

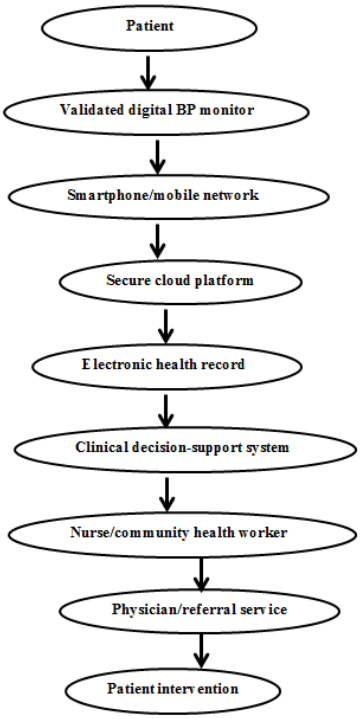

Figure 1: Conceptual architecture of an IoT-enabled hypertension system

Clinical Decision Support Systems could be especially valuable in primary healthcare settings where nurses and other non-physician healthcare workers undertake increasing responsibilities. However, decision-support systems must be aligned with national clinical guidelines and regularly updated (Abell *et al*., 2023).

i. WEARABLE TECHNOLOGIES

Wearables such as smartwatches and activity trackers have potential applications in hypertension management.They can monitor:

- ✓ physical activity;
- ✓ heart rate;
- ✓ sleep;
- ✓ sedentary behaviour;
- ✓ exercise patterns; and
- ✓ potentially other cardiovascular parameters.

Their greatest immediate value may be behavioural rather than diagnostic. For example, a patient could receive feedback indicating insufficient physical activity and be encouraged to increase daily exercise. However, consumer wearable devices should not automatically be regarded as substitutes for clinically validated BP monitors (Materia and Smyth, 2024).

j. ARTIFICIAL INTELLIGENCE

Artificial intelligence is one of the most promising emerging technologies for hypertension management. Potential applications include:

- ✓ predicting future hypertension;
- ✓ identifying patients at high cardiovascular risk;
- ✓ predicting treatment response;
- ✓ detecting abnormal BP patterns;
- ✓ identifying patients at risk of poor adherence;
- ✓ supporting clinical decision-making;
- ✓ population-level risk stratification; and
- ✓ personalizing interventions.

However, the African evidence base remains limited.

Previous research (such as Erku *et al*., 2023) identified mHealth, eHealth and SMS approaches rather than advanced AI-based systems. This represents both a limitation and an opportunity. African researchers should therefore increasingly develop AI models using locally relevant datasets. Algorithms trained primarily on populations from Europe, North America or East Asia may not perform equally well in African populations. AI development should thus emphasize:

- ✓ representative African datasets;
- ✓ external validation;
- ✓ transparency;
- ✓ explainability;
- ✓ bias assessment;
- ✓ cybersecurity;
- ✓ privacy; and
- ✓ human oversight.

IV. BARRIERS TO TECHNOLOGY ADOPTION

The most important contribution of recent African research is the recognition that digital-health implementation is fundamentally a socio-technical process. For example, Hinneh *et al*. (2025) identified several major barriers, in addition to Table 5, which include limited digital literacy, poor communication among healthcare workers, privacy concerns and weak internet infrastructure. Moreover, in addition to Table 5, Facilitators also included competency-based training, contextual adaptation, continuous technical support and effective feedback systems (Hinneh et al., 2025). A critical lesson is that technology should be designed *with users rather than for users*.

Variable	
Facilitators	1. Technology usability; Technical support; Integration into patient's daily routine 2. Positive impact on patient-provider communication; Improved and more timely feedback from providers; Shared decision making with providers; Better preparation for clinic visits 3. Improved self-management and patient experience; Increased motivation to better manage health; Increased access to health data; Alleviation in anxiety from better monitoring of health data 4. Reduction of in-office visits
Barriers	1. Lack of technology usability and technical support; Frequent technical glitches; Lack of ease of use of system; Patient not confident in using device 2. Interference with patient-provider relationship; Fear of having less direct in-person communication with provider; Lack of feedback from providers; Disrupting feelings of independence 3. Lack of validation of technology 4. Increased patient anxiety 5. Concern over data privacy and security 6. Cost of digital health equipment

Source: Palacholla et al., 2019

Table 5: Facilitators and Barriers to Digital-health Implementation for Hypertension Management

V. DIGITAL LITERACY

Digital literacy affects both patients and healthcare workers. Patients may have difficulty:

- ✓ interpreting BP readings;
- ✓ operating smartphone applications;
- ✓ navigating menus;
- ✓ recognizing medical terminology;
- ✓ transmitting measurements; or
- ✓ responding to digital prompts.

Also, healthcare workers may experience similar difficulties with more sophisticated clinical systems. In line with this, a recent systematic review by Hidayati *et al* (2026) found that competency-based training and continuing technical support were important facilitators of successful adoption Digital interventions should therefore include training as an integral component rather than an optional activity.

VI. DIGITAL EQUITY AND INCLUSION

One of the major concerns surrounding digital health is that technology can inadvertently increase inequality (Yao *et al*., 2022). For example, a smartphone application may be highly effective among educated urban populations but inaccessible to:

- ✓ older adults;
- ✓ rural populations;
- ✓ low-income households;
- ✓ people with disabilities;
- ✓ individuals with limited digital literacy; and
- ✓ communities with unreliable connectivity.

Therefore, an African hypertension technology strategy should use *multiple communication channels* as illustrated in Table 6.

Population	Preferred approach
Smartphone users	App + internet
Basic-phone users	SMS/USSD
Low-literacy users	Voice/local language
Rural patients	Community health worker + mobile
Older adults	Telephone/assisted digital care
High-risk patients	HBPM + telemonitoring
Complex cases	Telemedicine/specialist review

Table 6: Inclusive technology strategy for Hypertension management in Africa

The objective of digital technology adoption should not be maximum technology adoption; it should be *maximum equitable health benefit.*

VII. DATA PRIVACY, SECURITY AND GOVERNANCE

Hypertension technologies collect sensitive health information. Digital systems therefore require:

- ✓ informed consent;
- ✓ secure authentication;
- ✓ encryption;
- ✓ controlled data access;
- ✓ appropriate data storage;
- ✓ cybersecurity procedures;
- ✓ clear data ownership;
- ✓ appropriate retention policies; and
- ✓ regulatory compliance.

Privacy concerns have already emerged as a barrier to African digital-health adoption (Olayiwola *et al*., 2026). Countries should therefore strengthen digital-health governance while ensuring that regulations do not unnecessarily prevent beneficial innovation.

VIII. COST AND SUSTAINABILITY

Technology interventions are often introduced through research grants or donor-funded projects. The challenge is maintaining them after external funding ends. Sustainability thus requires consideration of:

- ✓ device costs;
- ✓ software licensing;
- ✓ internet/data costs;

- ✓ technical support;
- ✓ staff training;
- ✓ maintenance;
- ✓ replacement of damaged equipment;
- ✓ cybersecurity; and
- ✓ integration with national health systems.

A technology that works perfectly during a six-month research project but cannot be financed by the health system is unlikely to produce population-level impact. Cost-effectiveness should therefore become a standard outcome in future African hypertension technology research and approach.

IX. CONCLUSIONS

Technological innovation presents a significant opportunity to strengthen hypertension management in Africa. Several literatures demonstrate that mobile phones, SMS, smartphone applications and home BP monitoring can support medication adherence, lifestyle modification, patient engagement and BP monitoring. Also, they demonstrate that appropriately designed mobile interventions can improve clinical outcomes, although systematic evidence remains heterogeneous. In other words, they demonstrates that technology has considerable potential to improve hypertension management in Africa, however, the evidence does not support the assumption that technology alone will solve the problem.

Therefore, the strongest current opportunity is not necessarily the deployment of the most technologically sophisticated system. Rather, it is the development of affordable, clinically integrated and sustainable technologies that fit African health systems.

A practical model should therefore combine:

Mobile communication → validated BP monitoring → community health workers → electronic records → clinical decision support → telemedicine → specialist referral.

AI, IoT and wearable technologies should subsequently be incorporated where there is sufficient infrastructure, evidence and clinical justification, especially in African countries, where some infrastructure like internet, expertise etc are majorly not sufficient.

Thus, the major barriers—digital literacy, connectivity, electricity, cost, privacy, interoperability and sustainability—must be addressed simultaneously. Recent evidence emphasizes that competency-based training, contextual adaptation, technical support and effective feedback are central to successful implementation and sustainability of needed technologies.

Ultimately, the goal of technological innovation should not be the digitization of hypertension services for its own sake. The objective should be to transform hypertension care from episodic facility-based management into continuous, patient-centered, community-linked, data-informed and equitable care.

Three major conclusions therefore emerge.

First, simple technologies currently have the strongest African evidence base

SMS and mobile applications dominate the literature because they are relatively inexpensive and can operate within existing telecommunications infrastructure. Literature confirms that mHealth, eHealth and SMS are currently the dominant approaches in African hypertension research.

Second, technology is most effective when connected to clinical action

A message reminding patients to take medication is potentially useful, but an integrated system that combines medication reminders, BP monitoring and healthcare-worker follow-up is more likely to affect clinical outcomes.

The implication is that researchers should move from the question:

"Does mHealth work?"

to the more useful question:

"Which technology, for which patients, delivered by whom, through which healthcare pathway, and under what conditions, produces sustained BP control?"

Third, implementation context is as important as technology

Poor internet connectivity, inadequate training, privacy concerns, cultural mismatch and weak workflow integration can undermine technically sophisticated interventions.

This means that technology development must be accompanied by health-system research.

X. RECOMMENDATION: PROPOSED INTEGRATED MODEL FOR HYPERTENSION MANAGEMENT IN AFRICA

Based on the reviewed evidence, this review proposes an Integrated Digital Hypertension Management Model for Africa.

The model should be built around four principles:

Accessibility + Equity + Clinical integration + Sustainability

XI. IMPLICATIONS FOR POLICY AND PRACTICE

African governments should consider five strategic priorities.

Integrate digital hypertension services into primary healthcare

Digital hypertension services should be linked to routine primary healthcare rather than developed as isolated projects.

Expand access to validated Blood Pressure devices

Home BP monitoring should become an important component of hypertension management, particularly for patients with uncontrolled disease.

Strengthen community-based care

Community health workers and nurses should be trained to use digital systems for BP measurement, follow-up and referral.

Promote interoperability

Digital hypertension systems should be capable of exchanging information with national electronic health-information systems.

Support African innovation

African universities, hospitals, governments, telecommunications companies and technology developers should collaborate to develop locally appropriate technologies.

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