



Tackling the growing diabetes burden in Sub-Saharan Africa: A framework for enhancing outcomes in stroke patients



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ABSTRACT

According to the World Health Organization (WHO), more than 80% of worldwide diabetes (DM)-related deaths presently occur in low- and middle-income countries (LMIC), and left unchecked these DM-related deaths will likely double over the next 20 years. Cardiovascular disease (CVD) is the most prevalent and detrimental complication of DM: doubling the risk of CVD events (including stroke) and accounting for up to 80% of DM-related deaths. Given the aforementioned, interventions targeted at reducing CVD risk among people with DM are integral to limiting DM-related morbidity and mortality in LMIC, a majority of which are located in Sub-Saharan Africa (SSA). However, SSA is contextually unique: socioeconomic obstacles, cultural barriers, under-diagnosis, uncoordinated care, and shortage of physicians currently limit the capacity of SSA countries to implement CVD prevention among people with DM in a timely and sustainable manner. This article proposes a theory-based framework for conceptualizing integrated protocol-driven risk factor patient self-management interventions that could be adopted or adapted in future studies among hospitalized stroke patients with DM encountered in SSA. These interventions include systematic health education at hospital discharge, use of post-discharge trained community lay navigators, implementation of nurse-led group clinics and administration of health technology (personalized phone text messaging and home tele-monitoring), all aimed at increasing patient self-efficacy and intrinsic motivation for sustained adherence to therapies proven to reduce CVD event risk.

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1. Introduction

1.1. Burden of diabetes and stroke in Sub-Saharan Africa (SSA)

As of 2012, roughly 14 million Africans (4.8%) had diabetes (DM), and approximately 81% were undiagnosed (vs. 50% worldwide), making Africa the continent with the highest proportion of people with undiagnosed DM [1]. Projections for Sub-Saharan Africa (SSA) indicate that the number of diabetics will rise by 71% to 23.9 million by 2030 (predicted global increase is 37%) [1]. Pre-DM in SSA is expected to rise by 75.8%, from 26.9 million in 2010 to 47.3 million in 2030 [1]. DM accounts for 6.1% of deaths from all causes in SSA with absolute and relative mortality rates highest in 20 to 39 year olds, i.e., the most economically productive range of population [2].

Major CVD events (including stroke) cause about 80% of the total mortality in people with DM [3]. World Health Organization (WHO) estimates indicate stroke deaths in LMIC account for 85.5% of stroke deaths worldwide [4]. The disability-adjusted life years lost in these countries were almost seven times than those lost in high-income countries (HIC) [4]. Beyond the personal toll, costs (e.g. direct expenditures and lost productivity) related to stroke are prohibitive [5]. Data from

SSA suggest an annual stroke incidence rate up to 316 per 100,000, a prevalence rate up to 315 per 100,000 and 3-year fatality rate up to 84% [6]. Stroke is the leading cause of adult medical admissions and comas [7,8]. Among survivors, a major source of subsequent mortality and functional decline is recurrent stroke and myocardial infarction (MI) [9–13].

Of note, stroke risk is substantially higher in people with DM [14]. Optimal management of DM is likely an important recurrent CVD prevention activity [15–17]. Moreover, while people with a known date of pre-DM onset progress to DM in <3 years [16], pre-DM is itself independently linked with CVD events [15–17]. A meta-analysis of prospective cohort studies suggested that pre-DM is independently associated with stroke events [17]. Also analysis of nationally representative US data showed that 3.7% stroke survivors had undiagnosed DM, 32.3% had undiagnosed pre-DM, and prevalence of undiagnosed DM and pre-DM were highest in racial-ethnic minorities [18]. Similar data are not available for stroke survivors in SSA, but it's likely that under-diagnosis in SSA is much worse than the US.

2. Ameliorating the burden of diabetes and stroke in SSA

Fortunately, effective interventions exist to prevent progression of pre-DM to DM. Consensus guidelines recommend that persons with pre-DM be informed of their increased risk, counseled about effective

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Table 1

Guiding theoretical frameworks/models to support strategies to improve outcomes among stroke patients with or at risk of diabetes in Sub-Saharan Africa (SSA).

Model/theory	Description	Justification
Transtheoretical Healthcare navigator model	<ul style="list-style-type: none"> Behavioral interventions are most effective for people at the “determination” or “action” stage [47,48]. Goal of navigation is to improve self-management of chronic diseases and to reduce barriers to healthcare. Navigators are a subset of community health workers, who provide informal community-based health-related services and establish links between providers and persons in the community [49–51]. Navigators are usually lay workers provided with training and supervised by healthcare professionals. 	<ul style="list-style-type: none"> Pre-DM/DM in the context of a recent stroke is likely to be strong motivation for individuals to be ready to change. Effective in increasing compliance in DM and CVD in HIC [52–55,102,103]. Peer-for-progress model is successfully utilized in SSA demonstration projects including a DM project in Cameroon and a CVD project in Kenya [34–36]. Patient navigation is a central recommendation of the Institute of Medicine's report on healthcare disparities [56].
Chronic Care Model (CCM)	<ul style="list-style-type: none"> Identifies the essential elements of a healthcare system that promote high-quality chronic disease care. Includes delivery system redesign, self-management support, community resources, decision support, clinical information systems, and organization of healthcare. 	<ul style="list-style-type: none"> Majority of interventions based on model improved care processes or outcome measures, and reduce healthcare costs [57]. Delivery system redesign (enhanced coordination of care) component of model strongly linked to improvements in health outcomes [58–61]. Self-management (confidence in one's ability to behave in a way to produce a desirable outcome) support component of model strongly linked to favorable outcomes [58,62,63].

strategies to lower risks, have CVD risk factors treated, and be regularly monitored for DM [19]. Prevention of future CVD events is critical to reducing the morbidity/mortality of patients with stroke, since the risk is highest within 3 months of the index stroke [20,21]. Longitudinal studies in HIC have identified modifiable risk factors including hypertension, DM, and dyslipidemia [22], which if controlled, could substantially lessen CVD burden. Yet, the use of evidence-based therapies for CVD prevention among stroke patients receiving conventional care in LMIC is extremely low [23]. Scaling up interventions to prevent primary and secondary CVD in LMIC could meet a global goal of reducing chronic disease death rates by an additional 2% per year, with only a moderate rise in health expenditure [24]. However, Africans in general, do not use health services unless they are very sick or there is a specific need [25], and even

in times of infirmity, self-medication and the use of traditional medicine are usually the first line of action [26]. A study at the University College Hospital Ibadan, Nigeria, found that glycemic control was achieved in only one third of encountered DM patients, due to poor adherence with prescribed drug regimen, and practice of self-management [27].

Beyond barriers to optimal DM control at the patient level, in SSA countries, system-level barriers seem to have an even more adverse impact on healthcare in general, particularly among those with chronic diseases [28,29]. Inadequate workforces are perhaps the most serious challenges. Poor working conditions and low salaries have triggered a wave of migration of health professionals from SSA to western countries [30,31]. Successful and sustainable strategies for incrementally overcoming impediments to mitigating the burgeoning DM-related CVD

Table 2

Promising strategies to consider for the improvement of outcomes among stroke patients with or at risk of diabetes in Sub-Saharan Africa (SSA).

Strategy	Rationale
Lay health workers	<ul style="list-style-type: none"> Lay health workers have shown effectiveness in management of infectious diseases in SSA [64–70], and could be a viable aspect of interventions aimed at managing DM.
Task shifting	<ul style="list-style-type: none"> Community-based interventions are high on United Nations Millennium Development Goals' policy agenda [71]. Task shifting to “non-physician clinicians” in Cameroon resulted in a decrease of fasting plasma glucose by 3.4 mmol/l ($p < 0.001$) among diabetics [72]. WHO task shifting program in Nigeria associated with significant reduction of systolic and diastolic BP [33]. Task shifting is high on the United Nations Millennium Development Goals' policy agenda [71].
Nurse-led risk reduction	<ul style="list-style-type: none"> WHO is interested in the utilization of scalable task-shifting programs targeted at CVD risk reduction in LMIC [73]. Nurse-run care systems in SSA based on protocol/education [32], are feasible with improved glycemic control [74–76]. Local health system-wide nurse-led program used to follow patients with DM and HTN in South Africa, improved overall early detection and referral of high risk patients [77].
Group clinics	<ul style="list-style-type: none"> Comprise elements of a support group and subspecialty clinic [78–81]. Associated with improved patient knowledge [82], increased patient satisfaction [78,79,83], lower HbA_{1c} levels [78,82].
Mobile phone technology	<ul style="list-style-type: none"> Associated with reduction in ED visits [84], fewer inpatient admissions [83], reduced utilization [78], and reduced costs [83]. Survey conducted in Nigeria showed that two-thirds of DM patients had active mobile phone lines [37]. DM patients in an urban, public hospital receiving 2 daily text messages for 6 months showed trends toward improvement in HbA_{1c}, quality of life, medication adherence, and decreased ED utilization [85]. Phone text message program targeting DM resulted in positive perceptions of the program and positive behavior (diet and physical activity) change [86].
Home tele-monitoring	<ul style="list-style-type: none"> Multimodal intervention comprising cell phone delivery of lifestyle information, goal setting, health literacy information and navigator coaching had the best results over a 12 month trial, reducing HbA_{1c} by -1.9% vs. -0.7% in the standard care group [87]. Can produce accurate and reliable data, empowers patients, influences their attitudes and behaviors, and potentially improves their medical conditions [39,88].
Multimodal risk modification	<ul style="list-style-type: none"> Academic partnership in Kenya led to task-shifting strategy plus technology: Android tablet-based electronic decision support and integrated record-keeping tool to record patient data and assist with clinical decision-making; approach highly usable [89]. Home tele-monitoring is more effective when “augmented” with nurse-management [90]. Targeting multiple CVD risk factors with drugs plus lifestyle counseling may have an additive impact on CVD reduction [91,92]. Community Outreach and Cardiovascular Health (COACH) Trial in the United States showed that risk factor control implemented by a nurse and community health worker using drug titration algorithms and tailored behavioral counseling vs. usual care resulted in greater 12-month improvement in control of glycemia, BP and cholesterol [93]. While obtaining tighter risk factor control at 1 year in COACH resulted in more drug usage and laboratory tests, the mean incremental total cost per patient was only \$627 [94]. When compared to the average direct cost of a recurrent stroke of approximately \$12,000 in the first year [95], the intervention in COACH would probably result in a significant cost savings to the healthcare system.

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