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Review Article

The Case for Strategic Integration of Diabetes Education in Southern Nigeria, Informed by Insights from a Pilot Study

Lolia M Abibo[1*], Kariba Akhidue[2], Amjad Rabia[3], Sunday Chinenye[4], Chioma Unachukwu[5] and Theodore MacKinney[6]

[1]Departments of Internal Medicine and Pediatrics, Medical College of Wisconsin, USA, Tel: 1-414-955-0350

[2]Department of Endocrine and Metabolism, University of Port-Harcourt Teaching Hospital, Nigeria, Tel: +234 803 338 1448

[3]Department of Internal Medicine, Medical College of Wisconsin, USA, Tel No: (414) 955-8296

[4]Department of Endocrine and Metabolism, University of Port-Harcourt Teaching Hospital, Nigeria, Tel: +234 803 340 7316

[5]Department of Endocrine and Metabolism, University of Port-Harcourt Teaching Hospital, Nigeria, Tel: +2348023145107

[6]Department of Internal Medicine, Medical College of Wisconsin, USA, Tel: 1-414-955-0350

SUMMARY

The surge in diabetes cases affecting 3.6 million individuals in Nigeria demands a proactive response. Despite the high prevalence, the current Nigerian model is reactive leading to delayed treatment, heightened complications, elevated healthcare expenses, and diminished quality of life. This document proposes the solution of integrating culturally adapted Diabetes Self-Management Education and Support (DSMES) programs into Nigerian health policy as standard practice. Additionally, it recommends establishing diabetes educator training programs and a nationwide accreditation process. The development of such a program, in collaboration with the University of Port Harcourt Teaching Hospital, is outlined, highlighting both successes and failures during its initial implementation. These insights emphasize the importance of enhanced collaboration, sustainable funding, and a comprehensive monitoring and evaluation framework. These observations are currently driving ongoing program development.

***Corresponding author**

Lolia M Abibo, Departments of Internal Medicine and Pediatrics, Medical College of Wisconsin, USA, Tel: 1-414-955-0350

Introduction

Diabetes is a chronic metabolic disorder characterized by hyperglycemia which results in several acute and chronic negative health consequences. While it is a leading cause of mortality and reduced life expectancy in the world, it has been well established that the chronic complications of diabetes can be prevented or delayed through proper disease management which requires a thorough understanding of diabetes, its risk factors, and appropriate self-management behaviors. The global burden of diabetes has been steadily increasing, posing a substantial public health challenge. According to the 10th edition of the International Diabetes Federation Diabetes Atlas published in 2021, there were about 537 million people living with diabetes in 2021, with over 3.6 million diagnosed with diabetes in Nigeria, and an additional 1.9 million undiagnosed individuals with diabetes in Nigeria. These numbers are projected to rise to 700 million and over 7.9 million in the world and Nigeria respectively by 2045. These numbers place a significant strain on the healthcare system with a total disease related health expenditure of over 1.8 billion USD [1].

The escalating prevalence of diabetes in Nigeria presents a pressing need for an inclusive policy response. Currently, many patients present to secondary and tertiary health centers with advanced disease, high morbidity, and mortality [1]. As a result, there is a resultant rise in the prevalence of end-stage renal disease, erectile dysfunction, strokes, and lower extremity amputations [2-4]. This leads to negative economic impact with high health-care costs and health-care utilization in Nigeria [5-7]. There is some suggestion that the burden is highest in the south-south region of the country, and in urban areas [8, 9]. Studies have shown a rural prevalence of diabetes from between 0-2% and an urban prevalence of diabetes of up to 5-10% [10-12]. In Port-Harcourt, Rivers State, one study showed higher rates (23.4%) in individuals of a higher socioeconomic demographic when compared to individuals of a lower socioeconomic demographic (16%) [13]. This impact is also felt at prominent hospitals like the University of Port-Harcourt Teaching Hospital (UPTH) where type 2 diabetes accounts for about 15% of all hospital admissions[14]. There is a high case fatality rate with most deaths attributable to diabetic ketoacidosis (DKA) and diabetic foot syndrome at 25% and 23% respectively [14].

The healthcare system in Nigeria presents some structural challenges, particularly evident in primary care centers overseen by nurses lacking medical officers or physicians. Consequently, diabetes is seldom addressed at this level, and when it is,

management is often subpar due to inadequate training of healthcare professionals in these settings [14]. The next level of care is at secondary institutions, namely general hospitals, specialist hospitals, and private hospitals and simple diabetes cases are managed here. These secondary institutions have nurses, dietitians, general internists and sometimes consultant physicians such as diabetologists and endocrinologists. Most complicated cases of diabetes are seen at tertiary centers; however, these centers are also limited in their capabilities in terms of cardiac interventions, transplant services, and vascular interventions. In general diabetes educators are scarce, and diabetes education is primarily assumed by physicians. Additionally, due to a low doctor-to-patient ratio (3.95 doctors per 10,000), as well as logistic and financial obstacles interfering with care, there is a limited amount of time being spent with each patient during a medical consultation, which results in an insufficient amount of time to cover complete medical review, implement national standards of care, as well as properly educate patients on self-management, while mitigating the resulting psycho-emotional distress on patients and their families [15].

There is a high rate of poverty in Nigeria. In 2019 the national bureau of statistics reported that 40% of individuals had real per capita expenditures below 137,430 naira per year (the equivalent of $381.75 USD in 2019), and when compared to a total disease related health expenditure of over 1.8 billion USD, diabetes care places a great financial burden on the community [1, 16]. Financial challenges arise from the need for medications, regular blood glucose monitoring, healthcare visits and facility utilization, and other preventive measures. 4 in 5 patients in Nigeria finance their medical bills from personal or family income, and insurance coverage is less than 10 percent[17, 18] . As a result, due to cost effectiveness, there is still a high reliance on traditional and alternative medicine. Today many patients do not know about critical disease monitoring tests such as hemoglobin A1c and in some centers, only 20% of patients know what medications they are using [19]. Living with diabetes requires lifestyle modifications which can be challenging to initiate and sustain. This has led to poor self-management indices including subpar medication adherence (60.2%), and low levels of self-blood glucose monitoring (25.4%) in Nigeria [20].

Considering the diabetes crisis in Nigeria, compounded by systemic healthcare barriers and widespread poverty, it is vital to prioritize interventions that are accessible to individuals across diverse sociodemographic backgrounds, including marginalized and disadvantaged groups such as those living in poverty. This inclusivity is fundamental for a comprehensive response to the disease. This paper advocates for Diabetes Self-Management Education and Support (DSMES) as a crucial part of such intervention.

Diabetes Self-Management Education, An Inclusive Intervention
Studies have suggested that DSMES programs in developing countries have positive effects on HbA1c, glycemic control, and behavioral outcomes on short-term follow up [21-23]. It has been shown to reduce the onset of diabetes related complications, improve quality of life, and reduce health-care related costs, while also decreasing disease related mortality and morbidity [24-28]. DSMES programs hold substantial promise in Nigeria, given the prevailing healthcare system structure. Specifically, the fact that most specialized diabetes care is performed at tertiary medical centers, rather than primary or secondary medical centers. Health care professionals such as dietitians, nutritionists, and diabetes

educators are both scarce and expensive. This scarcity underscores the potential of DSMES programs to empower patients with essential self-care knowledge, a critical intervention that could significantly enhance disease parameters, elevate overall quality of life, and promote equity, particularly among those with limited resources.

In low- and middle-income countries, a large proportion of people with diabetes do not have the knowledge and skills to manage their disease [29, 30]. In Nigeria specifically, there has been a chronic systematic failure to manage blood glucose in patients [31]. However, there is evidence to suggest that DSMES will be well received within the Nigerian context. Health care professionals in Nigeria are overwhelmingly supportive of such initiatives; however, the majority assert that there is a shortage of qualified health personnel, educational facilities, and economic resources to effectively implement these programs [32]. There have been a few studies in Nigeria that have successfully implemented DSMES programs, however, these are still not widespread or accessible to many patients [33, 34].

Considering the rising prevalence and incidence of diabetes in Nigeria, along with the structural and financial healthcare challenges, our proposed intervention aims to support the existing healthcare system. Therefore, we are advocating for culturally adapted DSMES programs as an integral component of the national strategy. By tailoring such programs to Nigerian culture and context, and with robust support from national resources and stakeholders, their integration into diabetes care can significantly contribute to addressing the current challenges posed by diabetes.

Strategic Development of a Culturally Tailored DSMES Program
This section details the development of one of Nigeria's formal DSMES programs, forged through collaboration with the endocrinology unit of the Internal Medicine department at the University of Port Harcourt Teaching Hospital (UPTH). UPTH, a prominent tertiary healthcare institution established in 1980, is renowned for its community engagement, medical education, and research, notably serving a significant volume of diabetes patients weekly. With diabetes education as a primary goal of the unit/department, the program aims to raise awareness, promote preventive strategies, and enhance self-management skills among type two diabetes patients. Its core objectives include providing accurate and culturally sensitive information on diabetes, promoting healthy lifestyle behaviors, and teaching essential self-management skills. By improving access to diabetes management resources, the initiative seeks to enhance health outcomes, empower patients in effective disease management, and ultimately reduce healthcare utilization and costs, while fostering societal and economic productivity and psychosocial stability.

The success of the project was attributed to its collaboration with a prominent institution within the community, fostering a sense of ownership and sustainability within the Rivers State community. Collaboration played a crucial role in customizing the program to suit the southern Nigerian population. The project entailed the creation of a Diabetes Self-Management Education and Support Program integrating structured educational modules, behavioral change techniques, self-management strategies, peer support, and health coaching approaches. After reviewing best practice guidelines published by national medical bodies in Nigeria, as well as the scientific literature, successful diabetes education curriculums such as those provided by the American Diabetes Association and the International Diabetes Federation were

identified. A workgroup comprising local healthcare professionals and families living with diabetes in Nigeria critically evaluated and adjusted the curriculum to fit the cultural and social context of the country. Cultural adaptations involved developing educational materials using culturally and socially appropriate language, visuals, infographics, and examples. To ensure health equity and inclusion, the program materials were designed at the primary 5 (grade 5) literacy level. Although the materials were written in English, the national language of Nigeria, they were presented in clear and simple language.

Their curriculum covered a range of topics including diabetes overview, blood glucose monitoring, medication management, nutrition and meal planning, physical activity, acute and long-term complications of diabetes and risk reduction, and problem solving and coping skills. Emphasis was placed on addressing topics relevant to local cultural practices, such as traditional diets and common misconceptions about diabetes in Nigeria. Practical tips, real-life examples, and case studies specific to Rivers State were included. Recognizing the coexistence of diabetes with other chronic conditions like obesity, hypertension, and cardiovascular disease, brief discussions on these comorbidities were incorporated. The curriculum was designed for both group and individual sessions. Group sessions were preferred to leverage peer support, shared learning, skill modeling, motivation, psychoeducational support, behavior reinforcement, and community building. Interactive elements such as portion size estimation, problem-solving scenarios, and breakout group discussions were integrated into group sessions. Individual sessions were implemented for a more comprehensive assessment of participants' knowledge, skills, attitudes, and emotional support needs. This format allowed for tailored support, personalized goal setting, and in-depth behavior change assessment, particularly beneficial for those with low literacy levels.

Summary of Pilot Trial

In May 2019, a pilot implementation was initiated to assess the feasibility and reception of the intervention amid budget constraints. The aim was to refine the program, estimate future financial needs, and plan for more robust evaluations. Despite completing the educational project, funding limitations hindered concurrent program evaluation. The DSMES program comprised three group sessions and one individualized session per patient. Open to all type 2 diabetes patients at the UPTH endocrinology department, 35 patients enrolled, but only 17 completed the program due to various personal and socio-economic barriers, including illness, financial constraints, mobility issues, and natural disasters like flooding. Participants cited inadequate transportation stipends, chronic medical complications, and difficulties accessing sessions on the hospital's third floor as reasons for dropout.

Despite financial constraints, a retrospective evaluation was conducted in 2022 to assess the impact of the 2019 pilot on fasting blood glucose and HbA1c levels among the previous 17 participants. Approval was obtained from the Institutional Review Board at the Medical College of Wisconsin (MCW) and at the UPTH in Nigeria to ensure compliance with human subject protection protocols. However, obtaining valuable program evaluation data proved challenging due to several factors. The small sample size and a high attrition rate (>50%) caused by physical and economic challenges in the initial cohort were significant obstacles. This experience underscored the importance of financial support, such as subsidizing transportation costs, to mitigate attrition rates. Additionally, the retrospective study faced difficulties in data collection as medical records were stored in paper files, resulting in instances of missing charts and test results. Consequently, incomplete data collection points and statistically insignificant results were obtained. See Table 1, Table 2, and Table 3 for more details.

Table 1: Data Collection Form

SUBJECT	Pre A1c	Avg Glc mmol/L (mg/dl)	Post A1c	Avg Glc mmol/L (mg/dl)	Pre FGlc mmol/L	Post FGlc mmol/L	Pre FGlc mg/dl	Post FGlc mg/dl
1	5.3	5.8 (105)	md	md	7.8	5.2	140.0	93.6
2	6.9	8.3 (151)	6.5	7.8 (140)	8.1	7.1	145.8	127.8
3	8.5	10.9 (197)	md	md	9.9	9.3	178.2	167.4
4	11	14.9 (269)	md	md	16.2	15.5	291.6	279
5	8.4	10.8 (194)	md	md	8.0	6.9	144	124.2
6	5.7	6.5 (117)	md	md	5.9	6.5	106.2	117
7	md	md	md	md	9.4	md	169.2	md
8	md	md	md	md	12.2	7.0	219.6	126
9	md	md	6	7 (126)	5.9	8.0	106.2	144
10	md	md	md	md	10.1	7.6	181.8	136.8
11	1	-1(-)	md	md	5.0	md	90	md
12	md	md	md	md	md	md	md	md
13	md	md	md	md	md	md	md	md
14	md	md	md	md	md	md	md	md
15	md	md	md	md	md	md	md	md
16	md	md	md	md	md	md	md	md
17	md	md	md	md	md	md	md	md

Key:
Pre A1c: Pre pilot program Hemoglobin A1c
Post A1c: Post Pilot program Hemoglobin A1c

Pre FGlc: Pre Pilot study fasting glucose
Post FGlc: Post Pilot Study fasting glucose
Md: missing data
Note: values in mg/dl were rounded to the nearest whole number

Table 2: Sample Statistics

	Pre-Fasting Glucose (mmol/l)	**Post-Fasting Glucose (mmol/l)**	**Pre-Fasting Glucose (mg/dl)**	**Post-Fasting Glucose (mg/gl))**
Fasting Glucose (Mean ± SD)	9.3±3.27	8.1±2.98	161.1±57.70	146.2±53.7

Table 3: Comparison Between Pre-Fasting and Post-Fasting Glucose

	N	**t-value**	**p-value**
Pre /Post Fasting Glucose (mmol/l)	9	1.77	0.12

Statistical Analysis: First, mean and standard deviation were calculated for pre and post fasting glucose levels. Next, the paired sample t-test was performed to investigate if the mean difference in pre-fasting and post-fasting glucose was zero. The alpha level was set to <0.2. All the analysis was performed in SAS (9.4) software.

While the results lack statistical significance, here are noteworthy observations. Only 7 subjects had pre-program A1c data to compare. Out of the 7 subjects, only 6 had valid pre A1c values to compare. Subject 11 has a documented pre A1c of 1. Of note this is physiologically impossible as it would yield a negative average blood glucose result (-1) and must have been documentation error. There are expected differences between average blood glucose calculations based on A1c values and associated fasting blood glucose values. Because fasting glucose values depend on the prior day's self-management habits (diet, exercise, and medication adherence), overall change in disease management would be better evaluated using A1c. However only two individuals out of the 11 charts identified had post A1c results. This may be due to the higher cost of A1c to fasting blood glucose tests. Both recorded post pilot program A1c's were at treatment goal (<7). Overall, no useful statistical information was retrieved from the study above. This attempt has led to the acquisition of more funding and a more extensive evaluation framework currently used for ongoing evaluations.

Insights and Future Directions

The introduction of a self-management education and support program into a health care system requires financial resources, time, and manpower. To make a case for sustainability, its effectiveness within a culturally distinct society needs to be evaluated. Drawing insights from lessons learned from the described pilot trial, immediate feedback from the 17 program completers revealed a strong appreciation for its value. The majority expressed a keen interest in future refresher courses, underscoring the importance of sustaining and extending the program into rural communities. Participants emphasized the significance of incorporating props and nutrition samples to illustrate concepts like portion control, balanced meals, and carbohydrate consistency during program delivery. Additionally, many highlighted the essential need for financial assistance in medication procurement, transportation, and acquiring glucometers to enhance diabetes management. These reports has been pivotal in shaping and refining the curriculum's ongoing development.

Moving forward, prospective strategies are being integrated into the ongoing evaluation tools to address challenges related to the availability and integrity of medical records. In 2022, we initiated a dissemination effort for our 2019 curriculum, providing training to 10 healthcare professionals specializing in diabetes education, including 6 nurses and 4 dietitians. Following this, these professionals conducted DSMES training for a total of 120 patients. Presently, to assess our goals and objectives, we are collecting both quantitative data, encompassing BMI and HbA1c, and qualitative data, such as knowledge, attitudes, and behavior. This includes 24-hour dietary recall, medication adherence, exercise diary, and course evaluation. Evaluation indicators and metrics involve enhancements in BMI and HbA1c, the percentage increase in diabetes awareness within our target population, shifts in participants' knowledge, attitudes, and behaviors regarding diabetes, the percentage of participants adopting recommended self-management behaviors (e.g., 150 minutes of exercise per week and self-glucose monitoring), and participant ratings on the quality and relevance of the program. The ongoing evaluation findings will undergo thorough analysis and subsequently be published in an upcoming paper.

Future evaluations will expand their scope to encompass a broader range of quantitative indicators, such as blood pressure and lipid profile, alongside qualitative measures like psychosocial impact, quality of life, motivation, and empowerment. Comprehensive monitoring will also include assessments of acute and chronic complications, healthcare utilization, and costs, ensuring a thorough evaluation of program effectiveness.

Additionally, the next steps involve engaging more stakeholders, including local health authorities, community leaders, policymakers, and local organizations. This engagement will facilitate integration into existing healthcare systems, such as primary care clinics, hospitals, and community health centers. Collaborative partnerships will help build support, secure resources, and ensure the program's sustainability beyond its initial phase.

Furthermore, training and capacity building will promote program incorporation into the local healthcare system, focusing on both conventional and non-conventional healthcare workers. The training of various professionals, such as registered nurses, dietitians, pharmacists, community health workers, traditional healers, religious leaders, and chemists as diabetes educators, will enable dissemination of the program to community clinics, health centers, private clinics, and rural settings. These individuals, with established trust within their communities, can effectively convey health information and supplement physician care, thereby

enhancing diabetes control and strengthening the healthcare system and economy.

Future directions will explore the use of digital technology to enhance self-management education. Despite challenges in Nigeria, platforms like WhatsApp, Facebook, Instagram, and Twitter are gaining popularity in both urban and rural areas. Leveraging these platforms can improve access to health information, communication with healthcare professionals, and support for remote health workers. Other areas to be explored include e-learning for patients and healthcare workers, mobile health applications for remote monitoring of chronic diseases, and telehealth to increase access to medical experts. Additionally, traditional media channels such as radio, television, and print will be explored for information dissemination purposes.

Conclusion
The introduction and evaluation of Diabetes Self-Management Education and Support (DSMES) initiatives in Southern Nigeria signify a significant stride in tackling the rising diabetes burden. These programs empower individuals with essential self-care knowledge, aiding in the prevention and early management of diabetes complications. This proactive approach contrasts with reactive methods, addressing key healthcare obstacles. We illustrate an instance showcasing the multifaceted approach used to create and implement a DSMES program. Present endeavors prioritize widespread dissemination, sustainability, and rigorous program evaluation. Despite challenges highlighted in the example, it underscores the importance of proper resource allocation and stakeholder engagement in program development, execution, and evaluation.

In conclusion, the following policy recommendations are presented
1. **Integration of Culturally Adapted DSMES Programs into Standard of Care:** It is recommended that these programs are acknowledged as vital elements of diabetes care and integrated into standard treatment protocols across all healthcare delivery levels. This integration ensures that individuals with diabetes receive culturally relevant education and support for effective condition management.

2. **Diabetes Educator Capacity Building:** It is recommended to allocate resources for capacity building of healthcare professionals as diabetes educators, including the establishment of a nationwide accreditation process. This process aims to standardize training across various healthcare disciplines, such as nurses, dietitians, pharmacists, community health workers, traditional healers, religious leaders, and chemists. Investing in a skilled workforce will expand access to diabetes education and support services, ultimately enhancing the quality of care for individuals with diabetes.

3. **Enhanced Collaboration and Sustainable Funding:** Increased collaboration among government agencies, healthcare institutions, community organizations, and other stakeholders is recommended to facilitate the integration of DSMES services into existing healthcare systems. This collaboration should aim to secure sustainable governmental funding and resource allocation for DSMES programs, ensuring their long-term viability and impact on diabetes care.

4. **Utilization of Digital Health Technologies:** For continued accessibility and to enhance delivery, in accordance with privacy laws, utilize social media, mobile health applications, telehealth services, and other digital tools to disseminate health information, facilitate communication between patients and healthcare providers, and support remote monitoring and management of diabetes. Leveraging these technologies can address access barriers and enhance the effectiveness of Diabetes Self-Management Education and Support (DSMES) programs, benefiting individuals in urban and rural areas alike.

5. **Comprehensive Monitoring and Evaluation Framework:** To assess the effectiveness and impact of DSMES programs, a comprehensive monitoring and evaluation framework is necessary. This framework should incorporate both quantitative and qualitative indicators, including measures of glycemic control, changes in lifestyle behaviors, healthcare utilization, and patient satisfaction. Systematically evaluating program outcomes allows for the identification of areas for improvement, optimization of resource allocation, and demonstration of the value of diabetes education and support initiatives.

Conflict of Interest Statement
The authors declare that they have no conflicts of interest.

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