Diabetes Updates

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Diabetes care in delta state of Nigeria: An expository review

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Abstract

Background: Diabetes is one of the leading causes of morbidity and mortality with associated enormous burden and cost of care. To address this problem in Delta State, Nigeria, the International Diabetes Federation (IDF) is funding a 'peer-education intervention' project under the Bringing Research in Diabetes to Global Environments and Systems (BRIDGES2) program.

Objective: To provide clarification on the current state of diabetes care in the IDF BRIDGES2 project site.

Methods: Semi-systematic review design was used to assess critical literature on African Journals Online, google search, PubMed and Science Direct as well as information available from the Delta State. Relevant search terms included diabetes care in Nigeria, diabetes care in Delta State, diabetes care in the Niger-Delta region, and diabetes care in Southern Nigeria.

Findings: There is evidence of poor awareness as well as gap in 'knowledge, attitude and practice' of the disease in communities in Delta State. In particular, there is poor organization of diabetes care because of the dearth of well-trained diabetes specialists and necessary network. Lack of team work, non-availability of screening programs, poor government' behavioural change wheel and poor referral service system are identified themes of interest.

Conclusion: There is the need for a multi-prong approach to diabetes care to improve community awareness and health literacy programs. The 'peer-education intervention' project IDF BRIDGES2 will be very beneficial in this regard. Further, the task to reduce diabetes risk and improve self-management will benefit from establishment of more diabetes clinics, networks and registers in all health facilities.

Introduction

Prevalence of Diabetes and Multidisciplinary approach to care in Nigeria: Diabetes mellitus (DM) is a metabolic disorder characterized by either partial or absolute deficiency of insulin resulting in high glucose levels in the blood or hyperglycaemia. Diabetes is one of the leading causes of morbidity and mortality among adults aged 35 years and above in the world and especially in lower and middle income countries in Asia and Africa including Nigeria [1]. In Africa, Nigeria is the fourth country with the highest burden of diabetes with an estimated figure of over 1.7 million people living with the disease [2], but various reports indicate different prevalence rates (Figure 1) [2-5].

By World Health Organization (WHO) statistics, Nigeria has the highest number of diabetes in Sub-Saharan Africa [6]. Besides the 5.4% reported from Ndokwa-West Local Government Area [4], and consolidated 'Southern Nigeria' data indicating overall prevalence of 3.1% diabetes [7]; another study carried out among adult population in Agbor metropolis showed a prevalence of 59% among the participants in Delta State [8]. The implication is that prevalence rates as indicated by the Diabetes Association of Nigeria [3], may be erroneously over-estimated in the urban areas of Nigeria whilst being under-estimated in rural populations (Figure 1).

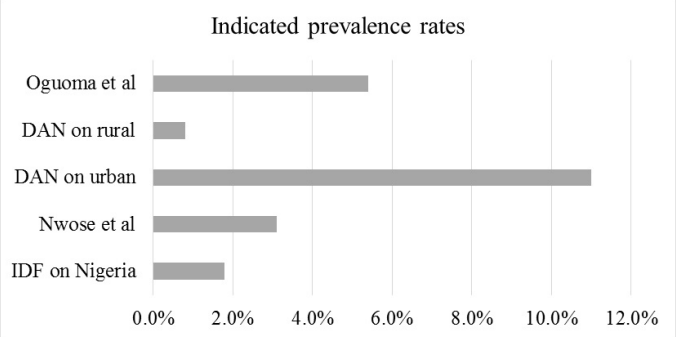

Figure 1. Prevalence rates of diabetes mellitus in Nigeria as previously reported [2-5]

Materials and methods

Google search engine was used to access Google scholar, PubMed and Science Direct related materials on Diabetes in Nigeria and Delta State in particular. In all 85 articles were accessed. Search themes were developed from the study objectives to serve as guides to extract relevant information on situation of diabetes in Nigeria and Delta

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State. In addition, a validated document review guide was used to collect information from State documents on health care programmes and facilities. Information searched for were diabetes care in Nigeria, diabetes care in Delta State, diabetes care in the Niger-Delta region, and diabetes care in Southern Nigeria. The information collected was subjected to thematic analysis based on the objectives of the study. The findings were presented as a narrative in thematic prose with figures and tables.

The narrative – overview

It is common knowledge that if DM is not properly managed, the condition can lead to acute or chronic complications such as nephropathy, neuropathy and retinopathy [9]. Other common complications include; cardiovascular and renal complications as well as diabetes foot ulcer, impotence [10,11]. Indeed, DM brings a lot of burden on the patients and their family including the health system. For instance, in the International Diabetes Federation (IDF) African Sub-region, an estimated 3.4 billion was spent on healthcare for people with diabetes in 2017; though this amount is less than 1% of the global expenditure and the lowest amount of all seven IDF sub-regions [12].

Persons with DM require continuing medical care and self-management health promotion education to prevent complications. Therefore, due to the burden of the disease among the adult population and the complexity and multi-faceted nature of management of the disease; experts have suggested the cooperation across health care specialties in diabetes care [13-15]. In addition, evidence suggests that using a care team-based approach to diabetes management by incorporating specialists across various disciplines is a cost-effective way to provide high-quality, patient-centered diabetes care [16]. However, in Nigeria hindrances to implementing multi-disciplinary approach to diabetes care include hierarchal structures, poor financing of the health sector, lack of synergy among the health care professionals, lack of well-trained dieticians and other relevant professional groups, domination of the health system by clinicians and lack of strong leadership in the health sector [17,18].

Presence/absence of necessary service factors

There is conceptual model for relationships between system-level factors and outcomes as well as patient-system interactions with processes of diabetes care [19]. In line with this, there are standards of care, which is being regularly reviewed [20-23]. Hence, this narrative review looks at five necessary service quality factors – endocrinology specialists, government funding, networks/teams, referral systems and screening programs.

Endocrinologist specialists: An endocrinologist is a physician who has been specially trained to treat diabetes patients. In Nigeria and other low-mid income communities/countries (LMIC), the availability of the endocrinologists in caring for people with diabetes has become critical in view of the combination of escalating disease prevalence and the shrinking pool of endocrinologists [24]. In Delta State, for instance, caring for diabetes patients have been constrained by insufficient number of diabetologists and endocrinologists. In particular, there are no endocrinologist in any secondary health facility. The implication is a state of lack of proper specialized treatment for diabetes. The long term effects such as increased burden and complications of the disease on the health system and families are yet to be assessed.

Screening programs: Blood and/or urine sugar screening for Diabetes is a sure way of detecting incidence and prevalence of the disease. This is important in Nigeria as the rate of undiagnosed diabetes cases has been reported to be a concern in Delta state [7]. In addition, the proportion of cases presenting to health facilities with typical diabetes symptoms of polyuria, polydipsia, polyphagia and weight loss is small when compared with the high prevalence of DM cases in the country [25]. This is attributed to lack of adequate screening programs for the disease, which is especially for pre-diabetes which accounts for much of the cases of high prevalence of asymptomatic and undiagnosed DM [25-27]. Furthermore, it is attributed that resource depletion especially at the primary health care centres and poor government funding have limited access to diabetes care including early detection and diagnosis of the disease. The result of these is a large proportion of population who has not been diagnosed and has no access to care [25,28]. This is of particular relevance in Delta State considering the reported 70% of the participants in the rural community survey who are yet to have health check or screening for DM and CVD risk [5].

Funding and governments support: Poor funding of the health sector has been one of the bane for high mortality and morbidity due to communicable and non-communicable diseases recorded among Nigerians. A review study on health financing system in Nigeria showed high out-of-pocket expenses for health care across the country, a very low budget for health at all levels of government, and poor health insurance organization [29]. A brief critical review of the budgetary allocations in terms of percentage of Nigerian government expenditure on health and dollar equivalent (Figure 2) [29,30]. These allocations are low when compared with allocation to the ministries of defense, education, interior affairs and power (Figure 3). This poor funding of the health sector has consistently increased out-of-pocket expenditure among the citizens [29]. Furthermore, there has been lack of political will and commitment to funding of chronic non-communicable diseases by all levels of government in Nigeria [10]. This lack of government support has hindered the implementation of a well-coordinated network of diabetes in the country and has also drained most diabetes patients financially due to the exorbitant cost of managing the disease.

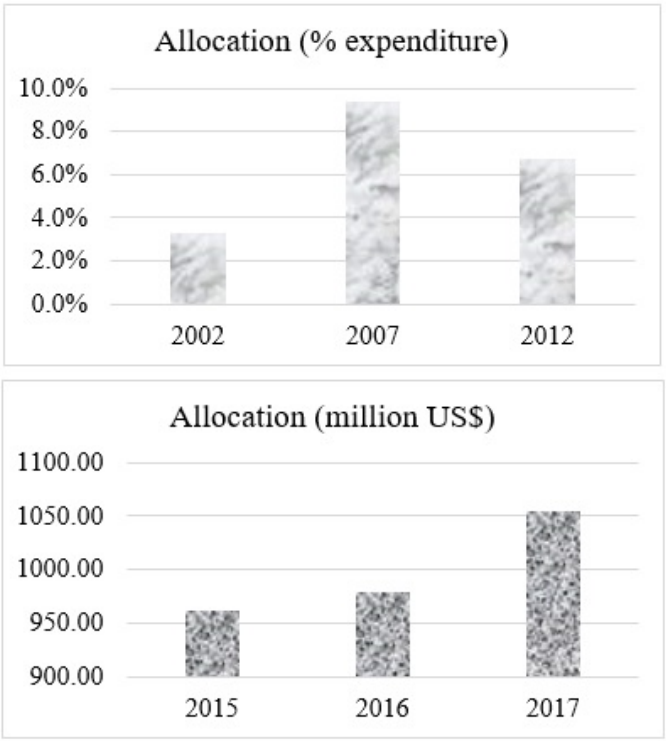

Figure 2. Budgetary allocations to health in Nigeria [29,30]

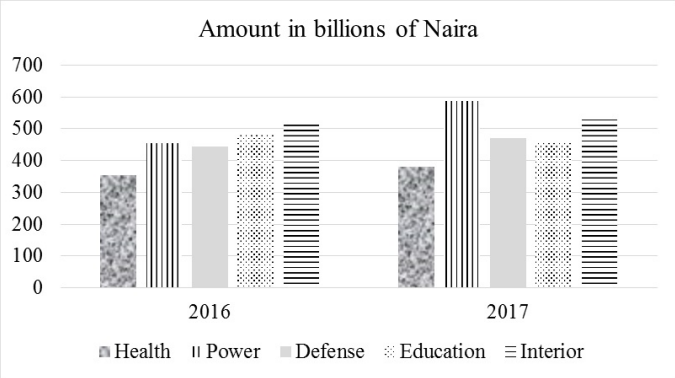

Figure 3. Comparative budget allocations to different ministries [30]

Referral system: The Nigerian health system is aggregated into three tiers of health care – i.e. primary, secondary and tertiary healthcare levels. This was designed to ensure synergy in terms of operation among the various levels in caring for patients and also serves as a link for patient follow-up [31,32]. In terms of diabetes care the primary health care is supposed to be the first point of call for patients, but it is ill-equipped. Thus, diagnosis of the disease, proper management and follow-up of patients with diabetes related complications and co-morbidities is hardly performed [33]. Consequently, most diabetes patients show up at the other two levels of care (secondary and tertiary facilities). This leads to an overwhelming of the limited health care professionals in these facilities, especially as the DM patients have to compete for healthcare professionals' attentions alongside other patients with other diseases.

In Delta State with no endocrinologist in secondary health facilities, this makes adequate attention and follow-up needed by diabetes patients difficult to attain. Compounding the problem further is the lack of affordance for referral and feedback system. Due to the fact that the available endocrinologist in stationed at the state headquarter, patients who are unable to afford the cost and logistics of travel do not accept referral. This makes adequate monitoring and follow-up of patients with serious complications difficult [32,34].

Networks and teams: Diabetes is a multifaceted and complex disease that requires collaboration of experts from various disciplines for management and care. Thus interdisciplinary team management has been endorsed as the ideal model for the delivery of care for people with diabetes [35]. Typically, interdisciplinary team members are expected to consist of a certified diabetes educator, behavioural health specialists vis-à-vis psychologists, dieticians, endocrinologist, general practitioner, nurses, pharmacists, case managers, dentists and hygienists, exercise physiologists, ophthalmologists, specialists in maternal and child care and community health workers at the primary health care.

In Nigeria, interdisciplinary diabetes care team is absent in PHC because of lack of diabetologists/endocrinologists and other specialized professionals. Furthermore, limited team care is offered in secondary facilities. More advanced specialized care is found mostly in tertiary facilities that possess the necessary specialists and specialized units for treatment, such as retinal surgery, laser eye treatment, and echocardiography [33]. Thus these have a better chance of implementing interdisciplinary team collaboration for diabetes care than the other two levels of care.

Diabetes care practices

Adopted screening programs: Type-2 diabetes is characterized by a long preclinical phase of prediabetes as well as asymptomatic undiagnosed DM that underscores the need for population based screening in order to promote early diagnosis and treatment [36]. Most screening programs in Nigeria are usually facility based screening where patients present with diabetes related complications. Few diagnosis for diabetes are done at the community because of the few number of community-based screening taking place [7,37,38], some others are diagnosed opportunistically during procedures such as mandatory pre-employment medical checks, or for investigation of other conditions [33,37-40].

Adopted international recommendations: The treatment and management of diabetes in Nigeria cannot be without consideration international recommendations so as to maintain best practices. Studies have shown that most facilities in Nigeria adopt international guidelines in the diagnosis of the disease [40-42]. Although the Diabetes Association of Nigeria launched the second edition of Clinical Practice Guidelines for Diabetes Management in Nigeria in the year 2013 [3], the management of the disease is still challenging. This is probably why three of top priorities on the agenda of Diabetes Association of Nigeria include [3]

» Universal access to care

» Preventive care by healthy lifestyle promotion

» National diabetes programme of care that includes regular surveys

The role of nurses in low-mid income countries: In Nigeria, nurses are professionally well trained, but not necessarily with specialised skills for diabetes care. Instead, all nurses undergo training to provide care for patients at all levels of care [33]. For instance, the scope of practice for nurses may include bedside vis-à-vis point-of-care blood glucose and urine tests, basic nutritional advice, patient education for insulin self-injection, and insulin administration for patients amongst others [33,35].

In the absence accessible endocrinologists at almost all secondary health facilities in Delta State, nurses constitute the largest group of healthcare professionals who have a lengthy contact with the patients; hence play a key role in diabetes care [43]. Nurses are drafted as diabetes educator in most health care facilities, but without the 'specialist' training. Though some may be described as being trained on the job [33], research has shown that this role is not being undertaken appropriately [44]; and some nurses still lack relevant knowledge of diabetes care that is necessary for high quality management of the disease [43,45].

Urgent interventions: There do arise the need for urgent intervention in the management of diabetes and Nigeria or Delta State are no exceptions. However, there is escalating prevalence of the disease among adults in the country [41], which makes it worthy of mention in this narration. With over 90% of diagnosed metabolic syndrome cases being DM and cardiovascular complications, there is an increase in hyperglycaemic emergencies and much of the diabetes-related morbidity and mortality [36,46,47]. For instance, in Nigeria admissions due to diabetes emergencies (including both hyperglycaemic and hypoglycaemia comas) and diabetic foot ulcers are high; while fatalities of cerebrovascular disease and lower limbs are not negligible (Table 1). In the Niger-Delta region, report shows the same trend [25,48]. Also, with gestational diabetes on the rise [12], Delta State is not left out given the relative prevalence of hyperglycaemia in pregnancy [49], which could result in post-partum type-2 DM [50].

In view of the rapid escalation of diabetes epidemic in Nigeria, recommendations have been made for urgent intervention at all levels

Table 1. Diabetes admissions and fatalities [25,47]

Study area	Descriptive	Rate
Nigeria (including Delta State)	Hyperglycaemic emergencies	46%
	Diabetic foot ulcers	30%
	Foot ulcer fatalities	28%
	Cerebrovascular fatalities	25%
Delta State data, specifically	Diabetes admissions	15%
	10years In-patients	10.4%
	Fatality rate	16%

of care in Nigeria. Specifically, intervention have been recommended to be implemented in primary health care since it is closer to the population especially the rural population [41], the government have been urged to be involved in diabetes care and diabetes education and training programs have been suggested to be implemented for health care professionals and diabetes patients [23,25].

Diabetes literacy

Awareness among patients and healthcare professionals: Diabetes mellitus have been described as a silent killer because many of its victims are not aware of having the disease until the manifestations of complications [51]. There is poor awareness of the extent of the problem in the public as many victims are not sufficiently aware of the available interventions for preventing the disease and managing complications [52-54]. For instance, a study carried out in a rural community in Enugu State of Nigeria reported that only approximately 18%, 19% and 19.5% of respondents were knowledgeable of symptoms, risk factors, and complications of the disease, respectively [55].

To affirm this state of lack of knowledge, another cohort study of 174 participants at Jos North-Central Nigeria reported that majority do not have knowledge of diabetes diet or the effect of sweetened fruit juice on blood glucose [56]. Even among health care professionals, poor knowledge of diabetes care has been reported [44,45,57]; and the situation is the same in Nigeria including Delta State, [38,43]. Perhaps, it is pertinent to emphasize the survey of public health staff and students indicated that age vis-à-vis experience is an important factor to enable a successful program [38].

Nurse education program: This is a point of concern or emphasis with regards to 'diabetes educator' specialization, which is mostly undertaken by nurses and nutritionists [58]. It is known that diabetes health education to maintain healthy lifestyle including dietary habit and adherence to treatment guidelines are essential requirements diabetes self-management [25,59]. Diabetes education programs are important to address any negative perceptions, as well as religious and sociocultural beliefs among DM patients. In addition, diabetes education specialization program for the nurse would help to create a sense of obligation to maintain up-to-date awareness of the latest management practices [25].

In a survey of nurses and nutritionists [59], 66% of participants disagreed or were unsure that their establishments were prepared to implement diabetes self-management education (DSME) program. Several barriers were indicated by a large proportion of the participants to buttress their disagreement. However, critical review shows majority of respondents could not affirm adequacy of personnel, resources or socio-cultural-religions practices as barriers (Table 2). The implication is a situation whereby some healthcare professionals are unaware of their incapability to provide a high quality diabetes education [60].

Training workshops for nurses and doctors: The capacity of healthcare professionals to manage diabetes is usually low in Sub-Saharan Africa [61]. There are organizations in the UK and other countries who run courses for diabetes healthcare professionals who are responsible for primary care to improve their knowledge and skill for effective management of people with diabetes [62-64]. Some of these courses are online so healthcare professionals can have access [64]. In Nigeria there is evidence of limited or no 'continuous education' of the healthcare professionals when it comes to dealing with diabetes [65], except for some workshops [33,66]. Furthermore, in Sub-Saharan Africa efforts to improve the knowledge and skills of the healthcare professionals as it concerns diabetes management have focused more on task shifting, which relies on the expertise of 'experienced' physicians to train other healthcare professionals [65-67]. Pilot program have been conducted in Delta State involving focus group discussions and survey (dissertation yet to be published – Public and Community Health department, Novena University Nigeria) indicates that there is

- No specialist Endocrinologist in Delta State health facilities. Thus referrals are made to the Federal Medical Centre based at the metropolitan state capital, Asaba
- No specialist Diabetes Educator in Ndokwa communities
- No register of referrals – i.e. no record of diabetes (i) patients who have been referred or (ii) specialists networks where clients are referred
- Neither the medical officers, nor nurses have gone on diabetes-related conference/workshop in recent years.

Peculiarities of the area

Barriers to diabetes care in the area: The increasing prevalence of diabetes in Nigeria means a myriad of challenges to care in both rural and urban areas. In the rural areas of Delta State, poverty has been identified as major factor patients' ability or willingness to access medical check-up [5]. A story was told of a friend's father despite urinating frequently and developing diabetic foot ulcer still would not seek medical attention due to ignorance of the disease [68]. In addition, religious and sociocultural beliefs, lack of tools and basic infrastructure are responsible for much of the failure in early identification and intervention [59]. The relevance of this to diabetes care in Delta State lies in the known fact that "though diabetes is an ancient and world-wide disease and the protocol of care is universal, socioeconomic and cultural behaviours to the disease, its medications, care, support and diet differ from country to country and these do affect treatment outcomes local staple foods recommended for diabetics in Europe

Table 2. Responses from a diabetes self-management education (DSME) survey [59]

	Affirmative	Non-affirmative
Intensifying DSME amongst DM patients is a good idea	88	12
Current diabetes education for DM patients is adequate	44	56
DSME will be helpful to patients, generally	93	7
DSME will be effective to reduce diabetes complications	91	9
My healthcare facility is prepared for DSME	34	66
Qualified health personnel to deal with DSME are insufficient	25	75
There are insufficient economic resources for DSME	26	74
There are insufficient educational facilities to assist with DSME	30	70
Religious practices may militate against DSME	10	90
Sociocultural practices may militate against DSME	21	79

and North America are also quite different from those in African populations. Similarly sociocultural attitudes and illness behaviour differ from culture to culture, even within Nigeria" [41].

In Delta State; cultural practices of using herbs for treatment of the disease pose a challenge to adherence to treatment and control measures [68,69]. While the health values of herbs are never to be undermined [70], the issue is using herbs and undermining healthcare's prescription [71]. Indeed, the lack of emphasis on non-pharmacological aspects of diabetes treatment by healthcare professionals constitutes a barrier [25,72].

In the same vein, the challenge of limited altruism and the abuse of altruism through tokenism been noticed in many communities in the state has also played a part in the challenge to proper diabetes care. That is, acknowledging the significance of altruism in diabetes care [73,74], the fact that poor and uninsured patients are unable to access service is hereby articulated as an altruistic factor. For instance, access to anti-diabetics drugs at an affordable cost is challenging for these patients living in rural communities leading to underuse of these drugs and avoidable metabolic complications [25,75]. Further, there is the problem of late diagnosis such that up to 56% of patients are diagnosed neuropathic complication [3].

Local data on risk factors: Delta State one of the oil producing states in Nigeria, and not spared from the diabetes epidemic as studies carried out showed a prevalence of the disease in the state (Figure 1). In Ndokwa community of Delta state where this study is anchored, and consolidate data; studies on CVD risk factors and prevention indicates:

» Knowledge, attitude and practice towards prevention [5]:

- >71% of survey participants have yet to screen blood sugar or lipid profile tests
- >50% do not engage in significant physical activity in the context of exercise.
- Only 35% of unhealthy cohort have attended medical check-up for their ailment.

» Prevalence of CVD risk factors among those with prediabetes or diabetes [42]:

- High blood pressure 23.1%.
- Overweight/obese 40.0%.
- Hypercholesterolaemia 25.9%.
- Hypertriglyceridaemia 23.4%.

This was corroborated by the abnormality in a family screened for metabolic syndrome (Figure 4) [76]. Compounding the problem is the poor facilities available for management of non-communicable diseases in the state. According to the Delta State baseline assessment for implementation of Delta State contributory health scheme, the management of non-communicable diseases including diabetes and hypertension was sub-optimal in some of the local governments such as Ndokwa East, Ndokwa West and Ukwuani [77]. In addition, tobacco use as a risk factor for cardiovascular diseases is very prevalent in most rural communities in Nigeria viz- a-viz Delta State [5,78]. Furthermore, Delta State being an oil producing state exposes residents to gas flaring and oil exploration activities [79-81], which have been linked to increase risk of metabolic syndrome risk factors [82-86].

Many risk factors have been documented in Nigeria as fuelling the increasing prevalence of diabetes mellitus. Available data in Delta State shows that prediabetes, hypertension, low HDL, hypertriglyceridemia, hypercholesterolemia and central obesity have been reported as risk factors for diabetes [87]. For instance, the presence of biochemical parameters including variables such as age, physical activity level and waist circumference in rural, sub-urban, urban, male and female in Delta State has been reported (Figure 5). Corroborative reports from neighbouring states do show or affirm these risk factors in the region DM [88,89].

Recommendations

This has led to increased admissions and long term hospital stay among diabetes patients [25,33,47]. In the absence adequate diabetic care services in Delta state, the expected significant impact on the patients could be the obvious increasing prevalence of complications [3,47,90]. Importantly, it is pertinent to note that lower limb amputations have been reported in the State [91,92], but there is no foreseeable program on ground to stem the tide. As a way forward, the following recommendations were made:

1. There is the need for a multi-prong approach to diabetes care to comprise of creating community awareness and health promotion programs to reduce risk factors to diabetes.
2. There should be investment in health care infrastructure and regular in-service training programs for health care professionals to work as a team to improve diabetes care in all health facilities and establishment of more screening centres in Delta State.
3. Furthermore, where any of these health care professionals is lacking others can be trained (task shifting or task sharing) to play their role.
4. The government and other international and local organizations should increase funding of programs to improve diabetes care.
5. The government should consider providing free or subsidized drugs to diabetes patients to ease the economic burden on patients and reduce out-of-pocket spending due to diabetes.

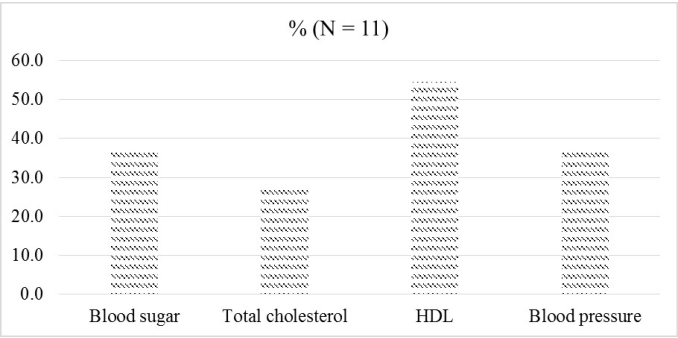

Figure 4. Level of abnormality in a family screened for metabolic syndrome [76]

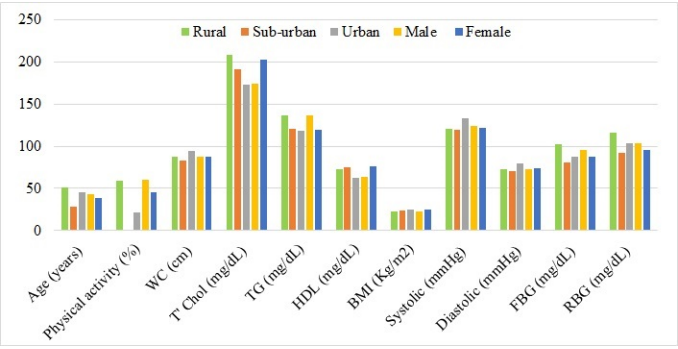

Figure 5. Local data on risk factors [7]

6. The "task shifting" program been implemented in some African countries in Sub-Saharan Africa should be implemented here in Nigeria so as to train and equip health care professionals with knowledge and skills of diabetes management.

7. Finally, the on-going screening activities in Abbi community in Ndokwa West Local Government Area of Delta State should be supported by the Delta State government in order to extend the program to other communities in the state.

Conclusion

This narrative reviewed provides an exposition on the current state of diabetes care in Delta state. The absence/presence of necessary service factors, diabetes care practices, diabetes literacy and peculiarities of the area are presented. The review revealed increasing prevalence of diabetes, low level of awareness of diabetes care, poor infrastructural support and systemic problems including lack of team work between healthcare professionals as well as prevailing disease complications and risk factors. Recommendations are proposed.

References

1. International Diabetes Federation. IDF Diabetes Atlas 3rd Edition. 2006 Available from: https://www.idf.org/e-library/epidemiology-research/diabetes-atlas/22-atlas-3rd-edition.html

2. International Diabetes Federation (2014) Diabetes: Facts and Figures. 6th ed. available from: https://www.idf.org/worlddiabetesday/toolkit/gp/factsfigures

3. Diabetes association of Nigeria (2013) Diabetes ducation and prevention. 2nd ed. [cited 28th May, 2017]; Available from: http://diabetesnigeria.org/diabetes-education-and-prevention/

4. Nwose EU, Oguoma VM, Bwititi PT, Richards RS (2015) Metabolic syndrome and prediabetes in ndokwa community of Nigeria: preliminary study. *N Am J Med Sci* 7: 53-58. [Crossref]

5. Oguoma VM, Nwose EU, Bwititi PT (2014) Cardiovascular disease risk prevention: preliminary survey of baseline knowledge, attitude and practices of a nigerian rural community. *North Am J Med Sci* 6: 466-471. [Crossref]

6. Diabetes Association of Nigeria Admin (2015) Diabetes ducation and prevention. [cited 28th May, 2017]; available from: http://diabetesnigeria.org/diabetes-education-and-prevention/

7. Nwose EU, Richards RS, Bwititi PT, Igumbor EO, Oshionwu EJ, et al (2017) Prediabetes and cardiovascular complications study (PACCS): international collaboration 4 years' summary and future direction. *BMC Res Notes* 10: 730.

8. Oshilonya HU, Ijioma SN, Ibeh IN (2015) Prevalence of type-2 diabetes mellitus amongst suspected subjects in Agbor, Delta State, Nigeria and its relationship with age and gender. *Archives of Applied Science Research* 7: 18-20.

9. Young EE, Okafor CN, Okwara CC (2016) Diabetes mellitus, associated co-morbidities and complications - A review. *Journal of Medicine and Medical Sciences* 7: 47-55.

10. Adogu POU, Chineke HN, Ewuzie MU, Enwere OO, Egenti NB (2015) The prevalence and presentation pattern of piabetes pellitus in patients at Imo state university teaching hospital (IMSUTH) Orlu and Imo state specialist hospital (IMSSH) umuguma owerri (A 10-Year retrospective study: 1st november 2004 to 31st October 2013). *Journal of Diabetes Mellitus* 5: 49-57.

11. Adebisi SA, Oghagbon EK, Akande TM, Olarinoye JK (2009) Glycated haemoglobin and glycaemic control of diabetics in Ilorin. *Niger J Clin Pract* 12: 87-91. [Crossref]

12. International Diabetes Federation (2017) World diabetes day 2017:. 2017 [cited 2nd Nov, 2017]; Available from: https://www.idf.org/our-activities/world-diabetes-day/wdd-2017.html

13. Bright DR, Kroustos KR, Thompson RE, Swanson SC, Terrell SL, et al (2012) Preliminary results from a multidisciplinary university-based disease state management program focused on hypertension, hyperlipidemia, and diabetes. *Journal of Pharmacy Practice* 25: 130-135.

14. Pimazoni-Netto A, Rodbard D, Zanella MT (2011) Rapid improvement of glycemic control in type 2 diabetes using weekly intensive multifactorial interventions: structured glucose monitoring, patient education, and adjustment of therapy-a randomized controlled trial. *Diabetes Technology & Therapeutics* 13: 997-1004. [Crossref]

15. Rasekaba TM, Graco M, Risteski C, Jasper A, Berlowitz DJ, et al. (2012) Impact of a diabetes disease management program on diabetes control and patient quality of life. *Popul Health Manag* 15: 12-19.

16. Piccinino LJ, Devchand R, Gallivan J, Tuncer D, Nicols C, et al. (2017) insights from the national diabetes education program national diabetes survey: Opportunities for diabetes self-management education and support. *Diabetes Spectr* 30: 95-100. [Crossref]

17. McGill M, Blonde L, Chan JCN, Khunti K, Lavalle FJ, et al. (2016) The interdisciplinary team in type 2 diabetes management: Challenges and best practice solutions from real-world scenarios. *J Clin Transl Endocrinol* 7: 21-27. [Crossref]

18. Adeleye JO, Agada NO, Balogun WO, Adetunji OR, Onyegbutulem HO (2006) Diabetes care in Nigeria: time for a paradigm shift. *Afr J Med Med Sci* 35: 155-159. [Crossref]

19. TRIAD Study Group (2010) Health systems, patients factors, and quality of care for diabetes: a synthesis of findings from the TRIAD study. *Diabetes Care* 33: 940-947. [Crossref]

20. American Diabetes Association (2018) Introduction: National standards for diabetes self-management education - 2018. *Diabetes Care* 41: S1-S2.

21. Chamberlain JJ, Rhinehart AS, Shaefer CF Jr, Neuman A (2016) Diagnosis and management of diabetes: Synopsis of the 2016 American Diabetes Association standards of medical care in diabetes. *Ann Intern Med* 164: 542-552. [Crossref]

22. American Diabetes Association (2018) Summary of revisions: national standards for diabetes self-management education - 2018. *Diabetes Care* 41: S4-S6.

23. Mensing C, Boucher J, Cypress M, Weinger K, Mulcahy K, et al. (2007) National standards for diabetes self-management education. *Diabetes Care* 30: S96-S103.

24. Cobin RH (2002) Subspecialist care improves diabetes outcomes. *Diabetes Care* 25: 1654-1656. [Crossref]

25. Oguejiofor O, Odenigbo C, Onwukwe C (2014) Diabetes in Nigeria: impact, challenges, future directions. *Endocrinol Metab Synd* 3: 130.

26. Amoah AG, Owusu SK, Adjei S (2002) Diabetes in ghana: a community based prevalence study in greater accra. *Diabetes Res Clin Pract* 56: 197-205. [Crossref]

27. Aspray TJ, Mugusi F, Rashid S, Whiting D, Edwards R, et al (2000) Rural and urban differences in diabetes prevalence in Tanzania: the role of obesity, physical inactivity and urban living. *Trans R Soc Trop Med Hyg* 94: 637-644.

28. Pastakia SD, Pekny CR, Manyara SM, Fischer L (2017) Diabetes in sub-Saharan Africa - from policy to practice to progress: targeting the existing gaps for future care for diabetes. *Diabetes Metab Syndr Obes* 10: 247-263. [Crossref]

29. Awosusi A, Folaranmi T, Yates R (2015) Nigeria's new government and public financing for universal health coverage. *The Lancet global health* 3: 514-515.

30. Federal Government of Nigeria (2017) 2017 FGN budget proposal to NASS. Nigerian Budget Office [cited; Available from: yourbudgit.com/wp-content/uploads/2016/12/2017-Budget-Proposal-to-NASS.pdf

31. Irvine DH (1991) The advertising of doctors' services. *J Med Ethics* 17: 35-40. [Crossref]

32. Akande TM (2004) Referral system in Nigeria: Study of a tertiary health facility. *Annals of African Medicine* 3: 130-133.

33. Fasanmade OA, Dagogo-Jack S (2015) Diabetes care in Nigeria. *Ann Glob Health* 81: 821-829. [Crossref]

34. Otovwe A, Baba A (2016) Knowledge of referral and feedback system among health workers in billiri local government area of gombe state, Nigeria. *European Journal of Pharmaceutical and Medical Research* 3: 111-155.

35. McCarthy R (2009) Diabetes management: A team approach. Available from: https://pdfs.semanticscholar.org/presentation/8e51/92061a51cd48b640a60f16bb199ebcf6574b.pdf

36. Chinenye S, Young E (2011) State of diabetes care in nigeria: A review. *Nigerian health journal* 11: 101-106.

37. Azodo CC (2009) Current trends in the management of diabetes mellitus: the dentist's perspective. *Benin journal of postgraduate medicine* 11: 113-129.

38. Nwose EU, Digban KA, Anyasodor AE, Bwititi PT, Richards RS, et al (2017) Development of public health program for type 1 diabetes in a university community: preliminary evaluation of behavioural change wheel. *Acta Biomed* 88: 281-288.

39. Kashim RM, Newton P, Ojo O (2018) Diabetic Retinopathy Screening: A systematic review on patients' non-attendance. *Int J Environ Res Public Health* 15. [Crossref]

40. Ekeke N, Ukwaja KN, Chukwu JN, Nwafor CC, Meka AO, et al. (2017) Screening for diabetes mellitus among tuberculosis patients in Southern Nigeria: a multi-centre implementation study under programme settings. *Sci Rep* 7: 44205. [Crossref]

41. Chinenye S (2015) Living with diabetes in Nigeria. The care, cure & prevention. In: inaugural lecture series 126 delivered at the university of port harcourt 2015 [cited 23rd Aug 2018]; Available from: https://www.uniport.edu.ng/files/126InauguralLectureUpdated2.pdf

42. Oguoma VM, Nwose EU, Ulasi I, Akintunde AA, Chukwukelu EE, et al. (2017) Cardiovascular disease risk factors in a Nigerian population with impaired fasting blood glucose level and diabetes mellitus. *BMC public health* 17: 36.

43. Odili VU, Eke I (2010) Knowledge of diabetes mellitus among registered nurses in benin city. *Int J Health Res* 3: 145-151.

44. El-Deirawi KM, Zuraikat N (2001) Registered nurses' actual and perceived knowledge of diabetes mellitus. *J Nurses Staff Dev* 17: 5-11. [Crossref]

45. Nettles AT (2005) Patient education in the Hospital. *Diabetes Spectrum* 18: 44.

46. Chinenye S, Uloko AE, Ogbera AO, Ofoegbu EN, Fasanmade OA, et al. (2012) Profile of Nigerians with diabetes mellitus - Diabcare Nigeria study group (2008): Results of a multicenter study. *Indian J Endocrinol Metab* 16: 558-564. [Crossref]

47. Ogbera AO, Chinenye S, Onyekwere A, Fasanmade O (2007) Prognostic indices of diabetes mortality. *Ethn Dis* 17: 721-725. [Crossref]

48. Unachukwu CN, Uchenna DI, Young EE (2008) Mortality among diabetes in-patients in port harcourt Nigeria. *African Journal of Endocrinology and Metabolism* 7: 1-4.

49. Orru MI, Nwose EU, Bwititi PT, Igumbor EO (2018) World diabetes day 2017 focus: antepartum hyperglycaemia (or gestational prediabetes) is more in women below 40 years. *Int J Reprod Contracept Obstet Gynecol* 7: 355-356.

50. Orru MI, Nwose EU, bwititi PT, Igumbor EO (2018) Screening for gestational diabetes: evaluation of prevalence in age-stratified subgroups at Central hospital Warri Nigeria. *Int J Reprod Contracept Obstet Gynecol* 7: 63-68.

51. Wee HL, Ho HK, Li SC (2002) Public awareness of diabetes mellitus in Singapore. *Singapore Med J* 43: 128-134. [Crossref]

52. Uchenna D, Ambakederemo TE, Jesuorobo DE (2012) Awareness of heart disease prevention among patients attending a specialist clinic in Southern Nigeria. *International Journal of Prevention and Treatment* 1: 40-43.

53. Odili VU, Isiboge PD, Eregie A (2011) Patients' Knowledge of diabetes mellitus in a Nigerian city. *Trop J Pham Res* 10: 637-642.

54. Hamoudi NM, Al Ayoubi ID, Vanama J, Yahaya H, Usman UF (2012) Assessment of knowledge and awareness of diabetic and non-diabetic population towards diabetes mellitus in Kaduna, Nigeria. *Journal of Advanced Scientific Research* 3: 46-50.

55. Ndibuagu EO, Arinze-Onyia SU, Chime OH (2016) Knowledge and attitude on diabetes mellitus among residents of a rural community in Enugu State, Southeast, Nigeria. *Int Res J Medical Sci* 4: 1-7.

56. Jasper US, Ogundunmade BG, Opara MC, Akinrolie O, Pyiki EB, et al. (2014) Determinants of diabetes knowledge in a cohort of Nigerian diabetics. *J Diabetes Metab Disord* 13: 39.

57. Ahmed A, Jabbar A, Zuberi L, Islam M, Shamim K (2012) Diabetes related knowledge among residents and nurses: a multicenter study in Karachi, Pakistan. *BMC Endocr Disord* 12: 18. [Crossref]

58. King O, Nancarrow S, Grace S, Borthwick A (2017) Diabetes educator role boundaries in Australia: a documentary analysis. *J Foot Ankle Res* 10: 28. [Crossref]

59. Nwankwo CU, Ezenwaka CE, Onuoha PC, Agbakoba NR (2015) Implementing diabetes self-management education (DSME) in a Nigerian population: perceptions of practice nurses and dieticians. *Arch Physiol Biochem* 121: 123-127.

60. Hollis M, Glaister K, Lapsley JA (2014) Do practice nurses have the knowledge to provide diabetes self-management education? *Contemporary Nurse* 46: 234-241.

61. Nuche-Berenguer B, Kupfer LE (2018) Readiness of Sub-Saharan Africa healthcare systems for the new pandemic, diabetes: A systematic review. *J Diabetes Res* 2018: 9262395.

62. Yacoub MI, Demeh WM, Barr JL, Darawad MW, Saleh AM, et al. (2015) Outcomes of a diabetes education program for registered nurses caring for individuals with diabetes. *J Contin Educ Nurs* 46: 129-133. [Crossref]

63. Tregonning PB, Simmons D, Fleming C (2001) A community diabetes educator course for the unemployed in South Auckland, New Zealand. *Diabetes Educ* 27: 94-100. [Crossref]

64. Wiecha J, Barrie N (2002) Collaborative online learning: a new approach to distance CME. *Acad Med* 77: 928-929. [Crossref]

65. Alebiosu OC (2009) Original Research: Knowledge of diabetes and hypertension care among health care workers in southwest Nigeria. *Postgraduate Medicine* 121: 173-177.

66. Chinenye S, Young EE (2013) Diabetes conversation map in Nigeria: A new socioeducational tool in diabetes care. *Indian J Endocrinol Metab* 17: 1009-1011. [Crossref]

67. Joshi R, Alim M, Kengne AP, Jan S, Maulik PK, et al. (2014) Task shifting for non-communicable disease management in low and middle income countries--a systematic review. *PLoS One* 9: e103754. [Crossref]

68. Oyewole EO, Otovwe A (2015) Patterns of adherence to management among patients with type 2 diabetes mellitus in South-South Region of Nigeria. *J Soc Health Diabetes* 3: 115-119.

69. Otovwe A, Oyewole EO, Okandeji-Barry RO (2015) Health seeking behaviour among patients with type-2 diabetes mellitus in warri, delta sate, Nigeria. *Journal of Agric Bio and App Sci* 4: 161-171.

70. Nwose EU, Onodu BC, Anyasodor AE, Sedowo MO, Okuzor JN, et al. (2017) Ethnopharmacological values of cassava and its potential for diabetes and dyslipidemia management: Knowledge survey and critical review of report. *J Intercult Ethnopharmacol* 6: 260-266. [Crossref]

71. Ekor M (2013) The growing use of herbal medicines: issues relating to adverse reactions and challenges in monitoring safety. *Frontiers in Pharmacology* 4: 177.

72. Haque M, Emerson SH, Dennison CR , Navsa M, Levitt NS (2005) Barriers to initiating insulin therapy in patients with type 2 diabetes mellitus in public-sector primary health care centres in cape town. *S Afr Med J* 95: 798-802. [Crossref]

73. Miller ST, Marolen K (2012) Physical activity-related experiences, counseling expectations, personal responsibility, and altruism among urban African American women with type 2 diabetes. *The Diabetes Educator* 38: 229-235.

74. Lane JD, McCaskill CC, Williams PG, Parekh PI, Feinglos MN, et al. (2000) Personality correlates of glycemic control in type 2 diabetes. *Diabetes Care* 23: 1321-1325. [Crossref]

75. Gill GV, Mbanya JC, Ramaiya KL, Tesfaye S (2009) A sub-Saharan African perspective of diabetes. *Diabetologia* 52: 8-16. [Crossref]

76. Anyasodor AE, Nwose EU, Richards RS, Bwititi PT, Mudiaga LI, et al. (2017) Prediabetes and cardiovascular complications screening in Nigeria: A family case presentation. *Diabetes Metab Syndr* 11: 273-275. [Crossref]

77. Delta State Contributory Health Commission. Baseline assessment for implementation of delta state contributory health scheme. Delta state government 2016 available from: https://www.dschc.org.ng/Baseline_Assesmment_Report.pdf

78. World Health Organization (2011) Noncommunicable Diseases Country Profiles 2011. Available from: http://www.who.int/nmh/publications/ncd_profiles_report.pdf

79. Ordinioha B, Brisibe S (2013) The human health implications of crude oil spills in the Niger delta, Nigeria: An interpretation of published studies. *Nigerian Medical Journal : Journal of the Nigeria Medical Association* 54: 10-16. [Crossref]

80. Elum ZA, Mopipi K, Henri-Ukoha A (2016) Oil exploitation and its socioeconomic effects on the Niger Delta region of Nigeria. *Environ Sci Pollut Res Int* 23: 12880-12889. [Crossref]

81. Nriagu J, Udofia EA, Ekong I, Ebuk G (2016) Health risks associated with oil pollution in the niger delta, Nigeria. *Int J Environ Res Public Health* 13. [Crossref]

82. Shah AS, Lee KK, McAllister DA, Hunter A, Nair H, et al. (2015) Short term exposure to air pollution and stroke: systematic review and meta-analysis. *BMJ* 350: h1295. [Crossref]

83. Hoek G, Krishnan RM, Beelen R, Peters A, Ostro B, et al. (2013) Long-term air pollution exposure and cardio- respiratory mortality: a review. *Environ Health* 12: 43. [Crossref]

84. Eze IC, Hemkens LG, Bucher HC, Hoffmann B, Schindler C, et al. (2015) Association between ambient air pollution and diabetes mellitus in Europe and North America: systematic review and meta-analysis. *Environ Health Perspect* 123: 381-389. [Crossref]

85. Stieb DM, Chen L, Eshoul M, Judek S (2012) Ambient air pollution, birth weight and preterm birth: a systematic review and meta-analysis. *Environmental Research* 117: 100-111.

86. Ezejimofor MC, Uthman OA, Maduka O, Ezeabasili AC, Onwuchekwa AC, et al. (2016) The burden of hypertension in an oil- and gas-polluted environment: A comparative cross-sectional study. *Am J Hypertens* 29: 925-933. [Crossref]

87. Oguoma VM, Nwose EU, Skinner TC, Digban KA (2015) Prevalence of cardiovascular disease risk factors among a Nigerian adult population: relationship with income level and accessibility to CVD risks screening. *BMC Public Health* 15: 397. [Crossref]

88. Isara AR, Okundia PO (2015) The burden of hypertension and diabetes mellitus in rural communities in southern Nigeria. *Pan Afr Med J* 20: 103. [Crossref]

89. Arugu GM, Maduka O (2017) Risk factors for diabetes mellitus among adult residents of a rural district in southern Nigeria: Implications for prevention and control. *Niger J Clin Pract* 20: 1544-1549. [Crossref]

90. Shaeer KZ, Osegbe DN, Siddiqui SH , Razzaque A, Glasser DB, et al. (2003) Prevalence of erectile dysfunction and its correlates among men attending primary care clinics in three countries: Pakistan, Egypt, and Nigeria. *Int J Impot Res* 15: S8-S14.

91. Umuerri EM, Obasohan AO (2013) Lower extremity peripheral artery disease: prevalence and risk factors among adult Nigerians with diabetes mellitus. *West Afr J Med* 32: 200-205.

92. Odatuwa-Omagbemi D, Adiki O (2012) Extremity amputations in warri, South-South Nigeria. *J West Afr Coll Surg* 2: 14-24. [Crossref]