

Review Article

Title Page

Review of ongoing activities and challenges to improve the care of patients with Type 2 diabetes across Africa and the implications for the future

Brian Godman^{1,2,3,4}, Debashis Basu⁵, Yogan Pillay⁶, Julius C. Mwita⁷, Godfrey Mutashambara Rwegerera⁸, Bene D Anand Paramadhas⁹, Celda Tiroyakgosi¹⁰, Patrick Mbah^{11,12}, Loveline Lum Niba^{11,13}, Justice Nonvignon¹⁴, Israel Sefah¹⁵, Margaret Oluka¹⁶, Anastasia N Guantai¹⁶, Dan Kibuule¹⁷, Francis Kalemeera¹⁷, Mwangana Mubita¹⁷, Joseph Fadare^{18,19}, Olayinka O. Ogunleye^{20, 21}, Larry A Distiller²², Enos M Rampamba^{2,23}, Jeffrey Wing²⁴, Debjani Mueller^{5,24}, Abubakr Alfadl^{25,26}, Adefolarin A Amu²⁷, Zinhle Matsebula²⁸, Aubrey Kalungia²⁹, Trust Zaranyika³⁰, Nyasha Masuka³¹, Janney Wale³², Ruaraidh Hill³³, Amanj Kurdi^{1,34}, Angela Timoney^{1,35}, Stephen Campbell^{36,37}, Johanna C Meyer²

¹Strathclyde Institute of Pharmacy and Biomedical Sciences, University of Strathclyde, Glasgow G4 0RE, United Kingdom. Email: amanj.baker@strath.ac.uk; brian.godman@strath.ac.uk

²Division of Public Health Pharmacy and Management, School of Pharmacy, Faculty of Health Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa. Email: mrampamba@gmail.com; hannelie.meyer@smu.ac.za

³Division of Clinical Pharmacology, Karolinska Institute, Karolinska University Hospital Huddinge, Stockholm, Sweden. Email: Brian.Godman@ki.se

⁴Health Economics Centre, University of Liverpool Management School, Liverpool, UK. Email: Brian.Godman@liverpool.ac.uk

⁵Department of Public Health Medicine, Steve Biko Academic Hospital and University of Pretoria, Steve Biko Road Prinshof 349-Jr, Pretoria, 0002 South Africa. Email: debashis.basu@up.ac.za

⁶National Department of Health, Pretoria, South Africa. Email: Yogan.Pillay@health.gov.za

⁷Department of Internal Medicine, Faculty of Medicine, University of Botswana, Gaborone, Botswana. Email: mwitajc@ub.ac.bw

⁸Faculty of Medicine, Department of Internal Medicine, University of Botswana and Department of Medicine, Princess Marina Hospital, Gaborone, Botswana. Email: grwege@yahoo.com;

⁹Department of Pharmacy, Nyangabgwe Hospital, Francistown, Botswana. Email: anandbene@yahoo.com

¹⁰Botswana Essential Drugs Action Program, Ministry of Health and Wellness, Nelson Mandela Drive, Gaborone, Botswana. Email: ctiroyakgosi@gov.bw

¹¹Effective Basic Services (eBASE) Africa, Ndamukong Street, Bamenda, Cameroon, Africa. Email: okwen@ebaseafrica.org; lovelinelum@ebaseafrica.org

¹²Adelaide University, Adelaide, Australia. Email: patrick.okwen@adelaide.edu.au

¹³Department of Public Health, University of Bamenda, P.O. Box 39, Bambili, Cameroon

¹⁴School of Public Health, University of Ghana, Legon, Accra, Ghana. Email: jnonvignon@ug.edu.gh

¹⁵Department of Pharmacy, Keta Municipal Hospital, Ghana Health Service, Ghana. Email: sefrael@yahoo.com

¹⁶Department of Pharmacology and Pharmacognosy, School of Pharmacy, University of Nairobi, P.O. Box 19676-00202, Nairobi, Kenya. Email: olukamarga@yahoo.com; dean-pharmacy@uonbi.ac.ke

¹⁷Department of Pharmacy Practice and Policy, Faculty of Health Sciences, University of Namibia, Windhoek, Namibia. Email: dkibuule@unam.na; fkalemeera@unam.na; mmubita@unam.na

¹⁸Department of Pharmacology and Therapeutics, Ekiti State University, Ado-Ekiti, Nigeria. Email: joseph.fadare@eksu.edu.ng

¹⁹Department of Medicine, Ekiti State University Teaching Hospital, Ado-Ekiti, Nigeria

²⁰Department of Pharmacology, Therapeutics and Toxicology, Lagos State University College of Medicine, Ikeja, Lagos, Nigeria. Email: yinkabode@yahoo.com

²¹Department of Medicine, Lagos State University Teaching Hospital, Ikeja, Lagos, Nigeria

²²Centre for Diabetes & Endocrinology (Pty) Ltd, 81 Central Street, Houghton Estate, Saxonwold, South Africa. Email: larryd@CDEDiabetes.co.za

²³Department of Health, Tshilidzini Hospital, Limpopo Province, South Africa. Email: mrampamba@gmail.com

²⁴Charlotte Maxeke Medical Research Cluster, Johannesburg, South Africa; Email: dbmueller7@yahoo.de; Jeffrey.wing@wits.ac.za

²⁵National Medicines Board, Federal Ministry of Health, Sudan; Email: abubakr13@yahoo.com

- ²⁶Unaizah College of Pharmacy, Qassim University, Saudi Arabia. Email: abubakr13@yahoo.com
- ²⁷Eswatini Medical Christian University, P.O Box A624, Swazi Plaza, Mbabane, Kingdom of Eswatini. Email: amuadefolarin@scu.ac.sz
- ²⁸Raleigh Fitkin Memorial Hospital, Manzini, Kingdom of Eswatini. Email: zmkholo@gmail.com
- ²⁹Department of Pharmacy, University of Zambia, Lusaka, Zambia. Email: ckalungia@unza.zm
- ³⁰Department Of Medicine, University of Zimbabwe College of Health Sciences, Harare, Zimbabwe. Email zaranyikatrust@gmail.com
- ³¹Independent Health Systems Consultant, Harare, Zimbabwe. Email: docnyasha@gmail.com
- ³²Independent consumer advocate, 11a Lydia Street, Brunswick, Victoria 3056, Australia. Email: socrates111@bigpond.com
- ³³Liverpool Reviews and Implementation Group, Whelan Building, Liverpool University, Liverpool, UK L693GB. Email: ruaraidh.hill@liverpool.ac.uk
- ³⁴Department of Pharmacology, College of Pharmacy, Hawler Medical University, Erbil, Iraq
- ³⁵NHS Lothian Director of Pharmacy, NHS Lothian, Edinburgh, UK. Email: angela.timoney@nhslothian.scot.nhs.uk
- ³⁶Centre for Primary Care, Division of Population Health, Health Services Research and Primary Care, University of Manchester, Manchester, M13 9PL, UK. Email: stephen.campbell@manchester.ac.uk
- ³⁷NIHR Greater Manchester Patient Safety Translational Research Centre, School of Health Sciences, University of Manchester, Manchester, UK

*Author for correspondence: Strathclyde Institute of Pharmacy and Biomedical Sciences, University of Strathclyde, Glasgow G4 0RE, United Kingdom. Email: brian.godman@strath.ac.uk. Telephone: 0141 548 3825. Fax: 0141 552 2562 and Division of Clinical Pharmacology, Karolinska Institute, Karolinska University Hospital Huddinge, SE-141 86, Stockholm, Sweden. Email: Brian.Godman@ki.se. Telephone + 46 8 58581068. Fax + 46 8 59581070

(Accepted for publication – Frontiers in Pharmacology)

Abstract

Background: There has been an appreciable increase in the number of people in Africa with metabolic syndrome and Type 2 diabetes (T2DM) in recent years as a result of a number of factors. Factors include lifestyle changes, urbanisation, and the growing consumption of process foods coupled with increasing levels of obesity. Currently there are 14.2 million adults in sub-Saharan Africa (SSA) with diabetes, mainly Type 2 diabetes (T2DM) (95%), estimated to grow to 34.2 million people by 2040 unless controlled. This has a considerable impact on morbidity, mortality and costs in the region. There are a number of issues to address to reduce the impact of T2DM including improving detection rates and current access to services alongside addressing issues of adherence to prescribed medicines. There are also high rates of co-morbidities with infectious diseases such as HIV and TB in patients with T2DM in SSA that requires attention. **Objective:** Document ongoing activities across Africa to improve the care of patients with T2DM especially around issues of identification, access, and adherence to changing lifestyles and prescribed medicines. In addition, suggest potential ways forward to improve the care of patients with T2DM based on ongoing activities and experiences including addressing key issues associated with co-morbidities with infectious diseases. **Our Approach:** Contextualise the findings from a wide range of publications including internet based publications of national approaches coupled with input from senior level government, academic and other professionals from across Africa to provide future guidance. **Ongoing activities:** A number of African countries are actively instigating programmes to improve the care of patients with T2DM starting with improved diagnosis. This recognises the growing burden of NCDs across Africa, which has been neglected in the past. Planned activities include programmes to improve detection rates and address key issues with diet and lifestyle changes, alongside improving monitoring of care and activities to improve adherence to prescribed medicines as well as address potential complexities involving diabetes patients with infectious disease co-morbidities. It is too early to fully assess the impact of such activities, **Conclusion:** There are a number of ongoing activities across Africa to improve the management of patients with diabetes including co-morbidities. However, more needs to be done considering the high and growing burden of T2DM in Africa. Ongoing research will help further benefit resource allocation and subsequent care.

Introduction

The number of overweight and obese people is rising across Africa as a result of changes in lifestyles including reduced physical activity, more sedentary lifestyles, changing dietary habits including easy access to inexpensive process foods, cultural habits, and increasing urbanisation (1-12). Such changes are leading to an increase in the number of patients with metabolic syndrome and Type 2 diabetes (T2DM) across the continent (10, 13-15). Studies in South Africa suggest over 50% of the adult population (18 years and above) are overweight or obese and rising (1), and in Nigeria 62% and 49% respectively of adults are overweight or obese (16). Kenyan women were also reported to be significantly more likely to have abdominal obesity compared to men (50.2% vs. 12.1%) (17). However, diabetes in sub-Saharan Africa is also present in patients with low to normal body mass indices (BMIs), which may reflect genetic diversities compared with populations in other continents (18). Overall, diabetes mellitus is a growing problem across Africa with an estimated 15.9 million affected including 14.2 million in sub-Saharan Africa (SSA) (18-21). Numbers are likely to grow to 34.2 million people in SSA by 2040 and up to 41.6 million across Africa by 2045, principally T2DM (20-23).

As mentioned, rapid urbanization in Africa is one of the principal risk factors for increasing rates of T2DM across the continent. SSA is often regarded as the world's fastest urbanizing region, with the global share of African urban residents projected to grow from 11.3% in 2010 to 20% in 2050 (24). The city of Johannesburg in South Africa has been a part of a world-wide initiative called 'Cities Changing for Diabetes', the purpose of which is to improve the management of patients with diabetes in urban areas using the principles of halves, i.e. approximately 50% of people with diabetes are diagnosed, of whom 50% receive care, of whom 50% achieve treatment target (recommended glucose levels), of whom approximately 50% would subsequently lead a life free from diabetes related complications equating to 6% of those with diabetes (25).

Activities are just starting across SSA to improve the care of patients with T2DM (Table 1). Typically though, the awareness of diabetes among patients remains a major challenge in SSA with only a minority of patients currently aware of their diabetic status and being actively treated, with only a small percentage being diagnosed pre-diabetes (11, 26). This needs to be urgently addressed given the morbidity, mortality and costs associated with diabetes (27-35). 80% of early deaths due to non-communicable diseases (NCDs) including diabetes and cardiovascular diseases (CVD) currently occur in lower and middle income countries (LMICs), with the morbidity and mortality of diabetes and other NCDs such as CVD likely to be greater than communicable disease by 2025 (36-38). Overall, SSA currently has the highest rate of morbidity and mortality associated with diabetes world-wide (20, 21). In South Africa for instance as a result of changes in peoples' diet and lifestyle, diabetes has moved from being the fifth leading underlying cause of death in 2013 to now the second most common cause, representing 5.5% of all recorded deaths (39, 40). T2DM also results in a lower health status and quality of life (29, 33, 41, 42), with high rates of sight threatening retinopathy among diabetic patients in SSA (20, 30, 31, 43, 44) as well as nephropathy (45, 46) and neuropathy (47, 48). Overall, populations of African origin appear to have the highest prevalence of microvascular complications of diabetes exacerbated by frequent high blood pressure and inappropriate diabetes control among the diabetes population along with challenges of access to appropriate care (49, 50).

Prevalence rates of T2DM vary considerably among individual countries in SSA, exacerbated by high rates of undiagnosed cases of diabetes (26, 32, 35, 51, 52) (Appendix -1). Overall, it is estimated that up to 70% or more of cases of diabetes are currently undiagnosed in SSA (20, 21, 41, 49, 53). This is a concern as diabetes and its associated comorbidities increase cardiovascular diseases (CVD), which are responsible for approximately 70% of diabetes-related deaths (28, 34, 54, 55). It is hoped that ongoing activities across Africa (Table 1) will start to address this especially with mortality rates are enhanced by the lack of control of blood pressure, HbA_{1c} and lipid levels, especially low density lipoproteins (LDL-C), coupled with inactivity (56-59). Currently, only a minority of patients with diabetes in Africa achieve optimal therapeutic targets (26, 60, 61), which is a real concern.

The economic impact of diabetes in SSA is also increasing with growing prevalence rates (53). Atun et al recently estimated that in 2015, the overall cost of diabetes in SSA was 1.2% of the gross domestic product (GDP), with approximately US\$10.81 billion spent on direct medical costs with out-of-pocket expenditure likely to exceed 50% of overall health expenditure in many of the countries (35). In Nigeria, estimates suggest the annual direct costs of diabetes are up to US\$1.639 billion per year

in view of its population size and current prevalence rates, with the estimated monthly direct medical costs for patients with T2DM in Cameroon at US\$148 per patient and in Nigeria varying between \$262.22 to \$400.52 per patient (27). Median monthly healthcare expenditure in Kenya in households with diabetes was US\$100.00 of which US\$7.00 was on medicines (62). The effect of NCDs in the work place is also of growing concern across countries including Kenya and South Africa (63).

Diagnosis rates need to be improved to achieve the World Health Organisation's (WHO) 25x25 Global Action Plan (2013) as well as Sustainable Development Goal (SDG) 3 goals to reduce premature deaths due to non-communicable diseases (NCDs) by a third by 2030 (64, 65). Concerns with rising rates of T2DM and its impact will persist unless addressed. This includes access to diagnostics and essential medicines in the first place (49, 66) along with adequate diagnostic facilities (26) given current concerns with diagnosis rates. The WHO in 2015 found that in Africa only 51% of the countries had metformin routinely available and only 40% insulin, well below the 80% target (35). This is a major concern especially with only metformin along with gliclazide and glibenclamide included in the WHO essential medicine list (EML) (67). There have been concerns though with hypoglycaemia with sulphonyl ureas (SUs) (68). However, this applies more to glibenclamide than other SUs including glipizide, glimepiride and gliclazide as well as gliclazide MR (69-71). This is reflected in the current South African guidelines recommending that glibenclamide should no longer be prescribed, with for instance gliclazide MR replacing the more general term SUs (68). Having said this in Nigeria, glibenclamide is still on the national EML; however, chlorpropamide is still being prescribed by some practitioners (72, 73). There have also been concerns recently with limited availability of insulin analogues when needed especially with the increasing availability of lower costs biosimilars. However in the first instance, soluble insulin injections as well as intermediate acting insulins need to be made routinely available to T2DM patients within public healthcare systems across SAA in accordance with the 2019 WHO EML before potentially funding any analogue (67).

The availability of medicines to treat patients with T2DM should improve with ongoing programmes across SSA, including South Africa, to improve access to medicines in patients with chronic diseases (74) as well as ongoing programmes to reduce the costs of medicines as a barrier to their use (75). However, more remains to be done with continual concerns regarding the availability of metformin and insulins across SSA. Efficient procurement of medicines is critical to ensure that patients with diabetes within public healthcare systems are able to obtain an uninterrupted supply of their medicines (76).

Newer oral medicines for patients with T2DM such as the DPP4 (dipeptidyl peptidase-4) and SGLT2 (sodium/glucose cotransporter 2) inhibitors have also been proposed (68, 77, 78). However, there are major issues with affordability within public healthcare systems struggling to routinely make available metformin and basic insulins. In addition, a number of patients with T2DM across Africa are ketosis prone and this is difficult to manage if their renal function is not routinely monitored in primary healthcare centres (PHCs). However, it is difficult to estimate the true prevalence of patients who are ketosis prone in SSA. Ketosis-prone diabetes is an "atypical" form of diabetes particularly prevalent in diabetic patients in SSA with characteristics of both Type 1 and Type 2 diabetes (49, 79, 80), principally though ketosis-prone T2DM (79). Published figures suggest a prevalence up to 15% of the diabetes population in Africa have ketosis-prone diabetes (49, 79, 81); however, this could be an under estimate. In addition, there are also concerns with available resources and co-payments within public healthcare systems in SSA leading to continued endorsement and listing of appropriate SUs and metformin rather than funding newer oral medicines such as the DPP4 and SGLT2 inhibitors, as well as addressing any inertia with prescribing insulins rather than again funding newer oral anti-diabetic medicines (82, 83).

Alongside this, many countries in SSA currently have inadequate facilities to manage both the microvascular and macrovascular complications of T2DM(35). This includes addressing sub-optimal management of patients with T2DM with currently only a minority of patients in SSA achieving glycaemic control (26, 60, 61, 66, 84, 85). Glycaemic control is improved though in specialist centres in SSA (61, 83, 86). This reflects the fact that NCDs such as diabetes have been relatively neglected over the last decade in SSA in favour of infectious diseases including human immunodeficiency viruses (HIV), tuberculosis (TB) and malaria due to their burden (20, 35, 87). However, this is beginning to change (Table 1 below). Diabetic populations of African origin appear to have the highest prevalence of microvascular complications exacerbated by frequent high blood pressure and inappropriate diabetes control along with challenges with access to appropriate care (49, 50).

Treatment of hypertension is a particular concern among the black population. Thiazide diuretics and calcium channels blockers rather angiotensin-converting-enzyme inhibitors (ACE inhibitors) are now seen as the most effective antihypertensives in the black population (88-90). Consequently, whilst ACE inhibitors are indicated for patients with diabetes and proteinuria, they have a lesser effect in reducing blood pressure in the black population and their prescribing needs to be carefully managed (83, 91). There is also typically low use of statins among diabetic patients in SSA, which again needs to be urgently addressed to reduce future CV complications (61, 83, 92).

Overall, a number of key issues have been identified surrounding the management of patients with T2DM in SSA that need to be addressed alongside issues of diagnosis and medicine availability. These include access to care in the first place, which is typically among public sector PHCs across most of SSA (35). Access to physicians and medicines continues to be a challenge especially if this involves high patient co-payments and/ or there are long distances and queues to see a healthcare professional, both of which have economic and emotional consequences for patients (93-95). The prohibitive costs of medicines in some LMICs, which can account for up to 60% or more of total healthcare costs, does affect continued medicine use if much of this is out-of-pocket including adherence for long term chronic conditions such as T2DM (96-99). For instance in Nigeria, typically household savings and family support are needed to fund treatments for patients with T2DM, with a mean monthly expenditure of US\$356 per patient (100) similar to other studies (27). In addition, for patients with diabetes in Nigeria, the costs of medicines can account for over 70% of total direct medical costs (101). Greater use of generic medicines could help reduce these costs (102); however, there are issues with the quality of generics in Nigeria which needs to be addressed (103).

Patient knowledge regarding diabetes and its management, including self-management, can also be poor among patients with T2DM in SSA (40, 104-106). This is exacerbated by low levels of education among patients attending PHCs in SSA with CVD including T2DM and hypertension; however, this is not universal (40, 94, 107-112). In addition, there are concerns that being overweight and obese is still seen as a sign of affluence in a number of African communities, although changing, and appreciable weight loss still has the stigma of HIV and acquired immune deficiency syndrome (AIDS) associated with it. This is important especially in countries where there are high prevalence rates of HIV as well as high rates of patients with both HIV and T2DM as seen for instance in Botswana compared with high income countries (113, 114). Treatment, including adherence to agreed guidelines for patients with T2DM, and subsequent patient adherence to prescribed medicines, are also generally sub-optimal in LMICs including Africa (40, 101, 107, 115-119).

A number of factors appear responsible for poor control of T2DM including the age of patients, their lack of perception of the consequences of diabetes, forgetfulness regarding taking medication, adverse effects of the prescribed medicines, living in rural areas, affordability and issues of motivation including family support (83, 86, 119-122). There are also concerns with the concomitant management of hypertension and hypercholesterolaemia along with controlling HbA1c in patients with T2DM in SSA (61, 83, 123). Other potential factors impacting on key issues such as adherence include concomitant co-morbidities including infectious diseases appreciably increasing the pill burden and regimen complexity (124). Treatments for HIV can themselves also lead to weight gain and obesity further complicating the management of T2DM patients with HIV (20, 125-128). A study undertaken in an HIV clinic in South Africa found the metabolic syndrome was seen in 20% of cases within one year after initiation of anti-retroviral treatment (ART) despite the young age of patients, presumably as a consequence of ART exposure (129). Similarly, diabetes increases the chances of patients getting TB nearly threefold (20). Consequently, T2DM patients with infectious disease co-morbidities must be carefully managed.

There have been a number of initiatives across SSA to improve identification, prevention and management of T2DM to reduce subsequent morbidity, mortality and costs. These include national strategies (6, 7, 130-135) as well as the development of contextualised guidelines combined with research to demonstrate the need for strategies to improve guideline adherence and to assess their impact in practice (5, 20, 118, 132). There have also been strategies to improve access and availability of medicines (74, 75, 136-138), as well as strategies to improve the monitoring and follow-up of patients including advice on the doses of medicines prescribed (110, 139, 140). However, such activities are not universal across SAA. Alongside this, there have been initiatives in SSA surrounding patient education and empowerment, along with support mechanisms such as the Central Chronic Medicine Dispensing and Distribution (CCMDD) initiative in South Africa, to improve access to

treatment as well as adherence to suggested lifestyle changes and prescribed medicines (26, 74, 104, 108, 109, 141-145). However, only a limited number of papers have been published assessing the impact of different initiatives in these patients (117, 143, 145). We are also seeing the rise in mobile technologies to improve care including adherence to medicines (146, 147), which will be one of the subjects for future research projects in SSA. Typically, multiple interventions are required to improve the care of patients with T2DM (117, 137). However, resources to expand such interventions to derive maximum benefits have to be balanced against ongoing needs in other high priority health conditions (37).

Consequently, the principal objective of this paper is to document and debate ongoing challenges and activities to improve the care of patients with T2DM in Africa especially around issues of adherence to changing lifestyles and prescribed medicines. This includes appraising key issues associated with co-morbidities with infectious diseases such as HIV and the resultant implications. There have been a number of systematic reviews looking at key issues surrounding the management of patients with diabetes in Africa including initiatives to strengthen healthcare systems (26, 35, 36, 45, 51, 99, 104, 138, 144, 148-150). We are also aware of the recent NCD research conference for Africa to share evidence and identifying research priorities (151). However to date, there have only been a limited number of publications that have comprehensively focused on all aspects of care covering diagnosis, prevention, education, and treatment including access to appropriate medicines for patients with T2DM and subsequent adherence rates. There have also been only a limited number of publications assessing the influence and impact of different interventions to improve the care of patients with T2DM in SSA. In view of this, we sought to document ongoing activities across SSA to improve the care of patients with T2DM as well as contextualise any findings from a wide range of co-authors from across SSA and wider to provide future guidance. This does not include issues of counterfeit medicines as this is outside the scope of this paper (152, 153).

We have specifically chosen T2DM as this accounts for up to 95% of patients with diabetes in SSA (41). In view of this, we believe our findings and subsequent implications should be of interest to key stakeholders across Africa and wider to help further improve the care of patients with T2DM building on current efforts. We will be monitoring these developments in the future.

Our approach

We did not perform a systematic review since there have been an appreciable number of recent publications, including systematic reviews, discussing ongoing research in this area and its implications including current prevalence rates, health system concerns, as well as possible policies and ways to improve future care (13, 20, 26, 27, 36, 45, 51, 104, 138, 144, 146, 148-150). In addition, a number of the references, especially regarding ongoing national activities, are typically only available on the Internet as some of these have only just been launched. It is too early to assess the influence and impact of such national activities on key patient parameters as well as suggested activities to address key elements in the care provided. As mentioned, there have only been a limited number of publications to date in this area and only a limited number of studies including Sapkota et al from LMICs (117, 143, 145).

To address this knowledge and policy gap, we used senior level personnel from governments and their advisers, clinicians, academia, rational medicine use advisers, HTA personnel, as well as patient organisation personnel, to suggest future activities for all key stakeholder groups across SSA to improve the future care of patients with T2DM. This included both short- and long-term initiatives, with the advice given based on relevant publications known to the co-authors coupled with their considerable knowledge of ongoing activities in their own countries. This builds on policy gaps and other recent papers to help improve the care of patients with T2DM across SSA (20, 26, 35, 150). The co-authors came from a wide range of backgrounds and countries in terms of their geography, population size, GDP per capita as well as progress towards universal healthcare. We have successfully used this approach before to stimulate debate in other priority healthcare areas and situations to provide future guidance (154-164).

We did not split the African countries into low- or middle-income countries as the burden of T2DM and its implications is growing across all of Africa. Consequently, countries can learn from each other. We also did not systematically review each paper for its quality using well-known scales such as the Newcastle-Ottawa scale or the Cochrane risk of bias tool as our emphasis was on contextualizing the

findings rather than performing a systematic review for the reasons given (99, 165-168). In addition, we did not review each paper to assess whether the presence of diabetes, especially T2DM, had been defined according to WHO and other internationally recognised diagnostic criteria in view of the objectives of this paper (26, 169).

3. Ongoing activities and the implications

Ongoing initiatives and activities among SSA countries to improve the identification and management of patients with T2DM will be described first before debating potential approaches among all key stakeholder groups to improve future identification and management of patients with T2DM in SSA. This includes the cascade of treating patients with T2DM starting with glucose testing, diagnosis, lifestyle advice as well as the prescribing of medicines and counselling for adherence to prescribed medicines (26). We are aware for instance that most guidelines on the management of patients with T2DM in LMICs including SSA are inadequate in terms of their applicability, clarity, and active plans for dissemination (150). We are also aware that national guidelines when produced are not always readily available in primary and community healthcare centres or routinely consulted (170, 171).

As mentioned, there will be a particular focus on strategies to improve access to medicines and subsequent adherence rates to prescribed medicines based on the combined experiences of the co-authors and the published literature.

3.1 Ongoing initiatives and activities among sub-Saharan African countries

Table 1 contains details of a range of activities being undertaken among SSA countries to improve the management of patients with T2DM.

Insert Table 1

3.2 Suggested activities among all key stakeholder groups to improve future management of patients with T2DM

We have based suggested activities and initiatives that still need to be undertaken among key stakeholder groups across SSA to improve the cascade of patient management (26), and subsequently reduce future morbidity, mortality and costs due to T2DM and its complications, principally on the experiences of the co-authors in the absence of published data. These are contained in Boxes 1 to 5 and build on Table 1.

Suggested activities include increasing recognition of the burden of T2DM across SSA to raise its priority status. As a result, seek to appreciably reduce the number of patients across SSA currently not being diagnosed with T2DM including those with pre-diabetes. Concerns with the availability and use of medicines, especially those contained in the WHO EML, needs to be addressed including metformin. There are also concerns with poor adherence rates to prescribed medicines and prescribing guidelines, the routine availability of prescribed medicines, and the development of insulin resistance among diabetic patients which also needs to be addressed to reduce future morbidity and mortality. The complexity of the management of patients with T2DM is enhanced in they have infectious diseases such as HIV and TB, which is appreciably more likely in SSA than high income countries where most guidelines emanate from. As a result, guidelines need be country and region specific taking into account genetic and other factors including patients with diabetes in SSA having low to normal BMIs, those with ketosis-prone T2DM, as well as appropriate management of those with co-morbidities including hypertension and infectious diseases. This is unlike the situation in many other continents.

Suggested activities will include those at governmental and national levels as well as among the different healthcare professional groups and patients to improve the future care of patients with T2DM. Potential initiatives to improve adherence rates to prescribed medicines will also be discussed given current concerns.

In addition, there is an ongoing need to improve HTA capabilities across SSA to help fully assess the effectiveness and cost-effectiveness of different approaches, including different treatment approaches

especially given limited available resources, and potentially multiple possible initiatives. This can build on existing research across countries (151, 172-176) for evidence based decision making.

4. Discussion and conclusion

We believe this is the first comprehensive study to collate ongoing and planned activities across Africa to improve the management of patients with T2DM as well as suggest potential future strategies especially around medicine management. As a result, enable SSA countries to compare and contrast ongoing activities as well as debate potential future activities whilst the evidence base grows regarding their potential influence on reducing future morbidity, mortality and costs due to T2DM.

It is encouraging to see that an appreciable number of African countries are actively instigating programmes to improve the care of patients with T2DM starting with improving diagnosis (Table 1), with countries such as Cameroon looking to instigate pilot activities starting in key regions. This is important with T2DM a growing problem across Africa with an estimated 15.9 million adults in Africa currently with diabetes and growing (19, 20), and recognises the growing burden of NCDs across Africa, and we will be reporting on some of the findings in the future.

Key national activities in Africa (Box 1) include health system strengthening as well as improving the subsequent management of patients with T2DM including those with co-morbidities. This starts with the development or refinement of national action plans to enhance the care of patients with NCDs including those with T2DM. Initial activities include improved screening and diagnosis of high risk patients at a number of venues including schools, workplaces, churches and shopping centres as well as in PHCs. This includes patients with pre-diabetes especially those with other cardiovascular diseases (14, 15, 177) to reduce future morbidity, mortality and costs. Treatment approaches comprise both pharmacological treatments to prevent cardiovascular complications as well as lifestyle changes including diet changes.

Access to medicines is especially important in SSA with for instance up to 75% of patients having difficulties with obtaining insulin (26). The very least is routine availability of metformin, appropriate SUs and soluble and intermediate insulins. The development of universal health care as well as the assistance of donors and commercial organisations can be beneficial here (74, 75, 136). Initiatives to encourage the use of generics where possible, obtain low prices for quality medicines, as well as instigate effective distribution systems can also enhance access to effective medicines in both public and community health centres (20, 74, 178, 179). The development and instigation of evidence based guidelines taking account of local co-morbidities including HIV and TB as well as genetics will also be a key step towards improving the management of patients with T2DM across Africa, enhanced by the auditing of current prescribing patterns (20, 150). Furthermore, key stakeholder involvement in the production of country guidelines is seen as important to enhance their utilisation building on the experiences in other countries (180-182).

A key concern in SSA is the multi-morbidity among patients with T2DM including co-morbidity with HIV and TB. This adds to the burden of the disease, exacerbated by these infectious conditions. Consequently, country specific guidelines need to be cognisant of this with rapid referral systems in place for more complex cases given the improved management of patients in tertiary centres. Prescribers need to be cognisance of the potential for HIV treatments to exacerbate diabetes and also for diabetes to exacerbate TB. This needs to be emphasized during physician and healthcare professional training, followed up by continuous professional development and other activities.

Concerns with the pharmacological management of patients with T2DM include adherence to medicines, which is typically sub-standard, as well as insulin resistance. A number of studies have shown the importance of healthcare professionals such as pharmacists, nurse practitioners, and community health workers, improving subsequent adherence and outcomes (95, 99), with more studies planned given current concerns. We envisage that innovative approaches such as the increasing use of mobile technologies will be adopted to enhance adherence to lifestyle changes and medicines, and we will be monitoring this development in the future (147, 183). Countries can also continue to learn from each other to improve future care.

Whatever new initiatives or treatment approaches are chosen, it is likely that countries will need to expand on their health technology assessment (HTA) capabilities to assist with rational choices given continuing pressure on resources. This is already happening in countries such as Ghana and South Africa, and will expand further. Potential choices for governments consist of enhancing the infrastructure including public/ community healthcare centres with multiple personnel including physicians, medical officers, pharmacists, nurses, and others, to aid identification and reduce the development of complications and associated hospitalisation. In addition, seek ways to address key issues regarding the availability of medicines for the management of diabetes and its complications including reducing co-payments where these exist. Multiple approaches also appear needed to address poor adherence rates to prescribed medicines where these occur, and these will be the subject of future research projects.

In conclusion, we believe our findings and subsequent implications, including suggested activities (Boxes 1 to 5) for all key stakeholder groups, should be of interest to key groups across Africa and wider benefit the continuous improvement in the care of patients with T2DM in sub-Saharan Africa building on current efforts (Table 1). This is essential given rising rates of obesity in Africa with their subsequent impact on morbidity, mortality and costs. We will be monitoring these developments in the future especially as more studies become available evaluating ongoing initiatives among the different African countries and the implications.

Conflicts of interest and funding

Larry A Distiller is employed by the Centre for Diabetes & Endocrinology (Pty) Ltd. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. However, a number of them are employed by national or regional governments in Ministries of Health or are advisers to them. In addition, advisers to the World Health Organisation.

There was no funding for this paper.

Author contribution

Author contribution: BG, JF, OOO and JCM devised the concept of the paper. All authors subsequently contributed to its content and approved the final version.

Tables and Boxes

Table 1 – Synopsis of ongoing national and local activities to improve the management of patients with T2DM in sub-Saharan Africa

Country	Activities
Botswana	<ul style="list-style-type: none"> • As part of Botswana National Multisectoral Strategy for the Prevention and Control of Non-Communicable Diseases 2017-2022 a number of activities are in place including (184): <ul style="list-style-type: none"> ○ Disseminating information on NCD prevention including T2DM regularly in various media outlets ○ Training and deploying community health agents (e.g. health education assistants) to conduct community outreach awareness and screening activities ○ All schools to integrate NCD education in health promotion curriculum ○ Promoting access to healthy food, including at schools (taxation on imports of unhealthy foods, regulations on food provided at schools or packed from home in both private and public schools) ○ Promoting physical activity at the workplace, at schools and recreationally • The Diabetes Association of Botswana collaborates with various organization/companies to conduct staff wellness activities; with services including screening for diabetes and education on physical activity, healthy eating among others (185) • Establishment of Diabetes clinics in different parts of the country as well as regular training of healthcare staff on diabetes management. Through the NCD unit at the Ministry of Health, education sessions on diabetes management using the primary health care guidelines - Hypertension and Diabetes (186) • Annual screening for diabetes mellitus across the country on World Diabetes Commemoration day • Training of community health care professionals who are already involved in HIV care on diabetes management and education given the complexities involved including increased weight gain with treatments for HIV • Increasing instigation of quality of care audits at different time intervals
Cameroon	<ul style="list-style-type: none"> • There are currently no ongoing national and local activities to improve the management of patients with T2DM in Cameroon • However, there are ongoing initiatives entitled “Cameroon National Diabetes and Hypertension Programme” - WDF16-1429 led by Prof Jean Claude Mbanya which aims at improving diagnosis and management as well as the prevention of diabetes and its complications in 2 regions of the country (North West and Centre) (187) • The key components of the programme include: <ul style="list-style-type: none"> ○ building capacity to improve diabetes and hypertension care both at the national and district level ○ strengthening the administrative and monitoring capability of the Cameroon Ministry of Health ○ improving the surveillance systems for NCDs in the country ○ implement campaigns among the population to raise awareness at the community level and among the media • The outcomes of any initiatives will be reported in the future
Ghana	<ul style="list-style-type: none"> • A Non-communicable Diseases Control Programme (NCDCP) was established by the Ministry of Health of Ghana in 1992 to respond to the growing burden of NCDs coordinating the national response to NCDs, working in partnership with other departments within the health sector, other Ministries, NGOs and civil society organizations (188) • In 1993, the NCDCP described general strategies for the prevention and control of chronic NCDs as well as disease-specific strategies, proposing a two-phase implementation of the programme, from January 1994 to

	<p>December 1998 and from January 1999 to December 2004, with specified targets for each phase (188, 189). In 1994, the MoH identified the development of more effective and efficient systems for the surveillance, prevention and control of non-communicable diseases as one of the main strategies to achieve its health service targets by the year 2008 (188)</p> <ul style="list-style-type: none"> • In 1998, another strategy paper was prepared with the view to document the burden of the problem, identify the risk factors and design the most appropriate intervention packages relevant to the Ghanaian situation (188). In 2006-2007, strategic frameworks for the control of the major NCDs were developed with increasing levels of obesity and CV diseases in the Ghanaian population (4, 188) • In June 2012, the Ministry of Health in Ghana launched its National Policy for the Prevention and Control of NCDs spanning 2012 to 2018 spanning issues of primary prevention and health system strengthening (131). Whilst the National Health Insurance Scheme (NHIS) in Ghana does not reimburse healthcare facilities for secondary prevention in terms of routine screening services for patients with T2DM, NHIS covers tertiary care of DM patients in terms of their management. The facilities provide services including inpatient and outpatient services together with oral hypoglycaemic drugs and insulins. All regional hospitals in the 10 administrative regions in Ghana and some selected district hospitals providing primary care have specialized DM clinics providing comprehensive care. These are either open for access in the entire week or have selected consulting days in the week • More recently: <ul style="list-style-type: none"> ○ There is also a new requirement by the Ghana Medical and Dental Council for doctors to accumulate credit points for re-licencing every year including update information on the treatment of NCDs ○ There is also a current initiative to improve on the clinical skills of pharmacist through the provision of the doctor of pharmacy (PharmD) programme in all public universities as a first degree in pharmacy and also specialist pharmacist training at the both Ghana College of Pharmacist and West African postgraduate College of Pharmacist to improve on the quality of pharmaceutical care provided by pharmacist in both community and hospital pharmacies including patients with NCDs such as T2DM
Lesotho	<ul style="list-style-type: none"> • A number of activities are ongoing including (190): <ul style="list-style-type: none"> ○ Operational policies and strategic action plans for patients with diabetes including addressing key issues such as physical inactivity ○ Ongoing developments surrounding guidelines and protocols of care for patients with diabetes ○ Strategies to enhance the referral of patients from primary care to more specialised services when pertinent to help reduce future complications
Kenya	<ul style="list-style-type: none"> • There are a number of strategies ongoing in Kenya to improve the management of patients with T2DM. These include: <ul style="list-style-type: none"> • Implementation of the Non-Communicable Disease 2015-2020 (191), which includes raising the priority of NCDs such as T2DM, promoting healthy lifestyles, promoting and conducting research to reduce NCDs as well as strengthen monitoring and evaluation systems. This builds on the Kenya National Diabetes Strategy 2010-2015 (130) • Incorporation of diabetes education into the National Health Policy enhanced by the provision of Educator Manuals (192) as well as education to patients and healthcare providers by Diabetes Kenya whose mission is to provide a high standard of diabetes education and care as well as implementing prevention programmes (193). Diabetes Kenya also links people with diabetes to resources and supply centres at discounted rates as well as publishing a quarterly journal, booklets on Diabetes care and Diabetes Brochures to help improve the care of patients with diabetes in Kenya

	<ul style="list-style-type: none"> • Promotion of diabetes self management supported by regular clinical follow-ups and the incorporation of diabetes screening in all medical camp activities particularly those targeting rural hard to reach areas • Joint collaboration between Familia Nawiri, a social venture program initiated in Kenya by Novartis, and several County Ministries of Health in partnership with the Centre for Research in Therapeutic Sciences at Strathmore University, Kenya, and the Swiss Tropical and Public Health Institute, Switzerland, to strengthen the government’s community health strategy through training of community health workers and health promotion at the household level (194) • Enhanced health cover for outpatient and inpatient care through the expanded National Hospital Insurance Fund with most patients with diabetes in Kenya certainly in the rural setting diagnosed in public facilities (194), although others have found that most patients are diagnosed in hospitals or private facilities rather than public clinics or health centres where there is a greater supply of pertinent medicines (62) • Improving access to care including medicines (75, 136) and improving the supply chain, with metformin and glibenclamide, the most prescribed medicines for patients with diabetes in Kenya (194). In addition, enhancing access and availability of medicines through Universal Health Coverage (UHC). Currently, there is typically low availability of medicines in the public sector. As a result, most patients currently purchase their privately from community pharmacies and clinics largely out of pocket even though they are available free-of-charge in public clinics (62, 195, 196) • Enhancing capacity building through targeted specialist training in diabetology • Sanofi in partnership with the International Diabetes Federation (IDF), Kenya Diabetes Study Group and Diabetes Kenya, supported by the Ministry of Health, launched mid 2019 a nationwide on-line three-month diabetes management training programme initially targeting 2000 General Practitioners. The objective being to help bridge the gap in the management of diabetes in Kenya with only a small number of diabetes specialists (12) currently available (197) • Boehringer Ingelheim with PharmAccess has also recently launched a mobile technology enabled program, “Tiba Yako” for Hypertension and Diabetes Patients to empower patients to become more aware, access care and take charge of their diabetes via a mobile health wallet, M-TIBA, and enables patients to manage their diabetes from their own home through digital tools (198) • The Digital Diabetes Patient Support Program (PSP) was also recently launched in Nairobi, Kenya, by Sanofi Kenya in partnership with CheckUps Medical Center in 2019. The program branded SPEED (Sanofi Patient Enlightenment and Empowerment Drive) looks to promote safe and effective use of medicines especially for patients with T2DM with up to 45% of adult diabetic patients or more currently not adhering to their oral diabetic medication (199)
Kingdom of Eswatini (formerly Swaziland)	<ul style="list-style-type: none"> • There are ongoing initiatives in the Kingdom of Eswatini to increase awareness of T2DM especially among women including the necessity to adopt changes in lifestyle (200), with diabetes accounting for 24% of deaths in patients with NCDs admitted to hospital (7), an increase on previous years • These include the development of essential healthcare packages including patients with chronic diseases (201) • The National Prevention and Control of NCD 2017 report highlighted a number of activities to help reduce morbidity and mortality of patients with diabetes (7). These included: <ul style="list-style-type: none"> ○ The development of the Educational Health Care Plan which states that screening for identification as well as for management of diabetes should be offered at all levels of care. Selected screening tests such as blood

	<p>sugar levels as well as fundoscopy and some specialized treatments such as nutritional supplements should be offered at all levels with currently only 35% of centres offering screening services</p> <ul style="list-style-type: none"> ○ Restructuring and upgrading of services including enough human resource to enable decentralisation of services from national to regional and local centres ○ Undertaking research to more accurately assess current incidence and prevalence rates to align services to improve future care
Namibia	<ul style="list-style-type: none"> ● National Policy Framework for diabetes prevention and control in Namibia. Key areas include: <ul style="list-style-type: none"> ○ Establishment of the National NCD Programme in the Ministry of Health and Social Services under the mandate of office of the Prime Minister ○ Government commitment to funding public health care including diabetes ○ Regular updates and reviews of STGs and essential medicines lists incorporating diabetes care ○ Publication of the national multi-sectoral strategic plan for prevention and control of non-communicable diseases (NCDs) in Namibia 2017/18 – 2021/22 (202) ○ Nutrition guidelines for prevention and management of non-communicable diet related diseases (203) ● Universal Health Coverage for diabetes – key aspects include: <ul style="list-style-type: none"> ○ Provision of diabetic care as close to the family as possible at nearly no cost in the public sector and ensuring cost-effective access to care through various medical aid schemes since there are concerns with issues such as attendance in primary care clinics and adherence to medicines if facilities are not close to families (94) ○ Establishment of specialist-run Diabetes Clinics in referral hospitals ○ Integration of diabetes care as part of primary health care delivery including regular screening in the communities and improved access to diabetes testing at the community healthcare level ○ National laboratory service through the Namibia Institute of Pathology to provide cost-effective testing for diabetes ● Special Interest and Advocacy Groups on diabetes <ul style="list-style-type: none"> ○ Commemoration of Healthy Lifestyles Day aimed at raising public awareness on the prevention of NCDs including diabetes ○ Community advocacy and awareness on diabetes by several interest groups such as the Diabetes Association of Namibia, University of Namibia Diabetes Association and Namibia Diabetes Lifestyle Foundation (204, 205) ○ Collaborative operational and clinical research on diabetes prevention, treatment and control ● National Surveillance of Non-communicable and communicable diseases: <ul style="list-style-type: none"> ○ Undertaking Namibia demographic health surveys (NDHS) to ascertain the current prevalence of diabetes and prediabetes as a basis for developing future programmes to reduce prevalence rates especially T2DM (206) ● Building sustainable capacity in the care and control of diabetes especially T2DM <ul style="list-style-type: none"> ○ Incorporating NCDs as part of training curricula of pre-service and in-service health professions training programmes including Medicine, Pharmacy, and Nursing
Nigeria	<ul style="list-style-type: none"> ● On-going joint efforts by The Diabetes Association of Nigeria and The Federal Ministry of Health to review the Guideline for the management of Diabetes Mellitus in Nigeria aimed at addressing current challenges as the last edition of the guideline was published in 2011 ● Efforts to strengthen the care of patients with diabetes at the PHC level through development of guidelines, training of medical officers, nurses,

	<p>pharmacists and community health workers at the PHC level and establishment of diabetes mellitus registries at the local government levels</p> <ul style="list-style-type: none"> • Pilot scheme in Lagos State, Nigeria, being sponsored by the State Government and Health Matters Inc. to improve diabetes care in poor urban communities in Lagos City among 35 PHCs located in hard-to-reach slum areas. The project will seek to increase awareness about diabetes through awareness and screening camps via radio campaigns (207) • Awareness and Advocacy programs organised nationally and locally by various interest groups and societies such as Diabetes Association of Nigeria (DAN) and The Endocrine and Metabolic Society of Nigeria (EMSON) especially during World Diabetes Days with educational materials produced and distributed. • Creation and regular meetings of Patient Support Groups by The Diabetes Association of Nigeria (208) • Periodic free health screening programs at community levels to identify undiagnosed cases of T2DM
South Africa	<ul style="list-style-type: none"> • Various initiatives are ongoing to improve the care of patients with T2DM throughout South Africa These include the following: <ul style="list-style-type: none"> ○ Publication of updated South African guidelines for the management of patients with T2DM (5) ○ Recent instigation of a tax on sugar (2018) (209) ○ Increasing patients' empowerment of their T2DM through counselling and patient diaries via pharmacists and others, i.e. improve diabetes self-management (5, 145) ○ Instigation of free screening centres for patients with suspected diabetes ○ Follow up of patients with diabetes and those at high risk in the public sector by outreach healthcare workers in rural areas (140) ○ Potential instigation of ward-based outreach teams (WBOTs) to improve access to primary healthcare (PHC) services including health promotion and disease prevention for patients with T2DM (210) ○ However, it is recognised that the management of patients with T2DM in the public sector is under-resourced. This may change with the introduction of a National Health Insurance Bill for Universal Health Coverage which will facilitate and promote the provision of health services for the management, prevention and control of communicable and NCDs (211) • Ongoing initiatives by the Government to realise its vision of a country free from the burden of disease include a multi-sectoral national wellness campaign "Cheka Impilo", which is a call to action for South Africans to move from a curative response to health to preventative approaches and the adoption of healthy lifestyles. The campaign was launched on commemoration of World AIDS Day, on 1 December 2018, and provides national support for testing and treating people who have HIV, TB, sexually transmitted infections and NCDs such as diabetes and hypertension, reinforcing the implementation of prevention strategies, linkages to care, management, treatment and support (212) • National Adherence Guidelines for Chronic Diseases (HIV, TB and NCDs) launched in 2016 for phased implementation throughout the country. This includes standard operating procedures for the early implementation of interventions in a sequential manner to support linkage, adherence and retention in care (134, 135). Evaluation of the impact of five of these interventions is currently being undertaken in a sample of PHCs in four of the provinces in South Africa (213) • Implementation of the Centralised Chronic Medication Dispensing and Distribution (CCMDD) programme, to improve access to chronic medication for stable patients through pre-dispensing and delivery to a point closest to the patient (74). The programme comprises two components: Central Chronic Medicines Dispensing and Distribution (CCMDD) and Pick-up Points (PuPs). With these initiatives, PHCs are decongested and patients will no longer be

	<p>required to travel long distances and wait several hours to collect their medication at healthcare facilities</p> <ul style="list-style-type: none"> • Synchronised National Communication in Health (SyNCH), which is a web system designed to improve process flows and transparency of the CCMD programme. This is a first for the South African public healthcare system, providing local, real-time data that informs decision-making and guideline development. Perceived advantages of the system include ensuring compliance to STGs, reducing medication errors and prescription rejections through validations built into the system, monitoring medicine collection status and promoting the rational prescribing of essential medicines. In terms of patient care, SyNCH facilitates patient adherence to treatment through the PuP interface and automatic notifications to healthcare facility for follow-up, thereby reducing the time taken to identify non-adherent patients • HIV Testing Service currently includes screening for HIV, TB, diabetes, hypertension, obesity and cervical cancer, with this service being used for screening multi-morbid conditions • Gauteng Province has been implementing a policy for health, happiness and wellness of its residents through though a comprehensive health prevention and promotion programme. • Cities changing Diabetes project currently being implemented Johannesburg included establishing a health service laboratory in a PHC clinic where smart protocols, smart technologies (such as point of care machines), smart medicines including insulin analogues where appropriate are being used under the leadership of a multi-disciplinary team comprising specialists in internal medicine, public health medicine, social workers, pharmacists, nursing staffs, allied health care workers and community health care workers • The South African Diabetes Association also provides educational and other support services; however variably influence on policies compared with other countries • Of current concern is that the South African Nursing Council does not recognise the role and qualification of Diabetes Nurse Educators. However, there are ongoing moves to have this qualification officially recognised to help improve patient care in the future • In the private sector, diabetes is typically managed in conjunction with Managed Care Programmes with variable effect. Medication formularies are in place to support care and reduce costs. In general, though, the Health Insurance companies seem more concerned with month-by-month costs of management rather than longer term outcomes • However, there are moves to upskill healthcare professionals in diabetes management and care in the private sector. This includes attendance at a 5-day intensive, advanced course in diabetes care, offered by the Centre for Diabetes & Endocrinology (CDE) Academy. To date (July 2019) over 1700 medical professionals, over 1000 nurses, over 450 dieticians as well as more than 300 other health care professionals have attended this particular course. This includes a number of participants from neighbouring SADAC countries • The CDE also promotes further training and education of healthcare professionals in diabetes management and care, such as an online Postgraduate Diploma in Diabetes and MSc Diabetes offered by the University of South Wales. To date (July 2019) 168 successful Postgraduate Diabetes Diplomas and 49 MSc's in Diabetes have graduated • In addition to the above formal qualifications, there is an initial 10-week online foundation course in diabetes offered by the University of South Wales, and promoted by the CDE in South Africa
Sudan	<ul style="list-style-type: none"> • Ambulatory centres working as multidisciplinary institutions specializing in diabetes care were recently established in Sudan with funding from The World Diabetes Foundation. The aims are (214): <ul style="list-style-type: none"> ○ Provision of specialized medical care for diabetic patients ○ Raising the public awareness about diabetes mellitus and its complications

	<ul style="list-style-type: none"> ○ Enhance specialized training of medical and paramedical staff working in diabetes management. ● Establishing the Diabetes Care Organization, which is one of the voluntary non-profit organizations under the Sudan Diabetes Federation with the aim of leading the provision of Diabetic Health Care services to communities across Sudan
Zambia	<ul style="list-style-type: none"> ● Zambia has recently introduced a national health insurance scheme aimed at improving and addressing access to healthcare and financing gaps, especially for patients with NCDs in Zambia. This is important since whilst Zambia has national policies and treatment guidelines for DM, operational policies and action plans are still required to reduce the risk of T2DM including public health promotion and educational prevention strategies in primary healthcare especially for high risk groups e.g. older age, overweight and obese (128) ● The future care of patients with T2DM should be helped by the introduction of healthy lifestyle campaigns (led by and exemplified by the Country President) to promote regular exercise as preventive measure among the citizens of Zambia. The Diabetes Association of Zambia is helping here ● However, Zambia currently lacks a national diabetes registry affecting health system planning and decision-making
Zimbabwe	<ul style="list-style-type: none"> ● Zimbabwe adopted the primary health care approach according the Alma Ata Declaration. There is currently a structure in place within the Ministry of Health handling NCDs headed by a deputy director. The office of the deputy director reports to the director of epidemiology who subsequently reports to the director of preventive services ● There are two main organisations in Zimbabwe very active in issues related to patients with T2DM. The Zimbabwe Diabetic Association(ZDA) consists of patients with diabetes with a mission to improve the physical and socio-economic welfare of patients with diabetes in Zimbabwe through regular promotion and other activities (215). Alongside this, there is the recently formed Zimbabwe Endocrinology, Diabetes and Metabolism Association (ZEDMA) in April 2018 ● The Ministry of Health in Zimbabwe in 2019 plans to conduct an NCDs risk survey with WHO support, with the last survey (STEPS) conducted 2005 giving a prevalence of T2DM at 10.2% as the MoH acknowledges that NCDs have been largely neglected in preference to HIV and TB ● Training workshops on essential NCDs package including T2DM will be conducted starting in August 2019 and the Essential Drug List of Zimbabwe (EDLIZ), including the management of Metabolic and Endocrine conditions, will also be published in 2019 version (last updated in 2015). Zimbabwe guidelines for diabetes management are currently largely contained in the EDLIZ

Box 1 – Suggested activities among national governments and authorities

A) Short term

- Prioritise the screening for diabetes at all health care facilities in the country including those with diabetes alongside infectious diseases such as TB (216). This includes providing the basic tools and technologies to identify at risk patients and to monitor their progress - including providing BP monitors in all clinics alongside glucose monitoring systems, with the provision of self-monitoring systems important for patients on insulin
- Improve the routine availability of medicines in the public sector to treat patients with T2DM including addressing concerns with the current lack of metformin, SUs or insulins when this occurs. This includes ensuring the availability and use of low cost quality medicines (generics) to reduce patient co-payments where applicable. Initiatives could include improved supply chain management incorporating better stock control and forecasting abilities - building on initiatives in South Africa such as the Central Chronic Medication Dispensing and Distribution (CCMDD) (74) – as well as improved regulatory controls limiting the availability of poor quality generics where this is a concern
- Introduce or enhance the implementation of programmes including educational programmes among T2DM patients to improve their lifestyles in association with other groups such as patient associations and other relevant NGOs
- Review and improve where pertinent the training of healthcare professionals in the management of patients with T2DM in both undergraduate and postgraduate programmes to improve future quality of care. This can include instigating CPD activities, and builds on ongoing programmes in Ghana, South Africa and wider
- Instigate/ refine training programmes at both undergraduate and postgraduate levels to improve the care of patients with T2DM. This can include developing and implementing CPD programmes building on initiatives in Ghana to upskill their knowledge – including understanding of the different oral medicines to treat T2DM and insulin preparations as well as their role and place especially in patients with various co-morbidities
- Instigate policies to enhance adherence to prescribed medicines and dietary modifications building on ongoing initiatives across SSA including Kenya and South Africa as well as learnings from other NCDs. This involves improved understanding of key factors influencing adherence including the level of education, family and support systems and funding issues, which is critical to enhance the future care of T2DM patients. It is likely mobile technologies will play an increasing role
- Instigate training and other measures to improve the detection and treatment of T2DM-related causes of blindness such as diabetic retinopathy as well as causes of renal complications including preventative measures along with general measures to improve BP control (217, 218)

B) Longer term

Leadership and governance

- Greater prioritisation of NCDs especially T2DM with its implications for morbidity, mortality and costs. As part of this, instigate activities to develop or refine national strategies to improve the care of patients with T2DM, building on current activities among SSA countries (Table 1). This can include implementing national NCD strategies with their emphasis on identification, healthy lifestyle changes (physical activity, healthy eating, limiting process foods and weight management – including addressing concerns with any stigma/ negative perceptions associated with weight loss) along with adequate treatment of patients with T2DM based on agreed national guidelines (cognisant of local co-morbidities including infectious diseases among the different SSA countries)
 - Conduct screening for NCDs including T2DM among at risk individuals including those with a family history of diabetes, overweight or obese at schools, workplaces, churches and shopping centres as well as in PHCs
- #### **Health workforce**
- Strengthen health care systems including ambulatory care systems as well as policies and initiatives to better identify and manage patients with T2DM. This can include making better use of healthcare professionals and community health workers in primary/ community health clinics as well as community pharmacists to help with education and medication adherence (Boxes 3 and 4)

- Seek to address shortages of physicians where applicable including training and utilising of other healthcare professionals such as clinical associates (or clinical officers), nurses and community pharmacists to help manage patients with T2DM. This can also include instigating home visits by healthcare professionals such as dieticians, diabetic nurse educators and podiatrists, to improve the care of patients; however, instilling that complex cases must be rapidly referred to specialists
- Task-shifting through utilization of mid-level workers (such as pharmacist, physiotherapy, podiatry) to support the clinical management of NCDs. As a result, enhance the multidisciplinary approach to the management of patients with T2DM throughout the healthcare system
- Undertake multidisciplinary research at local, regional and national settings to improve future care of patients with T2DM including adherence to medicines, and seek to instigate the finding
- **Financing**
- Accelerate the introduction of universal healthcare in the public sector where patient co-payments are currently an issue to improve the care of patients with T2DM
- **Improved efficiency**
- Strengthen HTA capabilities especially when Ministries of Health are confronted with a number of potential initiatives coupled with limited resources, building on ongoing initiatives across sub-Saharan Africa including Ghana, Kenya and South Africa (172, 174, 176, 219)
- Address the social and cultural determinants of health in patients with T2DM through leadership at a national level if not already underway - building on initiatives in Botswana, Ghana, Kenya, Kingdom of Eswatini, Namibia and South Africa to prevent or manage the risk factors associated with T2DM through greater stakeholder collaboration (6, 7, 87, 184, 191, 220)
- Disseminate NCD information including T2DM regularly in national political forums, e.g. public speeches and in parliamentary debates
- Strengthen the monitoring and evaluation of the management and treatment of T2DM to ensure that efforts are in line with the burden of NCDs. This includes regular auditing of the management of patients with T2DM against agreed national guidelines and seek to introduce quality indicators where concerns. Quality indicators can include HbA1c, BP and lipid level goals developed with the help of all key stakeholders using robust methodologies (160, 221)
- **Research**
- Continue to research methods to improve medication and dietary adherence including counselling, concerns with processed foods, addressing patients' fears and beliefs including concerns with weight loss, potentially patient diaries and mobile messaging services, as well as measures to enhance patient satisfaction with healthcare services (40, 120, 145, 146, 222). Subsequently, seek to instigate such findings
- Fund ongoing research around diabetic phenotypes among the African population compared with other continents and its impact on key issues such as insulin resistance to improve future care (18, 20)

Box 2 – Suggested activities among physicians (hospital and ambulatory care)

A) Short term

- Instigate/ refine training programmes at both undergraduate and postgraduate levels to improve the care of patients with T2DM
- This can include developing and implementing CPD programmes building on initiatives in Ghana as well as programmes to enhance timely diagnosis, management and follow-up of patients with T2DM including the management of patients with T2DM with HIV and TB
- Instigate in-service training where pertinent including any updated guidelines for new medicines
- Take part in Pharmaceutical (Drug) and Therapeutic Committees and other fora to ensure possible treatment decisions are in line with national guidelines and essential medicine lists, and evidence based especially where co-morbidities
- Ensure prompt referral of patients (ambulatory/ primary care) to specialised centres where these exist and where necessary - including complex patients with multiple co-morbidities
- Formulate care plans for patients and monitor prescribing (audit) against agreed guidance, especially those with co-morbidities including infectious diseases with rapid referral to specialist centres for more complex patients including those with multiple co-morbidities

- Communicate with patients the importance of adherence to medicines, and seek to monitor this. This can be through diaries and other mechanisms including the use of mobile technologies
- B) Longer term**
- Actively become involved in future research to improve the management of patients with T2DM in SSA given the high rate of co-morbidities especially infectious diseases in SSA compared with other continents as well as positive views towards overweight and obesity among populations in SSA

Box 3 – Suggested activities among pharmacists (hospital and ambulatory care)

- A) Sort Term**
- Extend the role of pharmacists in hospitals and in the community to help improve the care of patients with T2DM. This can include counselling on issues of medication adherence, potential side-effects of medicines, and dispelling myths especially with community pharmacists often the first point of contact for patients with ailments in SSA
 - Encourage pharmacists to join national diabetes groups (such as ZEDMA in Zimbabwe) to help debate key issues regarding the use of medicines to treat patients with T2DM
 - Pharmacists as a vital part of the medicine supply chain need to instigate measures to reduce out-of-stock situations for essential medicines to treat patients with T2DM in public health facilities to reduce reliance on private pharmacies especially where co-payments are an issue
 - Pharmacists should also monitor medicine availability in hospitals as part of DTC activities to help reduce out-of-stock situations, and work with physicians and others to instigate alternative medicines should the need arise
 - Pharmacists should also seek to encourage the use of generic medicines where possible to reduce patient co-payments where pertinent
- B) Longer term**
- Pharmacists need to become actively involved with auditing medicine use and providing support and other services to improve medication adherence. These can include mobile alerts, diaries, storyboards and general information to enhance adherence, and can be part of DTC activities in hospitals as well as part of PHC activities in ambulatory care
 - Take part in research regarding factors impacting on medication adherence and possible ways to address this within their own health service, and seek to actively address and implement key findings

Box 4 – Suggested activities among other healthcare professionals in ambulatory and hospital care including nurse practitioners

- A) Short term**
- Use nurse practitioners and others to help screen for T2DM in the community especially at risk groups (Box 1)
 - Work with other key stakeholders to provide accurate information to patients on the management of their condition including self-care to help prevent complications from occurring
- B) Longer term**
- Become involved with developing minimal standards of care for patients with T2DM in primary/community healthcare centres and subsequently monitoring the management of patients against agreed standards. This can include lifestyle changes and adherence to medicines as well as identifying acute and chronic complications for rapid referral
 - Actively seek ways to provide support to patients and their caregivers to take control of their own health and to enhance adherence to lifestyle advice and any medicines prescribed
 - Actively seek to improve the knowledge of medicines and self-management practices among fellow nurses and other community health workers regarding the care of patients with T2DM to enhance task shifting efforts at primary/community level - ultimately helping to reduce time spent on long queues and the implications on key issues such as adherence. Concurrently with this, rapidly refer more complex patients to specialists given ongoing concerns
 - Provide evidence based care especially regarding complications of diabetes such as ulcers
 - Take part in research initiatives to improve the future care of patients with T2DM, and seek to instigate the outcome of any research activities

Box 5 – Suggested activities among patients/ support services

A) Short term

- Help communicate the importance of detection and management of T2DM including lifestyle changes and adherence to medicines to help reduce the morbidity and mortality of T2DM. This builds on progressive activities of a number of diabetes patient groups in SSA (Table 1) – and is especially important where there are limited facilities to manage the complications of diabetes including renal complications, retinopathy and diabetic ulceration
- Help to instigate communication and other programmes to encourage patients to join national Diabetic Associations as well as generally encouraging patients and their carers to take part in peer education and support groups
- Help provide easy to understand guidance to patients to help with their understanding of their condition as well as improve the management of their condition including lifestyle and medication advice. Such guidance should also help to dispel cultural and social stigmas associated with T2DM including those surrounding weight loss
- Instigate activities encouraging recreational activities as well encouraging patients to ask questions when they are still unsure of their condition/ instructions given and to seek prompt medical help when they experience changes in their condition
- Seek generally to strengthen family support structures through education and socio-economic empowerment
- Work with all key stakeholders to enhance their understanding of any concerns that patients and their support network may have regarding the management of T2DM and potential complications to better target educational and other activities

B) Longer term

- Formulate and empower support groups among patients with T2DM such as adherence clubs to enhance the transfer of knowledge and self-management aspects among patients
- Help longer term to develop innovative interventions tailored to the culture of patients in given SSA countries to enhance adherence to medication and lifestyle changes, such as storytelling, which have shown to be successful in other NCDs (223). This can increasingly be via mobile technologies and other support systems (30, 146, 183, 224)
- Encourage greater involvement in the prevention of diabetes complications by self-monitoring of foot health and active participation in screening for eye, foot, and renal complications
- Encourage key stakeholders to include patient support groups in future research activities and with the communication of their findings to improve future care

References

1. Cois A, Day C. Obesity trends and risk factors in the South African adult population. *BMC obesity*. 2015;2:42.
2. Trends in obesity and diabetes across Africa from 1980 to 2014: an analysis of pooled population-based studies. *International journal of epidemiology*. 2017.
3. Ofori-Asenso R, Agyeman AA, Laar A, Boateng D. Overweight and obesity epidemic in Ghana-a systematic review and meta-analysis. *BMC public health*. 2016;16(1):1239.
4. Owiredu WKBA, Adamu MS, Amidu N, Woode E, Bam V, Plange-Rhule J, et al. Obesity and Cardiovascular Risk Factors in a Pentecostal Population in Kumasi-Ghana. *J Med Sci* 2008; 8:682-690.
5. SEMDSA 2017 Guidelines for the Management of Type 2 diabetes mellitus. SEMDSA Type 2 Diabetes Guidelines Expert Committee. *JEMDSA* 2017; 22(1)(Supplement 1): S1-S196.
6. Ministry of Health and Social Services, Primary Health Care Directorate, Namibia. National Multisectoral Strategic Plan For Prevention and Control of Non-Communicable Diseases (NCDs) in Namibia 2017/18 – 2021/22. 2017. Available at URL: <https://www.iccp-portal.org/system/files/plans/NAMIBIA%20NATIONAL%20MULTISECTORAL%20STRATEGIC%20PLAN%20FOR%20PREVENTION%20AND%20CONTROL%20OF%20NCDs.pdf>.
7. KINGDOM OF ESWATINI - MINISTRY OF HEALTH. 2017 NATIONAL PREVENTION AND CONTROL OF NON COMMUNICABLE DISEASES (NCDs). 2017 Annual Program Report.
8. Buse K, Tanaka S, Hawkes S. Healthy people and healthy profits? Elaborating a conceptual framework for governing the commercial determinants of non-communicable diseases and identifying options for reducing risk exposure. *Global Health*. 2017;13(1):34.

9. Werfalli M, Engel ME, Musekiwa A, Kengne AP, Levitt NS. The prevalence of type 2 diabetes among older people in Africa: a systematic review. *The lancet Diabetes & endocrinology*. 2016;4(1):72-84.
10. Mbanya JC, Assah FK, Saji J, Atanga EN. Obesity and type 2 diabetes in Sub-Saharan Africa. *Current diabetes reports*. 2014;14(7):501.
11. Zekewos A, Loha E, Egeno T, Wubshet K, Merga Z. Prevalence of Diabetes Mellitus and Associated Factors in Southern Ethiopia: A Community Based Study. *Ethiop J Health Sci*. 2018;28(4):451-60.
12. Osei-Yeboah J, Owiredu W, Norgbe G, Obirikorang C, Lokpo S, Ashigbi E, et al. Physical Activity Pattern and Its Association with Glycaemic and Blood Pressure Control among People Living with Diabetes (PLWD) In The Ho Municipality, Ghana. *Ethiopian journal of health sciences*. 2019;29(1):819-30.
13. Agyemang C, Meeks K, Beune E, Owusu-Dabo E, Mockenhaupt FP, Addo J, et al. Obesity and type 2 diabetes in sub-Saharan Africans - Is the burden in today's Africa similar to African migrants in Europe? The RODAM study. *BMC medicine*. 2016;14(1):166.
14. Kharroubi AT, Darwish HM. Diabetes mellitus: The epidemic of the century. *World journal of diabetes*. 2015;6(6):850-67.
15. Todowede OO, Sartorius B. Prevalence of metabolic syndrome, discrete or comorbid diabetes and hypertension in sub-Saharan Africa among people living with HIV versus HIV-negative populations: a systematic review and meta-analysis protocol. *BMJ open*. 2017;7(7):e016602.
16. Commodore-Mensah Y, Samuel LJ, Dennison-Himmelfarb CR, Agyemang C. Hypertension and overweight/obesity in Ghanaians and Nigerians living in West Africa and industrialized countries: a systematic review. *Journal of hypertension*. 2014;32(3):464-72.
17. Mohamed SF, Mwangi M, Mutua MK, Kibachio J, Hussein A, Ndegwa Z, et al. Prevalence and factors associated with pre-diabetes and diabetes mellitus in Kenya: results from a national survey. *BMC public health*. 2018;18(3):1215.
18. Kibirige D, Lumu W, Jones AG, Smeeth L, Hattersley AT, Nyirenda MJ. Understanding the manifestation of diabetes in sub Saharan Africa to inform therapeutic approaches and preventive strategies: a narrative review. *Clinical Diabetes and Endocrinology*. 2019;5(1):2.
19. WHO. World Health Organisation, Diabetes Fact sheet July 2016. Available at URL: <http://www.who.int/mediacentre/factsheets/fs312/en/>
20. Pastakia SD, Pekny CR, Manyara SM, Fischer L. Diabetes in sub-Saharan Africa - from policy to practice to progress: targeting the existing gaps for future care for diabetes. *Diabetes Metab Syndr Obes*. 2017;10:247-63.
21. International Diabetes Federation. IDF Diabetes Atlas 7th edition. Available at URL: <https://www.idf.org/e-library/epidemiology-research/diabetes-atlas/13-diabetes-atlas-seventh-edition.html>.
22. Waari G, Mutai J, Gikunju J. Medication adherence and factors associated with poor adherence among type 2 diabetes mellitus patients on follow-up at Kenyatta National Hospital, Kenya. *Pan Afr Med J*. 2018;29:82.
23. International Diabetes Federation. IDF Africa Members. 2019. Available at URL: <https://idf.org/our-network/regions-members/africa/members/25-south-africa.html>.
24. Saghir J, Santoro J. Urbanization in Sub-Saharan Africa - Meeting Challenges by Bridging Stakeholders. 2018. Available at URL: https://csis-prod.s3.amazonaws.com/s3fs-public/publication/180411_Saghir_UrbanizationAfrica_Web.pdf.
25. Napier AD, Nolan JJ, Bagger M, Hesseldal L, Volkmann AM. Study protocol for the Cities Changing Diabetes programme: a global mixed-methods approach. *BMJ open*. 2017;7(11):e015240.
26. Manne-Goehler J, Geldsetzer P, Agoudavi K, Andall-Brereton G, Aryal KK, Bicaba BW, et al. Health system performance for people with diabetes in 28 low- and middle-income countries: A cross-sectional study of nationally representative surveys. *PLoS Med*. 2019;16(3):e1002751.
27. Mapa-Tassou C, Katte JC, Mba Maadjhou C, Mbanya JC. Economic Impact of Diabetes in Africa. *Current diabetes reports*. 2019;19(2):5.
28. Low Wang CC, Hess CN, Hiatt WR, Goldfine AB. Clinical Update: Cardiovascular Disease in Diabetes Mellitus: Atherosclerotic Cardiovascular Disease and Heart Failure in Type 2 Diabetes Mellitus - Mechanisms, Management, and Clinical Considerations. *Circulation*. 2016;133(24):2459-502.
29. Adibe MO, Anosike C, Nduka SO, Isah A. Evaluation of Health Status of Type 2 Diabetes Outpatients Receiving Care in a Tertiary Hospital in Nigeria. *PharmacoEconomics - open*. 2018;2(3):337-45.

30. Lewis AD, Hogg RE, Chandran M, Musonda L, North L, Chakravarthy U, et al. Prevalence of diabetic retinopathy and visual impairment in patients with diabetes mellitus in Zambia through the implementation of a mobile diabetic retinopathy screening project in the Copperbelt province: a cross-sectional study. *Eye*. 2018;32(7):1201-8.
31. Glover SJ, Burgess PI, Cohen DB, Harding SP, Hofland HW, Zijlstra EE, et al. Prevalence of diabetic retinopathy, cataract and visual impairment in patients with diabetes in sub-Saharan Africa. *The British journal of ophthalmology*. 2012;96(2):156-61.
32. Pheiffer C, Pillay-van Wyk V, Joubert JD, Levitt N, Nglazi MD, Bradshaw D. The prevalence of type 2 diabetes in South Africa: a systematic review protocol. *BMJ open*. 2018;8(7):e021029-e.
33. Rwegerera GM, Moshomo T, Gaenamong M, Oyewo TA, Gollakota S, Rivera YP, et al. Health-related quality of life and associated factors among patients with diabetes mellitus in Botswana. *Alexandria Journal of Medicine*. 2018;54(2):111-8.
34. Glezeva N, Gallagher J, Ledwidge M, O'Donoghue J, McDonald K, Chipolombwe J, et al. Heart failure in sub-Saharan Africa: review of the aetiology of heart failure and the role of point-of-care biomarker diagnostics. *Trop Med Int Health*. 2015;20(5):581-8.
35. Atun R, Davies JI, Gale EAM, Barnighausen T, Beran D, Kengne AP, et al. Diabetes in sub-Saharan Africa: from clinical care to health policy. *The lancet Diabetes & endocrinology*. 2017;5(8):622-67.
36. Issaka A, Paradies Y, Stevenson C. Modifiable and emerging risk factors for type 2 diabetes in Africa: a systematic review and meta-analysis protocol. *Systematic reviews*. 2018;7(1):139.
37. Renzaho AMN. The post-2015 development agenda for diabetes in sub-Saharan Africa: challenges and future directions. *Global health action*. 2015;8:27600-.
38. Peer N, Kengne AP, Motala AA, Mbanya JC. Diabetes in the Africa Region: an update. *Diabetes research and clinical practice*. 2014;103(2):197-205.
39. Statistics South Africa. Mortality and causes of death in South Africa, 2016: Findings from death notification. Available at URL: <http://www.statssa.gov.za/publications/P03093/P030932016.pdf>.
40. Moosa A, Bezuidenhout S, Meyer JC, Godman B. Knowledge regarding medicines management of type-2 diabetes among patients attending a Community Health Centre in South Africa. *Journal of Pharmaceutical Health Services Research*. 2019, 10; 13–21.
41. Fasanmade OA, Dagogo-Jack S. Diabetes Care in Nigeria. *Ann Glob Health*. 2015;81(6):821-9.
42. da Mata AR, Alvares J, Diniz LM, da Silva MR, Alvernaz dos Santos BR, Guerra Junior AA, et al. Quality of life of patients with Diabetes Mellitus Types 1 and 2 from a referral health centre in Minas Gerais, Brazil. *Expert review of clinical pharmacology*. 2016;9(5):739-46.
43. Jingi AM, Nansseu JR, Noubiap JJ, Bilong Y, Ellong A, Mvogo CE. Diabetes and visual impairment in sub-Saharan Africa: evidence from Cameroon. *Journal of diabetes and metabolic disorders*. 2015;14:21.
44. Cairncross JP, Steinberg WJ, Labuschagne MJ. Prevalence of eye pathology in a group of diabetic patients at National District Hospital Outpatient Department in Bloemfontein, South Africa. *Afr J Prim Health Care Fam Med*. 2017;9(1):e1-e7.
45. Wagnew F, Eshetie S, Kibret GD, Zegeye A, Dessie G, Mulugeta H, et al. Diabetic nephropathy and hypertension in diabetes patients of sub-Saharan countries: a systematic review and meta-analysis. *BMC research notes*. 2018;11(1):565.
46. Thomas MC, Cooper ME, Zimmet P. Changing epidemiology of type 2 diabetes mellitus and associated chronic kidney disease. *Nature reviews Nephrology*. 2016;12(2):73-81.
47. Sun J, Wang Y, Zhang X, Zhu S, He H. Prevalence of peripheral neuropathy in patients with diabetes: A systematic review and meta-analysis. *Primary care diabetes*. 2020.
48. Awadalla H, Noor SK, Elmadhoun WM, Almobarak AO, Elmak NE, Abdelaziz SI, et al. Diabetes complications in Sudanese individuals with type 2 diabetes: Overlooked problems in sub-Saharan Africa? *Diabetes & metabolic syndrome*. 2017;11 Suppl 2:S1047-s51.
49. Mbanya JC, Motala AA, Sobngwi E, Assah FK, Enoru ST. Diabetes in sub-Saharan Africa. *Lancet*. 2010; 375: 2254 – 66.
50. Mbanya JC, Sobngwi E. Diabetes microvascular and macrovascular disease in Africa. *J Cardiovasc Risk* 2003; 10: 97–102.
51. Asmelash D, Asmelash Y. The Burden of Undiagnosed Diabetes Mellitus in Adult African Population: A Systematic Review and Meta-Analysis. *Journal of diabetes research*. 2019;2019:4134937.
52. Stokes A, Berry KM, McHiza Z, Parker WA, Labadarios D, Chola L, et al. Prevalence and unmet need for diabetes care across the care continuum in a national sample of South African adults: Evidence from the SANHANES-1, 2011-2012. *PLoS one*. 2017;12(10):e0184264.

53. International Diabetes Federation. IDF Diabetes Atlas. 2017; 8th edition. Available at URL: <http://www.diabetesatlas.org>.
54. Mwita JC, Magafu M, Omech B, Tsima B, Dewhurst MJ, Goepamang M, et al. Undiagnosed and diagnosed diabetes mellitus among hospitalised acute heart failure patients in Botswana. *SAGE open medicine*. 2017;5:2050312117731473.
55. Sarfo FS, Mobula LM, Plange-Rhule J, Ansong D, Ofori-Adjei D. Incident stroke among Ghanaians with hypertension and diabetes: A multicenter, prospective cohort study. *Journal of the neurological sciences*. 2018;395:17-24.
56. Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38. UK Prospective Diabetes Study Group. *BMJ*. 1998;317(7160):703-13.
57. U.K. prospective diabetes study 16. Overview of 6 years' therapy of type II diabetes: a progressive disease. U.K. Prospective Diabetes Study Group. *Diabetes*. 1995;44(11):1249-58.
58. MRC/BHF Heart Protection Study of cholesterol lowering with simvastatin in 20,536 high-risk individuals: a randomised placebo-controlled trial. *Lancet*. 2002;360(9326):7-22.
59. Wan EYF, Fung CSC, Yu EYT, Chin WY, Fong DYT, Chan AKC, et al. Effect of Multifactorial Treatment Targets and Relative Importance of Hemoglobin A1c, Blood Pressure, and Low-Density Lipoprotein-Cholesterol on Cardiovascular Diseases in Chinese Primary Care Patients With Type 2 Diabetes Mellitus: A Population-Based Retrospective Cohort Study. *Journal of the American Heart Association*. 2017;6(8).
60. Pinchevsky Y, Butkow N, Chirwa T, Raal FJ. Glycaemic, blood pressure and cholesterol control in 25 629 diabetics. *Cardiovascular journal of Africa*. 2015;26(4):188-92.
61. Sobngwi E, Ndour-Mbaye M, Boateng KA, Ramaiya KL, Njenga EW, Diop SN, et al. Type 2 diabetes control and complications in specialised diabetes care centres of six sub-Saharan African countries: the Diabcare Africa study. *Diabetes research and clinical practice*. 2012;95(1):30-6.
62. Wirtz VJ, Turpin K, Laing RO, Mukiira CK, Rockers PC. Access to medicines for asthma, diabetes and hypertension in eight counties of Kenya. *Trop Med Int Health*. 2018;23(8):879-85.
63. Rasmussen B, Sweeny K, Sheehan P. HEALTH AND THE ECONOMY - The Impact of Wellness on Workforce Productivity in Global Markets. A Report to the U.S. Chamber of Commerce's Global Initiative on Health and Economy. 2016. Available at URL: https://www.uschamber.com/sites/default/files/documents/files/global_initiative_on_health_and_the_economy_-_report.pdf.
64. Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, et al. Global, Regional, and National Burden of Cardiovascular Diseases for 10 Causes, 1990 to 2015. *Journal of the American College of Cardiology*. 2017;70(1):1-25.
65. Joseph P, Leong D, McKee M, Anand SS, Schwalm JD, Teo K, et al. Reducing the Global Burden of Cardiovascular Disease, Part 1: The Epidemiology and Risk Factors. *Circulation research*. 2017;121(6):677-94.
66. Kibirige D, Atuhe D, Kampiire L, Kiggundu DS, Donggo P, Nabbaale J, et al. Access to medicines and diagnostic tests integral in the management of diabetes mellitus and cardiovascular diseases in Uganda: insights from the ACCODAD study. *Int J Equity Health*. 2017;16(1):154.
67. World Health Organization - Model List of Essential Medicines. 21st List 2019. Available at URL: <https://apps.who.int/iris/bitstream/handle/10665/325771/WHO-MVP-EMP-IAU-2019.06-eng.pdf?ua=1>.
68. Naidoo P, Rambiritch V, Butkow N, Saman S. Optimal utilisation of sulphonylureas in resource-constrained settings. *Cardiovascular journal of Africa*. 2014;25(2):83-5.
69. Abrahamson MJ. Should sulfonylureas remain an acceptable first-line add-on to metformin therapy in patients with type 2 diabetes? Yes, they continue to serve us well! *Diabetes Care*. 2015;38(1):166-9.
70. Colagiuri S, Matthews D, Leiter LA, Chan SP, Sesti G, Marre M. The place of gliclazide MR in the evolving type 2 diabetes landscape: A comparison with other sulfonylureas and newer oral antihyperglycemic agents. *Diabetes research and clinical practice*. 2018;143:1-14.
71. Kalra S, Bahendeka S, Sahay R, Ghosh S, Md F, Orabi A, et al. Consensus Recommendations on Sulfonylurea and Sulfonylurea Combinations in the Management of Type 2 Diabetes Mellitus - International Task Force. *Indian J Endocrinol Metab*. 2018;22(1):132-57.
72. Federal Ministry of Health, Nigeria. Essential Medicines list, sixth revision, 2016. Available from URL: <https://apps.who.int/medicinedocs/documents/s23528en/s23528en.pdf>.
73. Erah PO, Eroje HI. Prescribing of antidiabetic medicines to older diabetes type 2 patients in Lagos, Nigeria. *Nigerian quarterly journal of hospital medicine*. 2013;23(1):12-6.

74. Meyer JC, Schellack N, Stokes J, Lancaster R, Zeeman H, Defty D, et al. Ongoing Initiatives to Improve the Quality and Efficiency of Medicine Use within the Public Healthcare System in South Africa; A Preliminary Study. *Frontiers in pharmacology*. 2017;8:751.
75. Sandoz - A Novartis Division. Kenya is first country to launch 'Novartis Access', expanding affordable treatment options against chronic diseases. 2015. Available at URL: <https://www.sandoz.com/news/media-releases/kenya-first-country-launch-novartis-access-expanding-affordable-treatment>.
76. Wirtz VJ, Kaplan WA, Kwan GF, Laing RO. Access to Medications for Cardiovascular Diseases in Low- and Middle-Income Countries. *Circulation*. 2016;133(21):2076-85.
77. Bailey CJ, Day C. The future of new drugs for diabetes management. *Diabetes research and clinical practice*. 2019;155:107785.
78. Li Z, Zhao L, Yu L, Yang J. Head-to-Head Comparison of the Hypoglycemic Efficacy and Safety Between Dipeptidyl Peptidase-4 Inhibitors and alpha-Glucosidase Inhibitors in Patients With Type 2 Diabetes Mellitus: A Meta-Analysis of Randomized Controlled Trials. *Frontiers in pharmacology*. 2019;10:777.
79. Sjöholm Å. Ketosis-Prone Type 2 Diabetes: A Case Series. *Frontiers in Endocrinology*. 2019;10:684.
80. Ahren B, Corrigan CB, Alberti KG. Plasma insulin and C-peptide responses to oral glucose in newly diagnosed diabetics in north-western Tanzania. *East Afr Med J*. 1988; 65:847–51.
81. Sobngwi E, Mauvais-Jarvis F, Vexiau P, Mbanya JC, Gautier JF. Diabetes in Africans, part 2: ketosis prone atypical diabetes mellitus. *Diabetes Metab* 2002; 28: 5–12.
82. Davies MJ, D'Alessio DA, Fradkin J, Kernan WN, Mathieu C, Mingrone G, et al. Management of Hyperglycemia in Type 2 Diabetes, 2018. A Consensus Report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care*. 2018;41(12):2669-701.
83. Mwita JC, Francis JM, Omech B, Botsile E, Oyewo A, Mokgwathi M, et al. Glycaemic, blood pressure and low-density lipoprotein-cholesterol control among patients with diabetes mellitus in a specialised clinic in Botswana: a cross-sectional study. *BMJ open*. 2019;9(7):e026807.
84. Kibirige D, Atuhe D, Sebunya R, Mwebaze R. Suboptimal glycaemic and blood pressure control and screening for diabetic complications in adult ambulatory diabetic patients in Uganda: a retrospective study from a developing country. *Journal of diabetes and metabolic disorders*. 2014;13(1):40.
85. Mwita JC, Mugusi F, Lwakatare J, Chiwanga F. Hypertension control and other cardiovascular risk factors among diabetic patients at Muhimbili National Hospital, Tanzania. *East African journal of public health*. 2012;9(2):70-3.
86. Rwegerera GM, Masaka A, Pina-Rivera Y, Moshomo T, Gaenamang M, Godman B, et al. Determinants of glycemic control among diabetes mellitus patients in a tertiary clinic in Gaborone, Botswana: findings and implications. *Hospital practice*. 2019;47(1):34-41.
87. South African Lancet National Commission. Confronting the right to ethical and accountable quality health care in South Africa: A consensus report. Pretoria: National Department of Health. 2019. Available at URL: http://rhap.org.za/wp-content/uploads/2019/01/SA-Lancet-Report-Synopsis-South-Africa_Confronting-the-Right-to-Ethical-Accountable-Healthcare.pdf.
88. Choukem SP, Kengne AP, Dehayem YM, Simo NL, Mbanya JC. Hypertension in people with diabetes in sub-Saharan Africa: revealing the hidden face of the iceberg. *Diabetes Res Clin Pract*. 2007;77(2):293-9.
89. James PA, Oparil S, Carter BL, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: Report from the panel members appointed to the eighth joint national committee (JNC 8). *Jama*. 2014;311(5):507-20.
90. SEMDSA Type 2 Diabetes Guidelines Expert Committee. SEMDSA 2017 guidelines for the management of type 2 diabetes mellitus. *J Endocr Metab Diabetes S Afr*. 2017;22(1 Suppl 1):S1-S196.
91. Mbui JM, Oluka MN, Guantai EM, Sinei KA, Achieng L, Baker A, et al. Prescription patterns and adequacy of blood pressure control among adult hypertensive patients in Kenya; findings and implications. *Expert review of clinical pharmacology*. 2017;10(11):1263-71.
92. Uloko AE, Ofoegbu EN, Chinenye S, et al. Profile of Nigerians with diabetes mellitus - Diabcare Nigeria study group (2008): Results of a multicenter study. *Indian journal of endocrinology and metabolism* 2012;16(4):558-64.
93. Mendenhall E, Norris SA. Diabetes care among urban women in Soweto, South Africa: a qualitative study. *BMC public health*. 2015;15:1300.

94. Nashilongo MM, Singu B, Kalemeera F, Mubita M, Naikaku E, Baker A, et al. Assessing Adherence to Antihypertensive Therapy in Primary Health Care in Namibia: Findings and Implications. *Cardiovascular drugs and therapy*. 2017;31(5-6):565-78.
95. Dube L, Rendall-Mkosi K, Van den Broucke S, Bergh A-M, Mafutha NG. Self-Management Support Needs of Patients with Chronic Diseases in a South African Township: A Qualitative Study. *Journal of Community Health Nursing*. 2017;34(1):21-31.
96. Cameron A, Ewen M, Ross-Degnan D, Ball D, Laing R. Medicine prices, availability, and affordability in 36 developing and middle-income countries: a secondary analysis. *Lancet*. 2009;373(9659):240-9.
97. Ofori-Asenso R, Agyeman AA. Irrational Use of Medicines—A Summary of Key Concepts. *Pharmacy* 2016;4, 35.
98. Mhlanga BS, Suleman F. Price, availability and affordability of medicines. *Afr J Prim Health Care Fam Med*. 2014;6(1):E1-6.
99. Ong SE, Koh JJK, Toh SES, Chia KS, Balabanova D, McKee M, et al. Assessing the influence of health systems on Type 2 Diabetes Mellitus awareness, treatment, adherence, and control: A systematic review. *PloS one*. 2018;13(3):e0195086.
100. Okoronkwo IL, Ekpemiro JN, Onwujekwe OE, Nwaneri AC, Iheanacho PN. Socioeconomic inequities and payment coping mechanisms used in the treatment of type 2 diabetes mellitus in Nigeria. *Nigerian journal of clinical practice*. 2016;19(1):104-9.
101. Fadare J, Olamoyegun M, Gbadegesin BA. Medication adherence and direct treatment cost among diabetes patients attending a tertiary healthcare facility in Ogbomoso, Nigeria. *Malawi Med J*. 2015;27(2):65-70.
102. Akunne OO, Godman B, Adedapo AD, Truter I, Fadare J. Statin prescribing among hypertensive patients in southwest Nigeria: findings and implications for the future. *Journal of comparative effectiveness research*. 2016;5(3):281-8.
103. Fadare JO, Adeoti AO, Desalu OO, Enwere OO, Makusidi AM, Ogunleye O, et al. The prescribing of generic medicines in Nigeria: knowledge, perceptions and attitudes of physicians. *Expert review of pharmacoeconomics & outcomes research*. 2016;16(5):639-50.
104. Stephani V, Opoku D, Beran D. Self-management of diabetes in Sub-Saharan Africa: a systematic review. *BMC public health*. 2018;18(1):1148.
105. Bongor Z, Shiferaw S, Tariku EZ. Adherence to diabetic self-care practices and its associated factors among patients with type 2 diabetes in Addis Ababa, Ethiopia. *Patient preference and adherence*. 2018;12:963-70.
106. Mogre V, Abanga ZO, Tzelepis F, Johnson NA, Paul C. Adherence to and factors associated with self-care behaviours in type 2 diabetes patients in Ghana. *BMC endocrine disorders*. 2017;17(1):20-.
107. Moosa A, Bezuidenhout S, Meyer JC. Knowledge of type-2 diabetes among patients attending a community health centre in Pretoria, South Africa : patient centered treatment and care. *Afr. J. Phys. Health Educ. Recr. Dance* 2015; Suppl 2 21: 241-251. Available at URL: <https://journals.co.za/content/ajpherd/21/sup-2?page=3>.
108. Mufunda E, Ernersson A, Hjelm K. Limited knowledge of diabetes in patients attending an outpatient diabetes clinic at a referral hospital in Zimbabwe: a cross-sectional study. *Pan Afr Med J*. 2018;29:144.
109. Kassahun T, Gesesew H, Mwanri L, Eshetie T. Diabetes related knowledge, self-care behaviours and adherence to medications among diabetic patients in Southwest Ethiopia: a cross-sectional survey. *BMC Endocr Disord*. 2016;16(1):28.
110. Chang H, Hawley NL, Kalyesubula R, Siddharthan T, Checkley W, Knauf F, et al. Challenges to hypertension and diabetes management in rural Uganda: a qualitative study with patients, village health team members, and health care professionals. *Int J Equity Health*. 2019;18(1):38.
111. Niguse H, Belay G, Fisseha G, Desale T, Gebremedhn G. Self-care related knowledge, attitude, practice and associated factors among patients with diabetes in Ayder Comprehensive Specialized Hospital, North Ethiopia. *BMC research notes*. 2019;12(1):34.
112. Rampamba EM, Meyer JC, Helberg E, Godman B. Knowledge of hypertension and its management among hypertensive patients on chronic medicines at primary health care public sector facilities in South Africa; findings and implications. *Expert review of cardiovascular therapy*. 2017;15(8):639-47.
113. Rankgoane-Pono G, Tshikuka JG, Magafu MGD, Masupe T, Molefi M, Hamda SG, et al. Incidence of diabetes mellitus-related comorbidities among patients attending two major HIV clinics in Botswana: a 12-year retrospective cohort study. *BMC research notes*. 2018;11(1):90.

114. Hatsu I, Baum MK, Huffman F, Bussmann H, Dusara P, Makhema J et al. Diabetes in HIV Positive Adults in Botswana: Nutritional and Demographic Characteristics. *The FASEB Journal*. 2009; 23 (Supplement 1): 547.15-547.15 (Available at URL: https://www.fasebj.org/doi/abs/10.1096/fasebj.23.1_supplement.547.15).
115. Awodele O, Osulale JA. Medication adherence in type 2 diabetes patients: study of patients in Alimosho General Hospital, Igando, Lagos, Nigeria. *Afr Health Sci*. 2015;15(2):513-22.
116. Elsous A, Radwan M, Al-Sharif H, Abu Mustafa A. Medications Adherence and Associated Factors among Patients with Type 2 Diabetes Mellitus in the Gaza Strip, Palestine. *Frontiers in Endocrinology*. 2017;8(100).
117. Sapkota S, Brien J-AE, Greenfield JR, Aslani P. A Systematic Review of Interventions Addressing Adherence to Anti-Diabetic Medications in Patients with Type 2 Diabetes--Components of Interventions. *PloS one*. 2015;10(6):e0128581-e.
118. Igbojiaku OJ, Harbor OC, Ross A. Compliance with diabetes guidelines at a regional hospital in KwaZulu-Natal, South Africa. *African Journal of Primary Health Care & Family Medicine*. 2013;5(1):447.
119. Abate TW. Medication non-adherence and associated factors among diabetes patients in Felege Hiwot Referral Hospital, Bahir Dar city administration, Northwest Ethiopia. *BMC research notes*. 2019;12(1):175.
120. Waari G, Mutai J, Gikunju J. Medication adherence and factors associated with poor adherence among type 2 diabetes mellitus patients on follow-up at Kenyatta National Hospital, Kenya. *The Pan African Medical Journal*. 2018;29:82.
121. Adegbola SA, Marincowitz GJ, Govender I, Ogunbanjo GA. Assessment of self-reported adherence among patients with type 2 diabetes in Matlala District Hospital, Limpopo Province. *Afr J Prim Health Care Fam Med*. 2016;8(1):e1-5.
122. Dedefo MG, Ejeta BM, Wakjira GB, Mekonen GF, Labata BG. Self-care practices regarding diabetes among diabetic patients in West Ethiopia. *BMC research notes*. 2019;12(1):212.
123. Gudina EK, Amade ST, Tesfamichael FA, Ram R. Assessment of quality of care given to diabetic patients at Jimma University Specialized Hospital diabetes follow-up clinic, Jimma, Ethiopia. *BMC Endocr Disord*. 2011;11:19.
124. Libby AM, Fish DN, Hosokawa PW, Linnebur SA, Metz KR, Nair KV, et al. Patient-level medication regimen complexity across populations with chronic disease. *Clinical therapeutics*. 2013;35(4):385-98.e1.
125. Venter WDF, Moorhouse M, Sokhela S, Fairlie L, Mashabane N, Masenya M, et al. Dolutegravir plus Two Different Prodrugs of Tenofovir to Treat HIV. *N Engl J Med*. 2019;381(9):803-815
126. Kumar S, Samaras K. The Impact of Weight Gain During HIV Treatment on Risk of Pre-diabetes, Diabetes Mellitus, Cardiovascular Disease, and Mortality. *Frontiers in Endocrinology*. 2018;9(705).
127. Coetzee L, Bogler L, De Neve JW, Barnighausen T, Geldsetzer P, Vollmer S. HIV, antiretroviral therapy and non-communicable diseases in sub-Saharan Africa: empirical evidence from 44 countries over the period 2000 to 2016. *Journal of the International AIDS Society*. 2019;22(7):e25364.
128. Bailey SL, Ayles H, Beyers N, Godfrey-Faussett P, Muyoyeta M, du Toit E, et al. Diabetes mellitus in Zambia and the Western Cape province of South Africa: Prevalence, risk factors, diagnosis and management. *Diabetes research and clinical practice*. 2016;118:1-11.
129. Julius H, Basu D, Ricci E, Wing J, Basu JK, Pocaterra D, et al. The burden of metabolic diseases amongst HIV positive patients on HAART attending The Johannesburg Hospital. *Current HIV research*. 2011;9(4):247-52.
130. Ministry of Public Health and Sanitation Kenya. KENYA NATIONAL DIABETES STRATEGY 2010-2015. 2010. Available at URL: <https://www.worlddiabetesfoundation.org/sites/default/files/WDF09-436%20Kenya%20National%20Diabetes%20Strategy%202010-2015%20-%20Complete.pdf>
131. Ministry of Health Ghana. National Policy for the Prevention and Control of Chronic Non-Communicable Diseases in Ghana. 2012. Available at URL: [https://www.iccp-portal.org/sites/default/files/plans/national_policy_for_the_prevention_and_control_of_chronic_non-communicable_diseases_in_ghana\(1\).pdf](https://www.iccp-portal.org/sites/default/files/plans/national_policy_for_the_prevention_and_control_of_chronic_non-communicable_diseases_in_ghana(1).pdf).
132. Mukanu MM, Zulu JM, Mweemba C, Mutale W. Responding to non-communicable diseases in Zambia: a policy analysis. *Health Research Policy and Systems*. 2017;15(1):34.

133. Federal Ministry of Health, SIDCAIN, World Diabetes Foundation. Diabetes and NCDs in Nigeria - Perspectives, Challenges & the Way Forward. 2017. Available at URL: <http://sidcain.org/download/ABUJA%20Proceedings%20Reviewed%20Nov%202017.pdf>.
134. NDOH. National Department of Health Republic of South Africa. Adherence Guidelines for HIV, TB and NCDs. Policy and service delivery guidelines to care, adherence to treatment and retention in care. February 2016. Available at URL: <https://www.nacosa.org.za/wp-content/uploads/2016/11/Integrated-Adherence-Guidelines-NDOH.pdf>
135. National Department of Health South Africa. Standard operating procedures for minimum package of interventions to support linkage to care, adherence and retention in care, adherence guidelines for HIV, TB and NCDs. Pretoria, South Africa, 2016. Available from: http://www.differentiatedcare.org/Portals/0/adam/Content/_YiT3_-qmECUkmkpQvZAIA/File/SOP%20A5%20booklet%2020-05-2016.pdf.
136. Shannon GD, Haghparast-Bidgoli H, Chelagat W, Kibachio J, Skordis-Worrall J. Innovating to increase access to diabetes care in Kenya: an evaluation of Novo Nordisk's base of the pyramid project. *Glob Health Action*. 2019;12(1):1605704.
137. Rockers PC, Laing RO, Ashigbie PG, Onyango MA, Mukiira CK, Wirtz VJ. Effect of Novartis Access on availability and price of non-communicable disease medicines in Kenya: a cluster-randomised controlled trial. *The Lancet Global health*. 2019;7(4):e492-e502.
138. Nuche-Berenguer B, Kupfer LE. Readiness of Sub-Saharan Africa Healthcare Systems for the New Pandemic, Diabetes: A Systematic Review. *Journal of diabetes research*. 2018;2018:9262395.
139. Pastakia SD, Cheng SY, Kirui NK, Kamano JH. Dynamics, Impact, and Feasibility of Self-Monitoring of Blood Glucose in the Rural, Resource-Constrained Setting of Western Kenya. *Clinical diabetes*. 2015;33(3):136-43.
140. Morris-Paxton AA, Rheeder P, Ewing RG, Woods D. Detection, referral and control of diabetes and hypertension in the rural Eastern Cape Province of South Africa by community health outreach workers in the rural primary healthcare project: Health in Every Hut. *Afr J Prim Health Care Fam Med*. 2018;10(1):e1-e8.
141. Ovbiagele B. Tackling the growing diabetes burden in Sub-Saharan Africa: a framework for enhancing outcomes in stroke patients. *Journal of the neurological sciences*. 2015;348(1-2):136-41.
142. Amadi CE, Lawal FO, Mbakwem AC, Ajuluchukwu JN, Oke DA. Knowledge of cardiovascular disease risk factors and practice of primary prevention of cardiovascular disease by Community Pharmacists in Nigeria: a cross-sectional study. *International journal of clinical pharmacy*. 2018;40(6):1587-95.
143. Gathu CW, Shabani J, Kuniya N, Ratansi R. Effect of diabetes self-management education on glycaemic control among type 2 diabetic patients at a family medicine clinic in Kenya: A randomised controlled trial. *Afr J Prim Health Care Fam Med*. 2018;10(1):e1-e9.
144. Jaam M, Ibrahim MIM, Kheir N, Awaisu A. Factors associated with medication adherence among patients with diabetes in the Middle East and North Africa region: A systematic mixed studies review. *Diabetes research and clinical practice*. 2017;129:1-15.
145. Rampamba E, Meyer JC, Helberg EA, Godman B. Empowering hypertensive patients on chronic medicines at primary health care facilities in South Africa with knowledge to improve disease management. *J Res Pharm Pract*. 2019;8:208-13
146. Farmer A, Bobrow K, Leon N, Williams N, Phiri E, Namadingo H, et al. Mobile Messaging Support Versus Usual Care for People With Type 2 Diabetes on Glycemic Control: Protocol for a Multicenter Randomized Controlled Trial. *JMIR research protocols*. 2019;8(6):e12377.
147. Opoku D, Busse R, Quentin W. Achieving Sustainability and Scale-Up of Mobile Health Noncommunicable Disease Interventions in Sub-Saharan Africa: Views of Policy Makers in Ghana. *JMIR Mhealth Uhealth* 2019;7(5):e11497.
148. Hill J, Peer N, Oldenburg B, Kengne AP. Roles, responsibilities and characteristics of lay community health workers involved in diabetes prevention programmes: A systematic review. *PLoS one*. 2017;12(12):e0189069.
149. Brouwer ED, Watkins D, Olson Z, Goett J, Nugent R, Levin C. Provider costs for prevention and treatment of cardiovascular and related conditions in low- and middle-income countries: a systematic review. *BMC public health*. 2015;15:1183.
150. Owolabi MO, Yaria JO, Daivadanam M, Makanjuola AI, Parker G, Oldenburg B, et al. Gaps in Guidelines for the Management of Diabetes in Low- and Middle-Income Versus High-Income Countries-A Systematic Review. *Diabetes care*. 2018;41(5):1097-105.

151. Juma K, Juma PA, Mohamed SF, Owuor J, Wanyoike A, Mulabi D, et al. First Africa non-communicable disease research conference 2017: sharing evidence and identifying research priorities. *J Glob Health*. 2019;8(2):020301.
152. Kawamura N. Counterfeit Diabetes Medications. 2011. Available at URL: <https://www.diabeteshealth.com/counterfeit-diabetes-medications/>.
153. Alghannam A, Aslanpour Z, Evans S, Schifano F. A systematic review of counterfeit and substandard medicines in field quality surveys. *Integrated Pharmacy Research and Practice*. 2014 Volume 2014; 3: 71–88.
154. Haque M, McKimm J, Godman B, Abu Bakar M, Sartelli M. Initiatives to reduce postoperative surgical site infections of the head and neck cancer surgery with a special emphasis on developing countries. *Expert review of anticancer therapy*. 2019;19(1):81-92.
155. Godman B, Wettermark B, van Woerkom M, Fraeyman J, Alvarez-Madrado S, Berg C, et al. Multiple policies to enhance prescribing efficiency for established medicines in Europe with a particular focus on demand-side measures: findings and future implications. *Frontiers in pharmacology*. 2014;5:106.
156. Godman B, Malmstrom RE, Diogene E, Gray A, Jayathissa S, Timoney A, et al. Are new models needed to optimize the utilization of new medicines to sustain healthcare systems? *Expert review of clinical pharmacology*. 2015;8(1):77-94.
157. Godman B, Bucsecs A, Vella Bonanno P, Oortwijn W, Rothe CC, Ferrario A, et al. Barriers for Access to New Medicines: Searching for the Balance Between Rising Costs and Limited Budgets. *Front Public Health*. 2018;6:328.
158. Godman B, Malmstrom RE, Diogene E, Jayathissa S, McTaggart S, Cars T, et al. Dabigatran - a continuing exemplar case history demonstrating the need for comprehensive models to optimize the utilization of new drugs. *Frontiers in pharmacology*. 2014;5:109.
159. Ermisch M, Bucsecs A, Vella Bonanno P, Arickx F, Bybau A, Bochenek T, et al. Payers' Views of the Changes Arising through the Possible Adoption of Adaptive Pathways. *Frontiers in pharmacology*. 2016;7:305.
160. Campbell SM, Godman B, Diogene E, Furst J, Gustafsson LL, MacBride-Stewart S, et al. Quality indicators as a tool in improving the introduction of new medicines. *Basic & clinical pharmacology & toxicology*. 2015;116(2):146-57.
161. Godman B, Shrank W, Andersen M, Berg C, Bishop I, Burkhardt T, et al. Policies to enhance prescribing efficiency in Europe: findings and future implications. *Frontiers in pharmacology*. 2010;1:141.
162. Moorkens E, Vulto AG, Huys I, Dylst P, Godman B, Keuerleber S, et al. Policies for biosimilar uptake in Europe: An overview. *PloS one*. 2017;12(12):e0190147.
163. Bochenek T, Abilova V, Alkan A, Asanin B, de Miguel Beriain I, Besovic Z, et al. Systemic Measures and Legislative and Organizational Frameworks Aimed at Preventing or Mitigating Drug Shortages in 28 European and Western Asian Countries. *Frontiers in pharmacology*. 2017;8:942.
164. Vella Bonanno P, Bucsecs A, Simoens S, Martin AP, Oortwijn W, Gulbinovic J, et al. Proposal for a regulation on health technology assessment in Europe - opinions of policy makers, payers and academics from the field of HTA. *Expert review of pharmacoeconomics & outcomes research*. 2019;19(3):251-61.
165. Almeida P, Silva TBC, de Assis Acurcio F, Guerra Junior AA, Araujo VE, Diniz LM, et al. Quality of Life of Patients with Type 1 Diabetes Mellitus Using Insulin Analog Glargine Compared with NPH Insulin: A Systematic Review and Policy Implications. *The patient*. 2018;11(4):377-89.
166. Saleem Z, Godman B, Hassali MA, Hashmi FK, Azhar F, Rehman IU. Point prevalence surveys of health-care-associated infections: a systematic review. *Pathogens and global health*. 2019:1-15.
167. da Silva WC, de Araujo VE, Lima E, Dos Santos JBR, Silva M, Almeida P, et al. Comparative Effectiveness and Safety of Monoclonal Antibodies (Bevacizumab, Cetuximab, and Panitumumab) in Combination with Chemotherapy for Metastatic Colorectal Cancer: A Systematic Review and Meta-Analysis. *BioDrugs : clinical immunotherapeutics, biopharmaceuticals and gene therapy*. 2018;32(6):585-606.
168. Marra LP, Araujo VE, Silva TB, Diniz LM, Guerra Junior AA, Acurcio FA, et al. Clinical Effectiveness and Safety of Analog Glargine in Type 1 Diabetes: A Systematic Review and Meta-Analysis. *Diabetes therapy : research, treatment and education of diabetes and related disorders*. 2016;7(2):241-58.
169. World Health Organisation. Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia: report of a WHO/IDF consultation. Available at URL:

https://apps.who.int/iris/bitstream/handle/10665/43588/9241594934_eng.pdf;jsessionid=75A0C3B74F6572D012AB00D9F8A23D4E?sequence=1.

170. Mashalla YJ, Sepako E, Setlhare V, Chuma M, Bulang M, Masele AY. Availability of guidelines and policy documents for enhancing performance of practitioners at the Primary Health Care (PHC) facilities in Gaborone, Tlokweng and Mogoditshane, Republic of Botswana. *J Public Health Epidemiol.* 2016;8(8):127-35.
171. Matsitse TB, Helberg E, Meyer JC, Godman B, Masele A, Schellack N. Compliance with the primary health care treatment guidelines and the essential medicines list in the management of sexually transmitted infections in correctional centres in South Africa: findings and implications. *Expert review of anti-infective therapy.* 2017;15(10):963-72.
172. Hernandez-Villafuerte K, Li R, Hofman KJ. Bibliometric trends of health economic evaluation in Sub-Saharan Africa. *Global Health.* 2016;12(1):50.
173. Kriza C, Hanass-Hancock J, Odame EA, Deghaye N, Aman R, Wahlster P, et al. A systematic review of health technology assessment tools in sub-Saharan Africa: methodological issues and implications. *Health research policy and systems.* 2014;12:66-.
174. Hollingworth S, Odame E, Winch A. Understanding data needs for HTA in Sub-Saharan Africa – a framework and Ghana case study. 2018. <https://www.idsihealth.org/wp-content/uploads/2018/10/Data-Sources-.pdf>.
175. Doherty JE, Wilkinson T, Edeka I, Hofman K. Strengthening expertise for health technology assessment and priority-setting in Africa. *Glob Health Action.* 2017;10(1):1370194.
176. Mueller D, Tivey D, Croce D. Health-technology assessment: Its role in strengthening health systems in developing countries. *Southern African Journal of Public Health.* 2017; 2 (1): 6-11.
177. Mbugua SM, Kimani ST, Munyoki G. Metabolic syndrome and its components among university students in Kenya. *BMC public health.* 2017;17(1):909.
178. Cameron A, Mantel-Teeuwisse AK, Leufkens HG, Laing RO. Switching from originator brand medicines to generic equivalents in selected developing countries: how much could be saved? *Value in health.* 2012;15(5):664-73.
179. Kaplan WA, Ritz LS, Vitello M, Wirtz VJ. Policies to promote use of generic medicines in low and middle income countries: a review of published literature, 2000-2010. *Health policy.* 2012;106(3):211-24.
180. Gustafsson LL, Wettermark B, Godman B, Andersen-Karlsson E, Bergman U, Hasselstrom J, et al. The 'wise list'- a comprehensive concept to select, communicate and achieve adherence to recommendations of essential drugs in ambulatory care in Stockholm. *Basic & clinical pharmacology & toxicology.* 2011;108(4):224-33.
181. Bjorkhem-Bergman L, Andersen-Karlsson E, Laing R, Diogene E, Melien O, Jirlow M, et al. Interface management of pharmacotherapy. Joint hospital and primary care drug recommendations. *European journal of clinical pharmacology.* 2013;69 Suppl 1:73-8.
182. Eriksen J, Gustafsson LL, Ateva K, Bastholm-Rahmner P, Ovesjo ML, Jirlow M, et al. High adherence to the 'Wise List' treatment recommendations in Stockholm: a 15-year retrospective review of a multifaceted approach promoting rational use of medicines. *BMJ open.* 2017;7(4):e014345.
183. Owolabi EO, Goon DT. The use of text messaging for improving adherence to anti-diabetic regimen and glycaemic control in low-resource settings of South Africa: A study protocol for a randomised controlled trial. *Contemporary clinical trials communications.* 2019;15:100418.
184. Botswana National Multisectoral Strategy for the Prevention and Control of Non-Communicable Diseases. 2017. Available at URL: <https://www.iccp-portal.org/system/files/plans/20171129%20Botswana%20multisec%20NCDs%20strategy%20-%20final.pdf>.
185. Diabetes Association of Botswana. 2019. Available at URL: <https://www.idf.org/our-network/regions-members/africa/members/1-botswana.html?layout=details&mid=20>.
186. Tsimba BM, Setlhare V, Nkomazana O. Developing the Botswana Primary Care Guideline: an integrated, symptom-based primary care guideline for the adult patient in a resource-limited setting. *Journal of multidisciplinary healthcare.* 2016;9:347-54.
187. World Diabetes Foundation. WDF16-1429 - The project seeks to improve the integrated national health care infrastructure for the prevention, diagnosis and management of diabetes and its complications in the Central and Northwest Regions of Cameroon. 2018. Available at URL: <https://www.worlddiabetesfoundation.org/projects/cameroon-wdf16-1429>.
188. Bosu WK. A comprehensive review of the policy and programmatic response to chronic non-communicable disease in Ghana. *Ghana Med J.* 2012;46(2 Suppl):69-78.
189. Sackey SO. Draft programme document: non-communicable diseases control programme. Accra: MOH Ghana; 1993.

190. World Health Organisation. Diabetes - Lesotho. 2016. Available at URL: https://www.who.int/diabetes/country-profiles/iso_en.pdf?ua=1.
191. MoH. Republic of Kenya Ministry of Health. KENYA NATIONAL STRATEGY FOR THE PREVENTION AND CONTROL OF NON-COMMUNICABLE DISEASES 2015 to 2020. Available at URL: <http://www.who.int/nmh/ncd-task-force/kenya-strategy-ncds-2015-2020.pdf> [
192. Republic of Kenya Ministry of Health and Sanitation. Kenya National Diabetes Educators Manual. 2010. Available at URL: <https://www.worlddiabetesfoundation.org/sites/default/files/Kenya%20National%20Diabetes%20Educators%20Manual.pdf>.
193. Diabetes Kenya. Available at URL: <https://www.idf.org/our-network/regions-members/africa/members/13-kenya.html?layout=details&mid=122>.
194. Karinja M, Pillai G, Schlienger R, Tanner M, Ogutu B. Care-Seeking Dynamics among Patients with Diabetes Mellitus and Hypertension in Selected Rural Settings in Kenya. *Int J Environ Res Public Health*. 2019;16(11).
195. Nzwilli F. Health Policy Watch - Kenya To Launch Universal Health Coverage Pilot Of Free Healthcare. 2018. Available at URL: <https://www.healthpolicy-watch.org/kenya-to-launch-universal-health-coverage-pilot-of-free-healthcare/>.
196. WHO Africa. Building Health: Kenya's Move to Universal Health Coverage. 2018. Available at URL: <https://www.afro.who.int/news/building-health-kenyas-move-universal-health-coverage>.
197. Destin Africa. Sanofi Partners with Diabetes Kenya, Kenya Diabetes Study Group and the International Diabetes Federation. 2019. Available at URL: <https://www.destinafrica.co.ke/2019/06/27/sanofi-partners-with-diabetes-kenya-kenya-diabetes-study-group-and-the-international-diabetes-federation/>.
198. Boehringer Ingelheim. Breaking access and awareness barriers in hypertension and diabetes care through mobile technology. 2019. Available at URL: <https://www.mea.boehringer-ingelheim.com/press-release/breaking-access-and-awareness-barriers-hypertension-and-diabetes-care-through-mobile>.
199. Aptantech. Sanofi Kenya launches its first Digital Diabetes Patient Support Program in Nairobi. 2019. Available at URL: <https://aptantech.com/2019/05/sanofi-kenya-launches-its-first-digital-diabetes-patient-support-program-in-nairobi/>.
200. WHO Swaziland. The Kingdom of Swaziland dedicates November to diabetes. 2017. Available at URL: <https://afro.who.int/news/kingdom-swaziland-dedicates-november-diabetes>.
201. Magagula SV. A case study of the Essential Health Care Package in Swaziland. Discussion paper 112 MoH Swaziland, IHI and TARSC and EQUINET. 2017. Available at URL: <https://www.equinet africa.org/sites/default/files/uploads/documents/Swaziland%20EHB%20case%20study%20rep%20final2017pv.pdf>
202. Ministry of Health and Social Services - Primary Health Care Directorate, Family Health Division. Non-Communicable Diseases (NCDs) Programme November 2017. Available at URL: <https://www.iccp-portal.org/system/files/plans/NAMIBIA%20NATIONAL%20MULTISECTORAL%20STRATEGIC%20PLAN%20FOR%20PREVENTION%20AND%20CONTROL%20OF%20NCDs.pdf>.
203. Ministry of Health and Social Services Namibia. Nutrition Guidelines for Prevention and Non-Communicable Diet Related Diseases [Internet]. Windhoek; 2013. Available from URL: <http://www.mhss.gov.na/documents/119527/364677/Nutrition+Guidelines+for+NCDRD-namibia.pdf/13ad87b2-61da-4c2a-9883-f050e02e5bc3>.
204. Diabetes Association of Namibia. 2019. Available at URL: <http://www.diabetes.iway.na/>.
205. Namibia Diabetes lifestyle Foundation. 2019. Available at URL: <https://allevents.in/org/namibia-diabetes-lifestyle-foundation/7206342#>.
206. Adekanmbi VT, Uthman OA, Erqou S, Echouffo-Tcheugui JB, Harhay MN, Harhay MO. Epidemiology of prediabetes and diabetes in Namibia, Africa: A multilevel analysis. *Journal of diabetes*. 2019;11(2):161-72.
207. World Diabetes Foundation. WDF16-1433. Strengthening diabetes care in Lagos state through 35 diabetes clinics, Nigeria. 2018. Available at URL: <https://www.worlddiabetesfoundation.org/projects/nigeria-wdf16-1433>.
208. DIABETES ASSOCIATION OF NIGERIA. 2019. Available at URL: <https://www.idf.org/our-network/regions-members/africa/members/20-nigeria.html?layout=details&mid=143>.
209. Arthur R. South Africa introduces sugar tax. 2018. Available at URL: <https://www.beveragedaily.com/Article/2018/04/03/South-Africa-introduces-sugar-tax>
210. Khuzwayo LS, Moshabela M. The perceived role of ward-based primary healthcare outreach teams in rural KwaZulu-Natal, South Africa. *Afr J Prim Health Care Fam Med*. 2017;9(1):e1-e5.

211. Republic of South Africa. National Health Insurance Bill. B11-2019. 2019. Available from URL: <https://www.gov.za/documents/national-health-insurance-bill-b-11-2019-6-aug-2019-0000>.
212. Mabuza D. Deputy President South Africa. Presidential Health Summit. Ekurhuleni, Johannesburg. 20 October 2018. Available from URL: <https://www.gov.za/speeches/address-deputy-president-david-mabuza-19-oct-2018-0000>.
213. Fox MP, Pascoe SJ, Huber AN, Murphy J, Phokojoe M, Gorgens M, et al. Assessing the impact of the National Department of Health's National Adherence Guidelines for Chronic Diseases in South Africa using routinely collected data: a cluster-randomised evaluation. *BMJ open*. 2018;8(1):e019680.
214. Khogali SS, Ali WA, Mohamed SY, Abdelrahim HE, Mirghani AA, Ali RH et al. Knowledge, attitude and practice of Sudanese individuals with type 2 diabetes about medication used in treatment of diabetes, hypertension and dyslipidaemia: a matter of debate or matter of concern? *J Public Health Emerg*. 2018;2:23.
215. Zimbabwe Diabetic Association. 2019. Available at URL: <https://www.idf.org/our-network/regions-members/africa/members/31-zimbabwe.html?layout=details&mid=142>.
216. Segafredo G, Kapur A, Robbiati C, Joseph N, de Sousa JR, Putoto G, et al. Integrating TB and non-communicable diseases services: Pilot experience of screening for diabetes and hypertension in patients with Tuberculosis in Luanda, Angola. *PloS one*. 2019;14(7):e0218052.
217. Chawla T, Sharma D, Singh A. Role of the renin angiotensin system in diabetic nephropathy. *World journal of diabetes*. 2010;1(5):141-5.
218. Cappuccio FP, Miller MA. Cardiovascular disease and hypertension in sub-Saharan Africa: burden, risk and interventions. *Internal and emergency medicine*. 2016;11(3):299-305.
219. SOUTHERN AFRICAN HEALTH TECHNOLOGY ASSESSMENT SOCIETY (SAHTAS). 2019. Available at URL: <http://www.htasa.org.za/>.
220. National Department of Health South Africa. STRATEGIC PLAN FOR THE PREVENTION AND CONTROL OF NON-COMMUNICABLE DISEASES 2013-17. 2013. Available at URL: [file:///C:/Users/mail/Desktop/My%20documents/Ongoing%20papers/South%20Africa%20Moosa/ZAF_B3_NCDs_STRAT_PLAN_1_29_1_3\[2\].pdf](file:///C:/Users/mail/Desktop/My%20documents/Ongoing%20papers/South%20Africa%20Moosa/ZAF_B3_NCDs_STRAT_PLAN_1_29_1_3[2].pdf).
221. Campbell SM, Kontopantelis E, Hannon K, Burke M, Barber A, Lester HE. Framework and indicator testing protocol for developing and piloting quality indicators for the UK quality and outcomes framework. *BMC Fam Pract*. 2011;12:85.
222. Habte BM, Kebede T, Fenta TG, Boon H. Barriers and facilitators to adherence to anti-diabetic medications: Ethiopian patients' perspectives. *Afr J Prim Health Care Fam Med*. 2017;9(1):e1-e9.
223. Houston TK, Allison JJ, Sussman M, Horn W, Holt CL, Trobaugh J, et al. Culturally appropriate storytelling to improve blood pressure: a randomized trial. *Annals of internal medicine*. 2011;154(2):77-84.
224. Bonoto BC, de Araujo VE, Godoi IP, de Lemos LL, Godman B, Bennie M, et al. Efficacy of Mobile Apps to Support the Care of Patients With Diabetes Mellitus: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *JMIR mHealth and uHealth*. 2017;5(3):e4.
225. Djrolo F, Adoukonou T, Houehanou C, Houinato JD, Houinato D. Diabetes in Borgou Department in Benin: Prevalence and Associated Factors. *Journal of Diabetes Mellitus*. 2015; 5: 90-96.
226. World Health Organization - Noncommunicable Diseases (NCD) Country Profiles, 2018. Botswana. Available at URL: https://www.who.int/nmh/countries/bwa_en.pdf?ua=1.
227. Bigna JJ, Nansseu JR, Katte JC, Noubiap JJ. Prevalence of prediabetes and diabetes mellitus among adults residing in Cameroon: A systematic review and meta-analysis. *Diabetes research and clinical practice*. 2018;137:109-18.
228. Asamoah-Boaheng M, Sarfo-Kantanka O, Tuffour AB, Eghan B, Mbanja JC. Prevalence and risk factors for diabetes mellitus among adults in Ghana: a systematic review and meta-analysis. *Int Health*. 2019;11(2):83-92.
229. Pastakia SD, Ali SM, Kamano JH, Akwanalo CO, Ndege SK, Buckwalter VL, et al. Screening for diabetes and hypertension in a rural low income setting in western Kenya utilizing home-based and community-based strategies. *Global Health*. 2013;9:21.
230. Bastawrous A, Mathenge W, Wing K, Bastawrous M, Rono H, Weiss HA, et al. The incidence of diabetes mellitus and diabetic retinopathy in a population-based cohort study of people age 50 years and over in Nakuru, Kenya. *BMC Endocr Disord*. 2017;17(1):19.
231. Onyango EM, Onyango BM. The Rise of Noncommunicable Diseases in Kenya: An Examination of the Time Trends and Contribution of the Changes in Diet and Physical Inactivity. *Journal of epidemiology and global health*. 2018;8(1-2):1-7.

232. Burn H, Pons J. Diabetic retinopathy in Swaziland. *Community Eye Health*. 2015;28(92):s18-s21.
233. Adeloye D, Ige JO, Aderemi AV, Adeleye N, Amoo EO, Auta A, et al. Estimating the prevalence, hospitalisation and mortality from type 2 diabetes mellitus in Nigeria: a systematic review and meta-analysis. *BMJ open*. 2017;7(5):e015424.
234. Ogbera AO, Ekpebegh C. Diabetes mellitus in Nigeria: The past, present and future. *World J Diabetes*. 2014;5(6):905-11.
235. Uloko AE, Musa BM, Ramalan MA, Gezawa ID, Puepet FH, Uloko AT, et al. Prevalence and Risk Factors for Diabetes Mellitus in Nigeria: A Systematic Review and Meta-Analysis. *Diabetes therapy*. 2018;9(3):1307-16.
236. Shen J, Kondal D, Rubinstein A, Irazola V, Gutierrez L, Miranda JJ, et al. A Multiethnic Study of Pre-Diabetes and Diabetes in LMIC. *Global heart*. 2016;11(1):61-70.
237. Manyema M, Veerman JL, Chola L, Tugendhaft A, Labadarios D, Hofman K. Decreasing the Burden of Type 2 Diabetes in South Africa: The Impact of Taxing Sugar-Sweetened Beverages. *PLoS one*. 2015;10(11):e0143050.
238. Basu S, Wagner RG, Sewpaul R, Reddy P, Davies J. Implications of scaling up cardiovascular disease treatment in South Africa: a microsimulation and cost-effectiveness analysis. *The Lancet Global health*. 2019;7(2):e270-e80.
239. Noor SK, Bushara SO, Sulaiman AA, Elmadhoun WM, Ahmed MH. Undiagnosed diabetes mellitus in rural communities in Sudan: prevalence and risk factors. *East Mediterr Health J*. 2015;21(3):164-70.
240. Elmadhoun WM, Noor SK, Ibrahim AA, Bushara SO, Ahmed MH. Prevalence of diabetes mellitus and its risk factors in urban communities of north Sudan: Population-based study. *Journal of diabetes*. 2016;8(6):839-46.
241. Eltom MA, Babiker Mohamed AH, Elrayah-Eliadarous H, Yassin K, Noor SK, Elmadhoun WM, et al. Increasing prevalence of type 2 diabetes mellitus and impact of ethnicity in north Sudan. *Diabetes research and clinical practice*. 2018;136:93-9.
242. El-Sayed EF, Awadalla H, Noor SK, Elmadhoun WM, Sulaiman AA, Almobarak AO, et al. Sugar intake in Sudanese individuals was associated with some features of the metabolic syndrome: Population based study. *Diabetes & metabolic syndrome*. 2018;12(3):245-50.
243. Ali YA, Almobarak AO, Awadalla H, Elmadhoun WM, Ahmed MH. Obesity among Sudanese adults with diabetes: a population-based survey. *Annals of translational medicine*. 2017;5(12):252.
244. Khalil S, Almobarak AO, Awadalla H, Elmadhoun WM, Noor SK, Sulaiman AA, et al. Low levels of physical activity in Sudanese individuals with some features of metabolic syndrome: Population based study. *Diabetes & metabolic syndrome*. 2017;11 Suppl 2:S551-s4.
245. Mutowo M, Gowda U, Mangwiro JC, Lorgelly P, Owen A, Renzaho A. Prevalence of diabetes in Zimbabwe: a systematic review with meta-analysis. *International journal of public health*. 2015;60(1):1-11.

Appendix

Appendix 1 - Prevalence rates of pre-diabetes and diabetes among a range of sub-Saharan African countries

Country	Prevalence rates
Republic of Benin	Prevalence rates including undiagnosed diabetes have been as high as 12.4% of the population although other authors have quoted considerably lower rates (20, 225)
Botswana	Documented prevalence rates for diabetes range from 4.8% to 6% of adults, with prevalence rates rising with increasing rates of obesity in recent years (53, 226)
Cameroon	The prevalence of pre-diabetes is 7.1% (227), with the prevalence of diabetes in adults in urban areas currently estimated at 6 – 8% of the population (187) It is estimated that with as many as 80% of patients living with diabetes are currently undiagnosed (187)
Democratic Republic of Congo (DRC)	There are an estimated 1.8 million (1.5-2.2 million) people with diabetes in DRC (5)
Ethiopia	Up to 7% of the population have diabetes, with an appreciable number of patients unaware that they have this condition (11, 119)
Ghana	A recent meta analysis suggested the overall prevalence of diabetes among adults was high at 6.46% of the population (228), with previous studies also documenting high rates of diabetes in Ghana (131, 188)
Kenya	The prevalence of diabetes including T2DM in patients in Kenya has been estimated at 3.3% and rising up to 4.5% by 2025, leading to the development of national strategies to reduce associated morbidity, mortality and costs (22, 130), whilst others have reported lower and higher rates (17, 229) Having said this, Bastawrous et al (2018) estimated the cumulative incidence of DM at 61.0 per 1000 in people aged ≥50 years in Kenya (230), with recent increases exacerbated by changes in diet and inactivity (231) Published prevalence rates in Kenya are likely to be under-estimates considering the number of patients with undiagnosed diabetes and pre-diabetes (17) The International Diabetes Federation current estimates that there are 460,000 people with diabetes in Kenya and likely to rise to 1.3 million within a generation unless addressed (197)
Lesotho	The prevalence of diabetes is 6% - 4.5% males and 7.5% females (190)
Kingdom of Eswatini (formerly Swaziland)	The prevalence of diabetes in the Kingdom of Eswatini is currently estimated at 3.7% among the adult population, and predicted to rise substantially in the coming years unless key changes are made to the management of patients with diabetes in the country (232) Currently, patients with diabetes account for 9.5% of all outpatient visits in the Kingdom, with a greater prevalence among women (59%), and 17.4% of inpatients by admission (7)
Namibia	The prevalence of diabetes has been estimated at 5.1% and pre-diabetes at 6.8% (206) Ministry of Health figures suggest higher rates at 6% among women and 7% among men with 7% of women and 6% of men pre-diabetic (202), with rates higher in urban versus rural areas
Nigeria	The age-adjusted prevalence rates for T2DM among those aged between 20 and 79 years has increased from 2.0% in 1990 to 5.7% in 2015, and rising (233), with others reporting prevalence rates as high as 10% of the population (142, 234)

	<p>A recent systematic review suggests an overall prevalence of 5.77%, highest in the south east (9.8%) and lowest in the north-east (3.8%) with urban dwelling, physical inactivity and unhealthy diets seen as are important risk factors (41, 235)</p> <p>However, it is estimated that up to 70 - 80% of patients with diabetes in Nigeria are either undiagnosed or untreated (21, 41), which is important since Nigeria currently accounts for one fifth of all the cases of diabetes in sub-Saharan Africa (41)</p> <p>Diabetes is also observed in up to a third of all admissions in medical wards adding to the burden (41).</p>
South Africa	<p>Published prevalence rates for diabetes vary between 7.2% to 10.1% or higher of the population depending whether undiagnosed patients are included (52, 128, 140, 236, 237). Overall, it is estimated that 4 million South Africans currently have diabetes (1.2-4.6 million) (5, 151)</p> <p>However, based on the SANHANES data there is a higher prevalence of diabetes in South Africa (15.3%) should a high percentage of patients with diabetes actually be diagnosed and treated (52, 238)</p> <p>A recent report from Johannesburg found 66% obesity and overweight in a random population attending PHC clinics, with a 4.9% undiagnosed diabetes. All the cases, who were diagnosed are receiving care (100%) and of all the patients, who are receiving care, 31% of them were controlled. The prevalence of co-morbidities including family history, obesity, overweight, hypercholesterolemia, hypertension, and HIV were common</p> <p>The analysis of HBA1C results from National Health Laboratory Service (2017) found 16% of 1.6 million patients from public health facilities in Gauteng Province had HBA1C <7%</p>
Sudan	<p>The current prevalence of diabetes in Sudan is estimated at 8%; however, this is not evenly distributed over the country. Prevalence rates are higher in some Northern states, and higher in urban (19.1%) versus rural area (2.6%) (239, 240). Individuals of Egyptian and mixed descent also have increased risk of getting T2DM (241)</p> <p>Researchers attributed the increase in prevalence of diabetes in Sudan to the increase in obesity rates, increased sugar intake, lack of physical activity and excess carbohydrate intake (242-244), with approximately 40% of the cases of T2DM attributable to obesity among the population in Sudan</p>
Zambia	<p>Prevalence rates for diabetes are estimated at 3.5% up to 5.35% of the population (128, 132)</p>
Zimbabwe	<p>Pooled prevalence rates suggest 5.7% of the population have diabetes and rising (245)</p>