

## Knowledge regarding medicines management of type-2 diabetes among patients attending a Community Health Centre in South Africa

Running head: Patient knowledge of diabetes medicines management

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### Abstract

**Objective:** The prevalence of Type 2 diabetes (T2DM) is growing in Sub-Saharan countries including South Africa. This is a concern given its appreciable impact on morbidity, mortality and costs with the recent introduction of universal healthcare in South Africa. The purpose of the study was to assess the knowledge of patients with T2DM attending a typical community health centres (CHC) regarding the management of their disease including risk factors and prevention to guide future initiatives. Typically, patients with T2DM in South Africa are managed in ambulatory care including CHCs. **Method:** A quantitative, descriptive cross-sectional study in a CHC. The sample included 217 adults with T2DM who have visited a physician as well as the pharmacy. Face-to-face patient exit interviews were conducted using a structured questionnaire. **Key finding:** Females predominated (65%), with the majority of patients >60 years (38.2%) and more than half from the Indian racial category. Most patients did not know how their medication controls their diabetes (79.3%) or did not know any of the side effects (83.9%) from their medication. Less than half of the patients knew how to take their medication, and more than a third of patients indicated that they were not practicing any form of self-care. **Conclusion:** The results indicate that these T2DM patients lacked sufficient knowledge regarding the management of their disease. Health care managers should consider instigating programmes to improve patients' knowledge about the management of their disease as part of general initiatives within South Africa to improve the management of patients with chronic diseases in the public sector.

**Keywords:** Type-2 diabetes, patient knowledge, medication, self-care, South Africa

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### 1. Introduction

Diabetes mellitus is a growing problem worldwide (1), with an estimated 16 million adults in Africa currently with diabetes. This figure is likely to grow to 41 million by 2045, enhanced by increasing urbanisation and changing lifestyles in Africa (2-4). In South Africa, currently three and a half million people have diabetes; however, this figure is likely to be an under-estimate with many patients undiagnosed (5). In view of increasing prevalence rates, diabetes has moved from being the fifth leading underlying cause of death in 2013 in South Africa to being the second most common cause in 2016, representing 5.5% of recorded deaths (7). This is no doubt enhanced by the high prevalence of overweight and obesity in South Africa, now at over 50% of the population (8).

Hypertension is also a concern in South Africa with estimates that up to 78% of adults over 50 currently have hypertension (11, 12). Consequently, the improved management of non-communicable

diseases (NCDs), including diabetes, is now a key part of the South African Department of Health's strategy to improve the health of the population in South Africa (13).

Medicines play an important role in the management of NCDs including patients with type-2 diabetes (T2DM) along with diet and lifestyle changes. T2DM is the most prevalent type of diabetes affecting between 90% and 95% of all patients with diabetes (6, 14, 15), with a considerable impact on morbidity, mortality and costs (2, 14, 16, 17). For instance, the prevalence of diabetic retinopathy was nearly 30% among patients attending diabetes clinics in Malawi in Africa, a rate four times that of Europe (20).

The goal of treatment in patients with T2DM is to keep blood sugar levels at normal or near-normal levels to help prevent long term adverse effects such as neuropathy, e.g. neuropathic pain, and nephropathy, i.e. kidney damage leading to dialysis (21). However, adherence to prescribed medicines is a key concern in patients with T2DM adversely impacting on morbidity and mortality (17, 22-28). Adherence rates to medicines among patients with T2DM typically range from 36% and 93% (24); with some authors documenting adherence rates as low as 23% among prescribed medicines (27). Adherence rates among patients with chronic diseases such as T2DM are typically much lower in developing countries than those seen in developed countries (29). This is particularly important in patients with T2DM as a combined approach of diet, physical exercise, and adherence to medicines helps with glycaemic control to reduce the risk of complications (24). Non-adherence to medicines in patients with T2DM is believed to be due in part to inadequate patient knowledge and awareness about the importance of adherence, which includes not fully understanding all the drug regimens and their implications, alongside issues of forgetfulness and the lack of support mechanisms (24, 26-28, 36). One way to develop pertinent targeted strategies to address important issues such as how patients view and use their medicines is to ascertain patients' knowledge regarding their medicines (12, 26, 37).

Given the rising rates of T2DM in South Africa, we sought as a first step to determine patients' knowledge regarding their medicines for their T2DM among those who attended public community health centres (CHCs). CHCs are an important part of ambulatory care in the public healthcare system, with currently over 80% of the population in South Africa being treated in public health facilities (39). This is particularly important at this time in South Africa following the introduction of universal health coverage for all South Africans through the National Health Insurance (NHI) scheme (40, 41). Under this initiative, there are ongoing programmes to improve the availability and accessibility of medicines to patients with chronic diseases such as T2DM (41), with regular 6-monthly clinical monitoring of patients.

We have previously reported our initial findings focusing on patients' knowledge attending CHCs in South Africa about their disease (42). We have taken this further and researched patients' knowledge about the management of their disease, particularly their medicines. We are aware that there have been a number of publications looking at key issues surrounding managing patients with T2DM including their knowledge and adherence to medicines (36, 43, 44); however, we believe it is still important to explore key aspects in South Africa. The findings will be used to help the authorities in South Africa further improve their management of patients with T2DM. In addition, help other African countries with a growing prevalence of NCDs.

## **2. Research Methods**

### **2.1 Study design and setting**

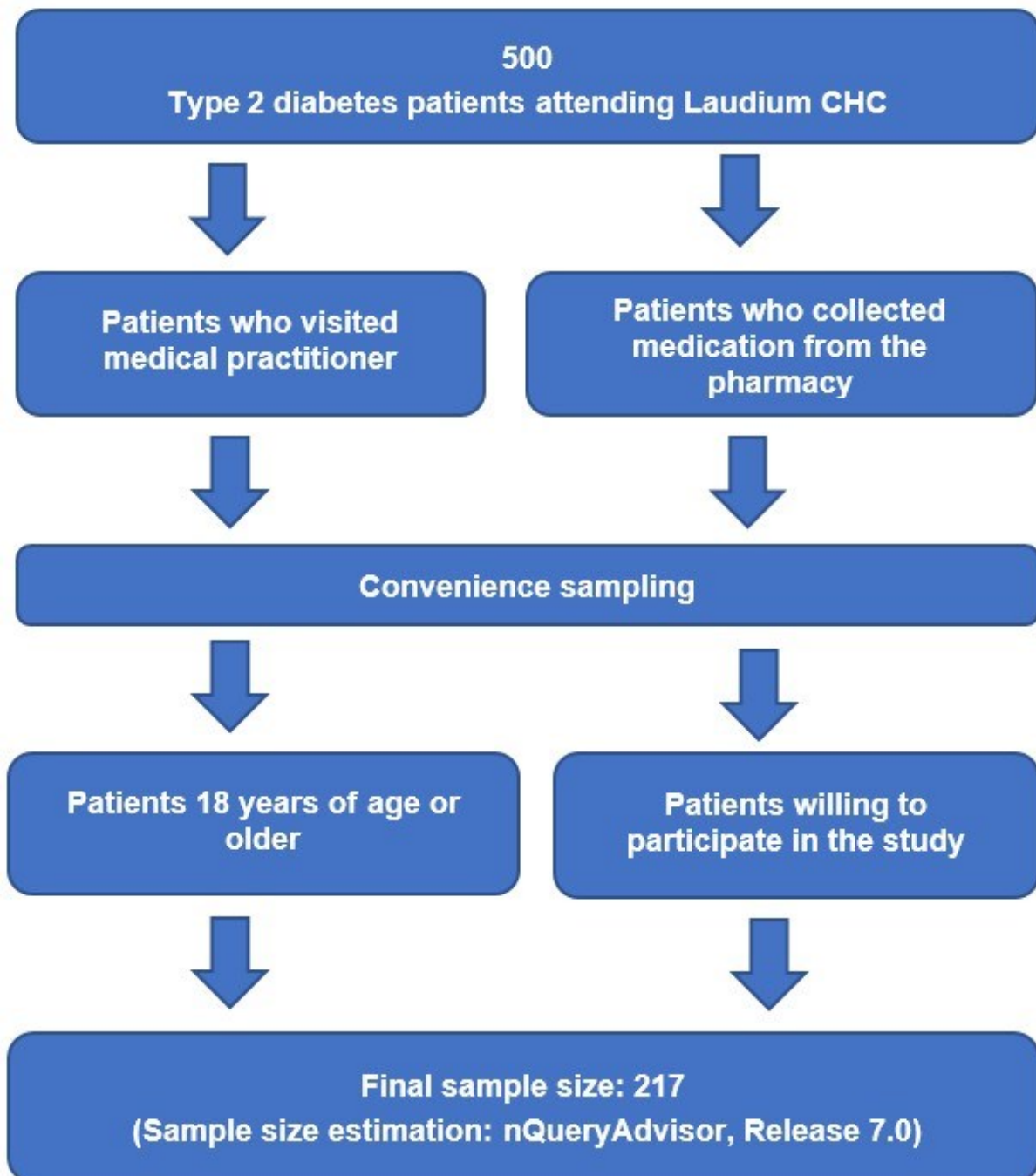
The study followed a descriptive, quantitative cross-sectional design. Data were collected by means of patient exit interviews using structured questionnaires. The study was conducted at Laudium CHC in Pretoria, South Africa. This is a typical CHC in South Africa,

### **2.2 Population and sample**

The study population included all T2DM patients attending Laudium CHC during the two month study period. This clinic treats approximately 500 patients a month with T2DM; consequently, can provide a robust basis for assess typical care of patients with T2DM in the public healthcare system in South Africa. Convenience sampling was undertaken of adult T2DM patients ( $\geq 18$  years) who had consulted with their medical practitioner as well as collected their medicines from the pharmacy. This resulted in

a final sample size of 217 (Figure 1). Potential participants were given an information leaflet about the study, after which they provided written informed consent for participation.

**Figure 1 – Patient Flow Chart**



### **2.3 Data collection**

The questionnaire was designed in a multiple choice format and consisted of mainly closed-ended questions on general knowledge, risk factors, lifestyle modifications including exercise, diet, reducing alcohol intake and stopping smoking, current use of medicines and prevention of T2DM. The structured questionnaire was developed based on the published literature of validated questionnaires regarding patients' knowledge of their diabetes (45). It was subsequently piloted. Based on the findings, amendments were made to the questionnaire including rephrasing certain questions to enhance its robustness and validity (Appendix 1). Face-to-face interviews were conducted in a private room by a single data collector (AM). The majority of patients visiting the clinic could speak English.

However, the questionnaire, study information leaflet and consent form were also available in Setswana, the other language commonly spoken in this area of South Africa.

## 2.4 Outcomes

The outcomes were in terms of patients' knowledge regarding their disease control and how the medicines work, what their prescribed medicines were and the potential side-effects of these. In addition, what activities they would take if they experienced any side-effects from their medicines, what their knowledge was regarding normal glucose levels and the extent of any self-care practices to help control T2DM.

## 2.5 Data analysis

Descriptive statistics were used to analyse data. All statistical procedures were performed on SAS, Release 9.2 compatible with Microsoft Windows. Responses to open-ended questions were captured and manually categorised. Responses to categorical variables were summarised as frequency counts and percentages.

## 2.6 Ethical considerations

Ethical approval for the study was obtained from the Medunsa Research Ethics Committee of the University of Limpopo, now Sefako Makgatho Health Sciences University, prior to the commencement of the study (MREC/H/269/2013:PG). Permission to conduct the study at Laudium CHC was obtained from the District Manager for Laudium CHC. All patients provided written informed consent for participation.

## 3. Results

### 3.1 Demographic details and duration of diabetes

Table 1 contains the demographic details of the 217 patients interviewed.

**Table 1: Socio-demographic characteristics of the patients (n=217)**

| Characteristics | No. | %    | Characteristics            | No. | %    |
|-----------------|-----|------|----------------------------|-----|------|
| Age (year)      |     |      | Occupational status        |     |      |
| Up to 30        | 5   | 2.3  | Employed                   | 93  | 42.9 |
| 31-40           | 23  | 10.6 | Unemployed                 | 32  | 14.7 |
| 41-50           | 49  | 22.6 | Housewife                  | 54  | 24.9 |
| 51-60           | 57  | 26.3 | Pensioner                  | 37  | 17.1 |
| >60             | 83  | 38.2 | Student                    | 1   | 0.5  |
| Gender          |     |      | Family history of diabetes |     |      |
| Female          | 142 | 65   | Family history             | 142 | 65   |
| Male            | 75  | 35   | No family history          | 75  | 35   |
| Race            |     |      | Education                  |     |      |
| Black           | 93  | 43   | No education               | 36  | 16   |
| White           | 8   | 4    | Primary school completed   | 108 | 50   |
| Coloured        | 5   | 2    | Secondary school completed | 67  | 31   |
| Indian          | 111 | 51   | Tertiary qualification     | 6   | 3    |

Two thirds of the patients interviewed indicated that they have been diagnosed for 5 years or more with T2DM (67.7%), and that they had been on their anti-diabetic medication for more than 5 years (65.5%) (Table 2).

**Table 2: Duration being diagnosed with diabetes and duration on medication (n=217)**

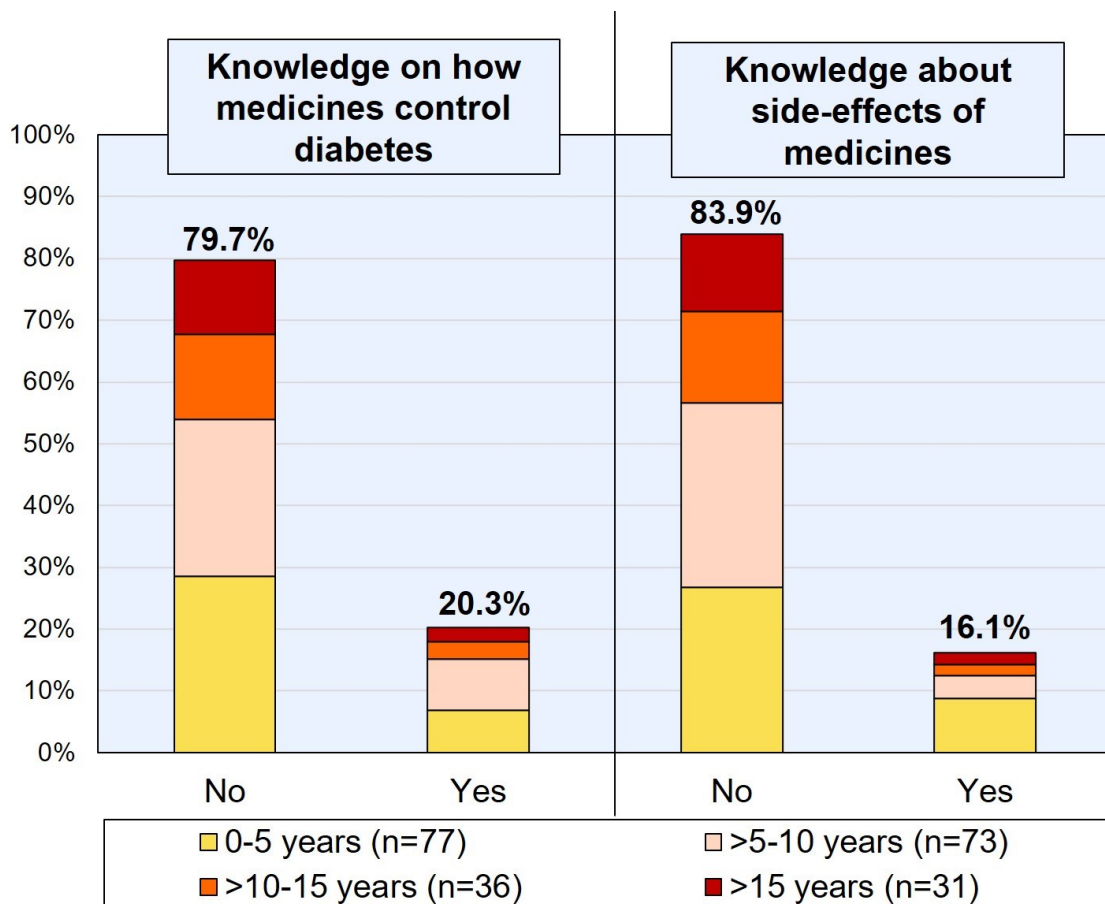
| <b>Patients with type-2 diabetes</b> | <b>No.</b> | <b>%</b> |
|--------------------------------------|------------|----------|
| Duration being diagnosed             |            |          |
| 0-5 years                            | 70         | 32.3     |
| 5-10 years                           | 77         | 35.5     |
| 10-15 years                          | 35         | 16.1     |
| 20+ years                            | 35         | 16.1     |
| Duration on medication               |            |          |
| 0-5 years                            | 77         | 35.5     |
| 5-10 years                           | 73         | 33.6     |
| 10-15 years                          | 36         | 16.6     |
| 20+ years                            | 31         | 14.3     |

### **3.2 Disease control**

Half of the patients knew whether their diabetes was either controlled (32.7%) or not controlled (20.3%); the other half (47.0%) did not know. Almost 80% of patients did not know how their medicines control their diabetes. The remainder said their medicines help lower blood sugar (9.2%), control high blood sugar levels (6.0%), stabilise glucose levels (4.6%) and control insulin in the body (0.5%). One of the patients (0.5%) reported that the medication does not help in controlling diabetes. This particular patient also did not know how to take his/her medicines and indeed had an uncontrolled blood glucose level.

The findings were similar across the groups in terms of the number of years on anti-diabetic medication (Figure 2).

**Figure 2 - Patients' knowledge on medicines for the treatment of diabetes by number of years on treatment (n=217)**



### 3.3 Patient knowledge about the side effects of their medicines

The majority of patients (182; 83.9%) were not aware of the potential side-effects of the medicines they were prescribed (Table 3). Of the 35 patients who knew about potential side-effects that could occur, headache and dizziness (57.1%) were the most common ones mentioned. Other common side-effects included gastrointestinal disturbances (34.3%) and hypoglycaemia, i.e. low blood sugar levels (31.4%). More than half of the 35 patients who were aware of the potential side-effects of their medicines indicated that they will immediately consult with their medical practitioner, nurse or clinic if these occurred. However, fifteen (42.9%) patients indicated that they do not know what to do if side-effects occurred (Table 3).

Knowledge, or lack of it, regarding the potential side effects of the medicines prescribed for patients with T2DM was again similar among the groups in terms of the number of years on anti-diabetic medication (Figure 1).

**Table 3: Patient knowledge about the side effects of their medicines (n=217), side effects experienced (n=35) and management of the side effects (n=35)**

| Characteristic  | No. | %    |
|---|-----|------|
| <b>Side effects knowledge (n=217)</b>                                   |     |      |
| Knowledge about potential side effects                                  | 35  | 16   |
| No knowledge about side effects   | 182 | 84   |
| <b>Knowledge of potential side effects (n=35)</b>                       |     |      |
| Headache, dizziness   | 20  | 57.1 |
| Gastrointestinal disturbances   | 12  | 34.3 |
| Hypoglycaemia   | 11  | 31.4 |
| Lactic acidosis   | 2   | 5.7  |
| <b>Actions to take when potential side effect is experienced (n=35)</b> |     |      |
| Immediately visit doctor/sister/clinic                                  | 18  | 51.4 |
| Do not know what to do  | 15  | 42.9 |
| Will stop the medication  | 2   | 5.7  |

### 3.4 Knowledge about medicine use

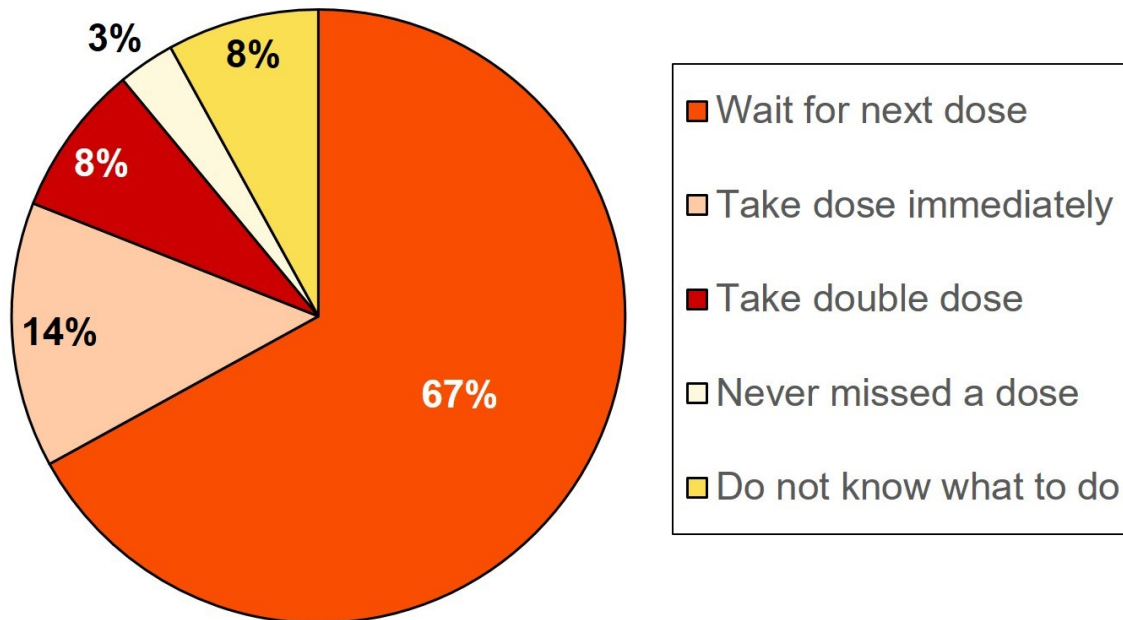
Metformin, glibenclamide, and gliclazide were the three medicines most prescribed and used for the treatment of patients with T2DM in this CHC (Table 4). The majority of prescribed medicines received by the patients were labelled appropriately. The instructions on the labels were compared with patients' responses when asked how they take their medicines. Although patients indicated that they were told how to take their medicines, less than half (47.9%) of the 213 patients on metformin, half (50%) of the 58 patients on gliclazide, and 2 of the 5 patients on glibenclamide, knew how to take them according to the instructions on the label (Table 4).

**Table 4: Patient knowledge on the use of medication (n=217)**

| Patients                         | Metformin (n=213) |       | Gliclazide (n=58) |       | Glibenclamide (n=5) |      |
|----------------------------------|-------------------|-------|-------------------|-------|---------------------|------|
|                                  | No.               | %     | No.               | %     | No.                 | %    |
| Know how to take their medicines | 102               | 47.9% | 29                | 50%   | 2                   | 40%  |
| Told how to take their medicines | 199               | 93.4% | 51                | 87.9% | 5                   | 100% |
| All medicines labelled correctly | 200               | 93.9% | 55                | 94.8% | 5                   | 100% |

With regards to missing a dose of their medicines, most patients (67%) said that they would wait for the next dose. A minority indicated they will immediately take the missed dose, would take a double dose, or did not know what to do (Figure 3). Only six (3%) patients were confident to say that they have never missed a dose of their medicines.

Figure 3 - Patients' actions when a dose of a medicine is missed (n=217)



### 3.5 Blood glucose testing

Less than half (48.4%) of the patients knew what the normal glucose levels for adults should be before a meal. When asked whether they knew what their own glucose level was, 62% of patients responded positively. A third (71; 32.7%) knew that their diabetes was controlled; 44 (20.3%) knew it was not controlled; and 102 (47.0%) did not know whether it was controlled or not controlled.

Patients' blood glucose levels are tested at the clinic during monthly visits. Patients were asked how often they test their own blood glucose levels themselves. Six (2.8%) patients admitted that they never test their blood glucose levels themselves, 59.0% indicated that they test less than once a week and 24.9% tested at least once a week. Very few patients reported that they test their blood glucose levels either once a day (9.2%) or twice a day (4.1%).

### 3.6 Self-care practices

More than a third of the patients (91; 41.9%) indicated that they were not practicing any form of self-care. Amongst the 126 patients who indicated they were practicing self-care, exercise (58.7%), following a healthy diet (54.8%) and taking their medicines (51.6%) were the most common self-care practices (Table 5).



**Table 5: Self-care practices (n=126)**

| Self-care practices     | No. | %    |
|-------------------------|-----|------|
| Do exercise             | 74  | 58.7 |
| Restrict diet           | 69  | 54.8 |
| Take medicines          | 65  | 51.6 |
| Monitor blood sugar     | 48  | 38.1 |
| No smoking              | 35  | 27.8 |
| Foot care               | 31  | 24.6 |
| Eye examination         | 27  | 21.4 |
| Moderate / no alcohol   | 11  | 8.7  |
| Identification bracelet | 5   | 4    |

#### 4. Discussion

The majority of patients in our study were female, consistent with other African countries (3, 24, 28, 46, 47). This is perhaps not surprising as in many sub-Saharan Africa countries, including South Africa, women are more likely to be obese or overweight than men, and therefore expected to have a higher prevalence of type-2 diabetes (8, 48).

Most of the patients in this study were 51 years and older (Table 1). This was probably due to the combined effect of a greater number of elderly women than men in most African populations and the increasing prevalence of diabetes with age (47). In 2013, it was reported that the majority of individuals with diabetes in Africa were under 60 years of age with the highest proportion in people aged 40–59 years (47). However, rates are rising among those aged 55 and over(4).

Although most of the patients had been diagnosed 5 to 10 years ago, the majority indicated that they were on diabetic medication between 0 and 5 years (Table 2). This is an indication that most patients did not commence with anti-diabetic medication as soon as they were diagnosed or they could have been prescribed lifestyle modification first. However, most patients (nearly 80%) did not know how their medicines control their diabetes (Figure 2), which is similar to other studies among ambulatory care patients in lower and middle income countries (44). Our findings are also similar to a study carried out among patients with diabetes visiting their general practitioner in the United Kingdom where only 15% of them knew the correct mechanism of action of their medication (50) and in India, where 50% of diabetic patients in the Warangal region were unaware what diabetes is (51). However, our findings are different from patients in Iraq attending a diabetic centre in Hilla city who were seen to have an acceptable level of knowledge regarding their disease and activities to keep their disease stable (52), and in India where 75.8% of patients attending an ambulatory care clinic knew about the names and doses of their diabetes medicines (53). More than 80% of patients in our study were also unaware of the potential side effects of their medicines (Table 3). This is similar to studies undertaken in Ethiopia, Lebanon and India among ambulatory care patients in the community or attending specialist clinics in hospitals (36, 54, 55). However, higher than another study in India were only 30.1% of patients were unaware of the potential side-effects of treatment (53). These findings are a concern as patient knowledge regarding their medication is critical not only to prevent medicine-related problems but also positively influence treatment success (56).

Encouragingly, most patients said they were told how to take their medicines (Table 4), similar to findings in Australia (57). Most patients (67%) said that they would wait for the next dose if they missed a dose (Figure 2), with only a limited number of patients (8%) indicating they would take a double dose if they missed a dose. This is similar to the findings of a study conducted by Thungathurthi et al among patients in the Warangal region of India where 7% of patients said they took a double dose of medicines when they realised they had missed a dose (51). Of concern is that only 3% of patients said that they never missed a dose. This is very low compared to the findings in a study carried out in Ethiopia where over 50% of patients never missed a dose (54). However, the patients in Ethiopia were attending ambulatory care clinics in a specialist hospital as opposed to a general CHC treating all patients.

In this study, patients who missed their dose of medication did not report it to their healthcare provider, which is a concern. Wabe et al. also found that the majority of patients attending ambulatory care clinics in a specialist hospital were unaware of the importance of missing doses of their medications in terms of reporting this to their physician (54). This is also a concern in view of the potential impact of poor adherence on morbidity, mortality and costs, and will be explored further in future research projects. There is also a concern that only 38% of patients knew about monitoring blood sugar as part of self-care practices (Table 5). However, similar to a study in India where only 28.1% of patients were regularly monitoring their blood sugar levels (53). Another concern is that appropriate foot care is not routinely being practiced among participating patients with only a quarter of patients reporting they are taking care of their feet (Table 5). Saleh et al in their study of newly diagnosed T2DM patients in ambulatory care also found that 80% of patients were not taking care of their feet (58). Appropriate foot care is an important self-care practice in patients with T2DM as it is a major cause of morbidity in patients, which leads to lower-extremity amputation in 2% or more of diabetes patients increasing costs (59-61). We will be exploring this further in future studies in view of the importance of appropriate foot care in these patients.

Wabe et al also reported that knowledge of diabetes self-management practices was higher amongst patients attending ambulatory care clinics who never missed a dose and those that have good adherence to their medication (54). As a result, highlighting the critical role played by patient awareness and practice of diabetes self-management with improving the care and outcomes of their T2DM, which is a key consideration for the future.

Patients must be actively involved in their treatment, and involving them will help increase their adherence to treatment (37). Healthcare staff can play an important role improving the self-confidence and self-care of patients building on patients being told how to take their medicines (Table 4). This includes pharmacists and others improving patients' knowledge about their disease, as well as ensuring they have a satisfactory experience when visiting ambulatory care clinics, to improve future medicine use (62-67). Such activities though must take account of the fact that the patient population attending CHCs in South Africa (Table 1) typically have no formal education or only primary education, similar to other ambulatory care settings in South Africa and other African countries (12, 24, 28, 68-70). Consequently, story board telling and other similar approaches may be appropriate, alongside initiatives such as diaries and counselling involving pharmacists, to improve patient knowledge and subsequent medicine use (71, 72). However, we are aware that socio-demographic and cultural barriers including issues of exercise, diet and self-monitoring of blood glucose levels, have restricted self-care activities in developing countries (73). This also needs to be addressed to improve care in this growing group of patients to reduce future morbidity and mortality as well as reduce future expenditure.

We acknowledge that there are a number of limitations with this study. Firstly, this study was conducted in only one CHC; however, we believe our findings are representational of other CHCs in South Africa due to the nature of our population and its location. Secondly, convenience sampling was used to enrol patients in the study, which could have introduced sampling bias. Patients could also have answered questions incorrectly due to reasons other than poor knowledge, such as being nervous when answering the questionnaire. We also did not look at any outcomes of treatment such as HbA1c levels, and the extent of any hypoglycaemic episodes, as our focus was purely on patients' knowledge regarding their medicines and current adherence rates. Similarly, we did not investigate the effect of duration of diabetes on current regimens. However in view of the number of patients involved and the comprehensive nature of the questionnaire, we believe that the study provides a good foundation for developing strategies among public ambulatory care facilities in South Africa to improve the management of patients with diabetes.

#### **4. Conclusions and recommendations**

Patient knowledge regarding medicines management of T2DM is important as this plays a key role in controlling the disease. The results of this study indicate that knowledge among T2DM patients attending CHCs in South Africa is not optimal in terms of their medication use and self-care, similar to many other countries. This needs to be urgently addressed as our findings fall short of South Africa's vision towards attaining long and healthy lives for all its citizens through the prevention, control and monitoring of patients with NCDs including T2DM.

We have already seen the government seek to increase access to medicines for all South Africans including those with chronic diseases through a variety of initiatives. However, our results highlight the need for additional measures to improve the care of patients with T2DM in CHCs else the government will not attain its objectives for these patients. Suggested measures include better monitoring of T2DM patients, adherence support, education regarding medicine-use including possible side-effects as well as improving self-care practices. In addition, prioritising high risk patients and instigating programmes for defaulters for follow-up in the CHCs especially for patients with poor adherence to medicines. Most importantly in going forward with additional and innovative strategies, future decision-making and measures should be underpinned by evidence from operational and practice-based research. Such suggestions and their potential implications for improving the care of patients with T2DM in South Africa are starting to happen and will be followed up in future research projects.

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### **References**

1. WHO. World Health Organisation, Diabetes Fact sheet July 2016. Available at URL: <http://www.who.int/mediacentre/factsheets/fs312/en/>
2. IDF Diabetes Atlas 8th Edition 2017. Available at URL: <http://www.diabetesatlas.org/resources/2017-atlas.html>.
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. 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.
5. B Ottermann. Prevalence of diabetes in South Africa. Jan 2017. Available at URL: <https://www.health24.com/Medical/Diabetes/About-diabetes/Diabetes-tsunami-hits-South-Africa-20130210>.
6. Al-Rifai RH, Aziz F. Prevalence of type 2 diabetes, prediabetes, and gestational diabetes mellitus in women of childbearing age in Middle East and North Africa, 2000-2017: protocol for two systematic reviews and meta-analyses. *Systematic reviews*. 2018;7(1):96.
7. 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>.
8. Cois A, Day C. Obesity trends and risk factors in the South African adult population. *BMC obesity*. 2015;2:42.
9. 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.
10. Onyenekwu CP, Dada AO, Babatunde OT. The prevalence of metabolic syndrome and its components among overweight and obese Nigerian adolescents and young adults. *Nigerian journal of clinical practice*. 2017;20(6):670-6.
11. Lloyd-Sherlock P, Beard J, Minicuci N, Ebrahim S, Chatterji S. Hypertension among older adults in low- and middle-income countries: prevalence, awareness and control. *International journal of epidemiology*. 2014;43(1):116-28.
12. 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.

13. 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%20Afica%20Moosa/ZA F\_B3\_NCDs\_STRAT\_PLAN\_1\_29\_1\_3[2].pdf.
14. 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>.
15. Holman N, Young B, Gadsby R. Current prevalence of Type 1 and Type 2 diabetes in adults and children in the UK. *Diabetic medicine : a journal of the British Diabetic Association*. 2015;32(9):1119-20.
16. World Health Organization. Global Report on Diabetes. 2016. Available at URL: file:///C:/Users/mail/Desktop/My%20documents/Ongoing%20papers/South%20Afica%20Moosa/W HO%20Global%20report%20on%20diabetes%202016.pdf.
17. Iqbal Q, Ul Haq N, Bashir S, Bashaar M. Profile and predictors of health related quality of life among type II diabetes mellitus patients in Quetta city, Pakistan. *Health and quality of life outcomes*. 2017;15(1):142.
18. 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.
19. 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.
20. The Lancet Diabetes E. The ageing of Africa. *The lancet Diabetes & endocrinology*. 2016;4(1):1.
21. Cade WT. Diabetes-related microvascular and macrovascular diseases in the physical therapy setting. *Physical therapy*. 2008;88(11):1322-35.
22. Cramer JA. A systematic review of adherence with medications for diabetes. *Diabetes Care*. 2004;27.
23. Cramer JA, Benedict A, Muszbek N, Keskinaslan A, Khan ZM. The significance of compliance and persistence in the treatment of diabetes, hypertension and dyslipidaemia: a review. *International journal of clinical practice*. 2008;62(1):76-87.
24. Rwegerera GM, Moshomo T, Gaenamong M, Oyewo TA, Gollakota S, Mhimbira FA, et al. Antidiabetic medication adherence and associated factors among patients in Botswana; implications for the future. *Alexandria Journal of Medicine*. 2018;54(2):103-9.
25. Rwegerera GM. Adherence to anti-diabetic drugs among patients with Type 2 diabetes mellitus at Muhimbili National Hospital, Dar es Salaam, Tanzania- A cross-sectional study. *Pan Afr Med J*. 2014;17:252.
26. Iqbal Q, Bashir S, Iqbal J, Iftikhar S, Godman B. Assessment of medication adherence among type 2 diabetic patients in Quetta city, Pakistan. *Postgraduate medicine*. 2017;129(6):637-43.
27. Kalyango J, Owino E, Nambuya A. Non-adherence to diabetes treatment at Mulago hospital in Uganda: prevalence and associated factors. *Afr Health Sci*. 2008;8(2): 67-73.
28. Sefah IA, Okotah ANB, Hollinworth S, Godman B, Afriyie DA. . Adherence to oral anti-diabetic medicines among type 2 diabetes mellitus patients in the Volta Region of Ghana. Fourth Training Workshop and Symposium MURIA Group in conjunction with ISPE 2018 Consolidated abstracts p21 Available at URL: file:///C:/Users/mail/Downloads/Consolidated-abstract-booklet%20(3).pdf.
29. World Health Organisation. Adherence to long-term therapies: evidence for action. 2003. Available at URL: file:///C:/Users/mail/Desktop/My%20documents/Ongoing%20papers/South%20Afica%20Moosa/W HO%20Adherence%20to%20long%20term%20therapies.pdf.
30. Simpson RJ, Jr., Mendys P. The effects of adherence and persistence on clinical outcomes in patients treated with statins: a systematic review. *Journal of clinical lipidology*. 2010;4(6):462-71.

31. Corrao G, Parodi A, Nicotra F, Zambon A, Merlino L, Cesana G, et al. Better compliance to antihypertensive medications reduces cardiovascular risk. *Journal of hypertension*. 2011;29(3):610-8.
32. Bitton A, Choudhry NK, Matlin OS, Swanton K, Shrank WH. The impact of medication adherence on coronary artery disease costs and outcomes: a systematic review. *The American journal of medicine*. 2013;126(4):357 e7- e27.
33. Herttua K, Martikainen P, Batty GD, Kivimäki M. Poor Adherence to Statin and Antihypertensive Therapies as Risk Factors for Fatal Stroke. *Journal of the American College of Cardiology*. 2016;67(13):1507-15.
34. 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.
35. 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.
36. Divya S, Nadig P. Factors contributing to non-adherence to medication among type 2 diabetes mellitus in patients attending tertiary care hospital in South India. *Asian Journal of Pharmaceutical and Clinical Research* 2015; 8(2):274-276.
37. Basaran NF, Akici A. Patients' experience and perspectives on the rational use of drugs in Turkey: a survey study. *Patient preference and adherence*. 2012;6:719-24.
38. World Health Organisation. Global Status Report on noncommunicable diseases. 2014. Available at URL: [http://apps.who.int/iris/bitstream/handle/10665/148114/9789241564854\\_eng.pdf;jsessionid=89D7CBFF5B60AE5394BEAB3AFD48A501?sequence=1](http://apps.who.int/iris/bitstream/handle/10665/148114/9789241564854_eng.pdf;jsessionid=89D7CBFF5B60AE5394BEAB3AFD48A501?sequence=1).
39. Mash B, Fairall L, Adejayan O, Ikpefan O, Kumari J, Mathee S, et al. A morbidity survey of South African primary care. *PloS one*. 2012;7(3):e32358.
40. Department Health Republic of South Africa. NATIONAL HEALTH INSURANCE FOR SOUTH AFRICA TOWARDS UNIVERSAL HEALTH COVERAGE. Available at URL: <https://www.health-e.org.za/wp-content/uploads/2015/12/National-Health-Insurance-for-South-Africa-White-Paper.pdf>
41. 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.
42. 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>.
43. Polonsky WH, Henry RR. Poor medication adherence in type 2 diabetes: recognizing the scope of the problem and its key contributors. *Patient preference and adherence*. 2016;10:1299-307.
44. Islam SM, Biswas T, Bhuiyan FA, Mustafa K, Islam A. Patients' perspective of disease and medication adherence for type 2 diabetes in an urban area in Bangladesh: a qualitative study. *BMC research notes*. 2017;10(1):131.
45. Gulabani M, John M, Isaac R. Knowledge of diabetes, its treatment and complications amongst diabetic patients in a tertiary care hospital. *Indian J Community Med*. 2008;33(3):204-6.
46. Kenaope T, Paramadhas BDA, Phiri HR, Luke R, Ramotsababa M, Tiroyakgosi C. CHARACTERISTICS AND OUTCOMES OF PATIENTS ATTENDING A TERTIARY CARE DIABETIC CENTRE IN BOTSWANA; FINDINGS AND IMPLICATIONS. Fourth Training Workshop and Symposium MURIA Group in conjunction with ISPE 2018. Consolidated abstracts p22. Available at URL: [file:///C:/Users/mail/Downloads/Consolidated-abstract-booklet%20\(3\).pdf](file:///C:/Users/mail/Downloads/Consolidated-abstract-booklet%20(3).pdf).
47. Jackson IL, Adibe MO, Okonta MJ, Ukwe CV. Knowledge of self-care among type 2 diabetes patients in two states of Nigeria. *Pharmacy practice*. 2014;12(3):404.

48. Hilawe EH, Yatsuya H, Kawaguchi L, Aoyama A. Differences by sex in the prevalence of diabetes mellitus, impaired fasting glycaemia and impaired glucose tolerance in sub-Saharan Africa: a systematic review and meta-analysis. *Bull World Health Organ.* 2013;91(9):671-82d.
49. Sundufu AJ, Bockarie CN, Jacobsen KH. The prevalence of type 2 diabetes in urban Bo, Sierra Leone, and in the 16 countries of the West Africa region. *Diabetes/metabolism research and reviews.* 2017;33(7).
50. Browne DL, Avery L, Turner BC, Kerr D, Cavan DA. What do patients with diabetes know about their tablets? *Diabetic medicine.* 2000;17(7):528-31.
51. Thungathurthi S TS, Kumar GV. SELF CARE KNOWLEDGE ON DIABETES AMONG DIABETIC PATIENTS IN WARANGAL REGION. *International Journal of Life Science and Pharma Research.* 2012;2(2):P-16 - P-21. Available at URL: [http://ijlpr.com/admin/php/uploads/79\\_pdf.pdf](http://ijlpr.com/admin/php/uploads/79_pdf.pdf).
52. Hajwal SK, Salma K. Assessment of Self-Care Knowledge among Type II Diabetics Mellitus Patients at Diabetic Center in Babylon Governorate/ Iraq. *International Journal of Scientific and Research Publications.* 2016;6(8):281 - 91. Available at URL: <http://www.ijsrp.org/research-paper-0816/ijsrp-p5637.pdf>.
53. Krishnan V, Thirunavukkarasu J. Assessment of Knowledge of Self Blood Glucose Monitoring and Extent of Self Titration of Anti-Diabetic Drugs among Diabetes Mellitus Patients - A Cross Sectional, Community Based Study. *J Clin Diagn Res.* 2016;10(3):Fc09-11.
54. Wabe NT, Angamo MT, Hussein S. Medication adherence in diabetes mellitus and self management practices among type-2 diabetics in Ethiopia. *North American journal of medical sciences.* 2011;3(9):418-23.
55. Karaoui LR, Deeb ME, Nasser L, Hallit S. Knowledge and practice of patients with diabetes mellitus in Lebanon: a cross-sectional study. *BMC public health.* 2018;18:525.
56. Ssemaluulu R, Adome R. Patients' knowledge of medication use as an equity issue in health care: Do health workers pay attention to this? EQUINET Project 2006. Available at URL: <http://www.equinet africa.org/sites/default/files/uploads/documents/CBP3EHSadome.pdf>.
57. Williams L, Caskey H, Coates V, Thompson K, Stewart H. A survey of patients' knowledge of their diabetes medication: *J Diabetes Nurs.*; 2007. 264-9 p.
58. Saleh F, Mumu SJ, Ara F, Begum HA, Ali L. Knowledge and self-care practices regarding diabetes among newly diagnosed type 2 diabetics in Bangladesh: a cross-sectional study. *BMC public health.* 2012;12:1112.
59. Kerr M, Rayman G, Jeffcoate WJ. Cost of diabetic foot disease to the National Health Service in England. *Diabetic medicine.* 2014;31(12):1498-504.
60. Oksuz E, Malhan S, Sonmez B, Numanoglu Tekin R. Cost of illness among patients with diabetic foot ulcer in Turkey. *World Journal of Diabetes.* 2016;7(18):462-9.
61. Raghav A, Khan ZA, Labala RK, Ahmad J, Noor S, Mishra BK. Financial burden of diabetic foot ulcers to world: a progressive topic to discuss always. *Therapeutic advances in endocrinology and metabolism.* 2018;9(1):29-31.
62. Smith M. Pharmacists' Role in Improving Diabetes Medication Management. *Journal of diabetes science and technology (Online).* 2009;3(1):175-9.
63. Erku DA, Ayele AA, Mekuria AB, Belachew SA, Hailemeskel B, Tegegn HG. The impact of pharmacist-led medication therapy management on medication adherence in patients with type 2 diabetes mellitus: a randomized controlled study. *Pharmacy practice.* 2017;15(3):1026.
64. Antoine S-L, Pieper D, Mathes T, Eikermann M. Improving the adherence of type 2 diabetes mellitus patients with pharmacy care: a systematic review of randomized controlled trials. *BMC Endocrine Disorders.* 2014;14(1):53.
65. Rampamba EM, Meyer JC, Helberg EA, Godman B. Satisfaction, experiences and perceptions of hypertensive patients with primary healthcare services in Vhembe District, South Africa. Fourth Training Workshop and Symposium MURIA Group in conjunction with ISPE 2018 Consolidated abstracts p24. Available at URL: file:///C:/Users/mail/Downloads/Consolidated-abstract-booklet%20(3).pdf.

66. Egbujie BA, Delobelle PA, Levitt N, Puoane T, Sanders D, van Wyk B. Role of community health workers in type 2 diabetes mellitus self-management: A scoping review. *PloS one*. 2018;13(6):e0198424.
67. Gorina M, Limonero JT, Alvarez M. Effectiveness of primary healthcare educational interventions undertaken by nurses to improve chronic disease management in patients with diabetes mellitus, hypertension and hypercholesterolemia: A systematic review. *Int J Nurs Stud*. 2018;86:139-50.
68. Rampamba EM, Meyer JC, Godman B, Kurdi A, Helberg E. Evaluation of antihypertensive adherence and its determinants at primary healthcare facilities in rural South Africa. *Journal of comparative effectiveness research*. 2018;7(7):661-72.
69. 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.
70. Jande M, Katabalo DM, Sravanam P, Marwa C, Madlan B, Burger J, et al. Patient-related beliefs and adherence toward their medications among the adult hypertensive outpatients in Tanzania. *Journal of comparative effectiveness research*. 2017.
71. Houston TK, Fix GM, Shimada SL, Long JA, Gordon HS, Pope C, et al. African American Veterans Storytelling: A Multisite Randomized Trial to Improve Hypertension. *Medical care*. 2017;55 Suppl 9 Suppl 2:S50-s8.
72. 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.
73. Shrivastava SR, Shrivastava PS, Ramasamy J. Role of self-care in management of diabetes mellitus. *Journal of diabetes and metabolic disorders*. 2013;12(1):14.