Statin prescription among patients with type 2 diabetes at a specialised diabetes clinic, Botswana

by

Julius Chacha Mwita

A thesis presented in fulfilment of the requirements for the degree of Master of Science (MSc) in Clinical Epidemiology in the Faculty of Medicine and Health Sciences at Stellenbosch University

Supervisor: Tonya M Esterhuizen

Co-supervisor: Brian Godman

December 2019

Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Signature: **Date: December 2019**

STELLENBOSCH UNIVERSITY
FACULTY OF MEDICINE AND HEALTH SCIENCES

TO WHOM IT MAY CONCERN

ASSIGNMENT/THESIS/DISSERTATION RELEASE

Student's surname	Julius Chacha Mwita	
Initials	Dr	Student no

Title of assignment/thesis/dissertation: **Statin prescription among patients with type 2 diabetes at a specialised diabetes clinic, Botswana**

Faculty	Faculty of Medicine and Health Sciences, Stellenbosch University
Division/Department	Division of Epidemiology and Biostatistics, Department of Global Health
Degree	MSc Clinical Epidemiology
Supervisor (s)	Tonya M Esterhuizen Prof Brian Godman

I confirm that

- I and the co-supervisor(s) (if applicable) have read the final draft of the assignment/thesis/dissertation
- The assignment/thesis/dissertation is ready for examination
- The assignment/thesis/dissertation has been checked using anti-plagiarism software

Supervisor signature: **Date:**

Part A: Completed manuscript

Abstract

Background

There is evidence of statin benefit among patients with diabetes regardless of their cholesterol levels or prior cardiovascular disease history. Despite the evidence, there is under-prescription of statins in clinical practice. This study aimed to assess statin prescriptions and associated factors among patients with type 2 diabetes in Botswana.

Methods

The study was a secondary data analysis of 500 randomly selected type 2 diabetes patients at a specialised diabetes clinic at Gaborone Botswana. We assessed the proportion of statin-eligible patients who were prescribed statins and evaluated the adjusted associations between various factors and statin prescription.

Results

Overall, 477(95.4%) participants were eligible for a statin prescription. Clinicians prescribed statins in 217(45.5%%; 95% confidence interval[CI]: 41.1%-50.0%) of eligible participants, and only one(4.4%) ineligible participant. The probability of statin prescription was high in participants with high baseline low-density lipoprotein cholesterol(risk ratio [RR]:1.49; 95%CI: 1.17 - 1.89), increasing duration of diabetes (RR: 1.01; 95%CI 1.00 - 1.03) and the presence of chronic kidney disease (RR: 1.35; 95%CI: 1.06 - 1.74).

Conclusion

Most patients with type 2 diabetes were not receiving statins. Clinicians did not consider most guideline-recommended indications for statin prescription. The findings call for improvement in diabetes quality of care by implementing evidence-based guideline recommendations.

Keywords: statin, type 2 diabetes mellitus, prescription and Botswana

Table of Contents

Background

Cardiovascular disease(CVD), which includes coronary artery disease (CAD), cerebrovascular accident, and peripheral arterial disease(PAD), are common and contribute to over two-thirds of mortality among patients with type 2 diabetes mellitus[1-3]. Although the presence of type 2 diabetes alone confers the highest risk for CVD of any single risk factor, the coexistence of other cardiovascular risk factors is a common phenomenon[3, 4]. Consequently, guidelines advise screening and optimal treatment of CVD risk factors in people with diabetes[5, 6]. Besides, prescribing of 3-hydroxy-3-methylglutaryl-coenzyme A reductase inhibitors(statins) among patients with type 2 diabetes reduces the risk of major CVD events by 23%-33%[7-9]. There is evidence of statin benefit among patients with diabetes regardless of their low-density lipoprotein cholesterol(LDL-C) values or prior CVD history[7, 9-14]. For each mmol/l reduction in LDL-C, there is evidence of a 9 % relative reduction in all-cause mortality in patients with diabetes[15]. Irrespective of LDL-C, guidelines recommend statins for patients with diabetes aged ≥ 40 years without atherosclerotic cardiovascular disease(ASCVD), or those who are younger than 40 years but with existing ASCVD or additional risk factors[5, 6]. While some studies in developed countries have reported high use of statins among patients with type 2 diabetes, there has generally been under-prescription of statins across many countries[16-18]. Statin prescription ranges between 0% and 100% in developed countries[17-20]. The proportion of patients with type 2 diabetes in Africa receiving a statin currently ranges between 3 and 13%[21-23]. The suboptimal utilisation of statin therapy in Africa is due to many factors, but mainly limited access to standard diabetes care because of the high cost of tests and medications[22]. Affordability is a critical issue in several African countries where there is no universal healthcare, with the cost of medicines accounting for up to 70% of total healthcare expenditure, much of which is out-of-pocket[24, 25]. This is a concern given the high growth rates of cardiovascular diseases in sub-Saharan African countries and current poor control of cardiovascular diseases [26-30]. The underuse of statins significantly increases the incidence of cardiovascular events and associated mortality[31]. Although healthcare is free in Botswana, factors not related to cost may still affect the uptake of statins in patients with diabetes. This is an issue given current prevalence rates of diabetes in Botswana and the resultant impact on

morbidity and mortality[32]. Currently, there is no study assessing statin prescriptions among patients with type 2 diabetes in Botswana. We aimed to address this by evaluating the extent of statin prescriptions among patients with diabetes in Botswana. Our secondary aim was to determine factors associated with statin prescriptions among Type 2 diabetes. Subsequently, we will use the findings to develop appropriate strategies to address the situation identified concerns.

Methods

Study design

We conducted a secondary analysis of data from a previous study among type 2 diabetics at a specialised diabetes clinic in Gaborone, Botswana. Any concerns with the management of diabetic patients in this dedicated leading clinic are likely to be exacerbated in non-specialist centres such as primary healthcare centres.

Participant recruitment and data collection

The original study took place between August 2017 and February 2018[33]. The primary objective of the original study was to assess glycemic, low-density lipoprotein, and hypertension control in patients with type 2 diabetes. The study included 500 randomly selected patients with type 2 diabetes aged ≥ 18 years who had received care from the clinic for at least three months before data collection. Demographic data(age, sex, occupation, educational attainments, and marital status), duration of diabetes, and the type of diabetes medications were collected. Other information was the history of hypertension, lipid disorders, ischemic heart diseases, stroke or peripheral vascular disease. We also recorded data on the use of medications for hypertension and lipid disorders (including statins), and anthropometric measurements (weight, height, hip and waist circumferences).

For the present study, we evaluated the extent of statin prescriptions among the participants in the dataset. The primary outcome measure was receiving a statin prescription among statin-eligible participants. We assessed statin eligibility based on the Society for Endocrinology, Metabolism, and Diabetes of South Africa(SEMDSA) guidelines[6]. According to SEMDSA, the eligibility for statin prescribing included any cardiovascular disease(CVD) or chronic kidney

disease(CKD), participant's age above 40 years, and diabetes duration longer than ten years. Also, the presence of one or more additional cardiovascular risk factors, i.e. hypertension, cigarette smoker, low high-density lipoprotein cholesterol(HDL-C) level, family history of early CAD, and any albuminuria were the other eligibility criteria[6]. Thus, we assessed the association of the above eligibility criteria for statin prescribing. Other independent variables included baseline serum LDL-C, body mass index(BMI), waist-hip ratio(WHR) and education attainment.

Definition of terms

The diagnosis of hypertension was based on the self-reported history of hypertension, the use of hypertension-lowering medications or sustained blood pressure ≥140/90 mmHg in more than one visit[34]. We defined CVD as the history of CAD, cerebrovascular diseases(ischemic stroke, transient ischemic attacks), or peripheral vascular diseases(PAD)[6]. CAD was any documented definite or probable myocardial infarction, CAD-related revascularisation(surgery, angioplasty, stenting, or any combination of these), or stable angina in patients' medical records[35]. Cerebrovascular and peripheral vascular diseases were extracted from patients' medical records as defined by the treating physician. Smoking status was a documented self-report of current smoking habits. We estimated glomerular filtration rate(eGFR) using the Modification of Diet in Renal Disease(MDRD), and classified patients with eGFR < 60 ml/minute/1.73m^2 as having chronic kidney disease and an increased risk of a cardiovascular event[5, 6, 36]. Body mass index(BMI) was categorized into underweight for BMI <18.5 kg/m^2; normal for BMI of 25.0–29.9 kg/m^2; or obese for BMI ≥30 kg/m^2[37]. We measured waist and hip circumferences using standard procedures and defined WHR ≥ 0.85 for women and ≥ 0.90 for men as high[38]. Dipstick proteinuria appeared as negative (−), trace, (+), (++), or (+++) in the dataset. We classified proteinuria in individuals with ≥(+) dipstick proteinuria results. For patients already on lipid-lowering medications and whose baseline 'untreated' levels of lipid profile were not available, we estimated the LDL-C levels before the initiation of statin treatment as in previous studies[39]. The adjustment was made based on the assumption that most patients received atorvastatin (the only statin available in the public sector in Botswana) at a dosage of at least 10mg per day. With an estimated adherence of 58.2 %, we calculated the

baseline LDL-C levels by assuming that the measured LDL-C is a result of a 25% reduction from baseline[39]. Baseline LDL-C levels above 4.13 mmol/l were considered high[40].

Statistical analysis

Clean data were imported and analysed using Stata Version 14(Stata Corp, College Station, TX). Categorical variables are presented as percentages and continuous variables as a mean(standard deviation[SD]) or median [first–third quartiles]. Comparison of clinical and demographic factors by gender and statin use was made using Chi-square or Fisher's exact tests for categorical variables, and independent student's t-tests or Wilcoxon rank-sum test for continuous variables as appropriate. A 2-sided p-value < 0.05 was considered as statistically significant. To assess for independent predictors for statin prescribing, generalised linear models for the binomial family were used, and a log link was specified to obtain relative risks and 95% confidence intervals. All factors with $p < 0.2$ on univariate analysis were added to the multivariable model. We used a backward selection modelling method, with probabilities set at 0.05 and 0.1 for inclusion and exclusion; respectively. We report adjusted risk ratios (RRs), 95% CIs, and p-values. We required a sample size of 477 to produce a two-sided 95% confidence interval with a width equal to 3.01% based on the assumptions of approximately 13% statin use among patients with type 2 diabetes in Botswana[22].

Results

Of the 500 patients in the dataset, the mean(SD) age was 58.9(12.2) years, 330 (66%) were females. Table 1 summarises the patients' characteristics by gender. The majority(96.7%) of participants aged ≥ 40 years and women were significantly older than men. Approximately a third (34.4%) of participants had a diabetes duration of over ten years. Hypertension(84.7%) and obesity(51.6%) were prevalent, especially in female participants. Overall, CKD(11.3%), proteinuria(10.7%), CVD (8.8%), and smoking(3.4%) were uncommon. The mean(SD) baseline LDL-C was 3.1(1.2) mmol/L, significantly higher in female than male participants.

[Table 1: Demographic and clinical characteristics of patients with type 2 diabetes at a specialised Diabetes clinic in Gaborone (N= 477)]

Statin eligibility and prescribing rates

Of the 500 participants, 477(95.4%) were eligible for a statin prescription. Clinicians prescribed statins (exclusively atorvastatin) in 217(45.5%; 95%CI:41.1%-50.0%) of statin-eligible participants, and only one(4.4%;95%CI:5.1%-28.4%) ineligible participants. Seven(1.5%) of all participants received prescriptions of other lipid-lowering medications alone or in combinations with statins. Of those who were eligible for statins, statin-prescribed individuals differed from those without prescriptions in several parameters on univariate analysis(Table 2). Relative to the statin-non-prescribed group, the statin-prescribed group had a longer duration of diabetes(8.9 years vs. 6.0 years; $p < 0.001$); were older (61.5 years vs 59.2 years ; $p = 0.018$), and had a a higher proportion of hypertensive patients(85.5% vs 81.5%; $p<0.036$), a higher proportion of those on antihypertensive(85.7% vs 78.1%, $p<0.032$), a higher proportion of participants with CKD(17.2% vs 6.6%; $p= 0.006$), and a higher baseline LDL-C(3.3 vs 2.9 mmol/L; $p <0.003$). The two groups did not differ significantly in the presence of CVD, proteinuria and gender.

[Table 2: Factors associated with statin prescription among statin-eligible patients with type 2 diabetes at a specialised Diabetes clinic in Gaborone (N= 477)].

Multivariable analysis

In the multivariable model which examined adjusted associations between statin prescription and various factors, the best fit had the following covariates: age, the duration of diabetes, BMI, hypertension a high baseline LDL-C, CKD, CVD, and proteinuria. Increasing diabetes duration was associated with an increased likelihood (RR: 1.01; 95%CI 1.00 - 1.03) of receiving a statin prescription (Table 3), as was the presence of CKD(RR: 1.35; 95%CI: 1.06 – 1.74) and a high baseline LDL-C(RR: 1.49; 95%CI: 1.17 - 1.89). Patients' age, BMI, history of CVD, and a diagnosis of hypertension were not associated with statin prescribing after adjustment for the other variables in the model.

[Table 3 Adjusted relative risks for associations between various factors and statin prescription among statin eligible patients with diabetes at a specialised diabetes clinic in Botswana]

Discussion

Among patients with type 2 diabetes at a specialised diabetes clinic in Botswana, less than half of the statin-eligible patients received a statin prescription. The longer duration of diabetes, a higher baseline LDL-C and the presence of chronic kidney disease were independently associated with the tendency to prescribe statins.

The under-prescription of statins in our cohort is a concern since the use of statins appreciably reduces cardiovascular events and mortality in patients with diabetes irrespective of their LDL-C levels[7, 9-13]. Although the proportion of patients with diabetes who are prescribed statins varies substantially worldwide, there is a low prescribing of statins both in developing and developed countries[18, 19, 21-23, 41-44]. The percentage of patients with diabetes who received statins(45.5%) in our cohort is consistent with findings from developed countries where 25% to 73% of patients with diabetes are prescribed statins despite recommendations from the guidelines[18, 19, 41-43]. The proportion of participants with a statin prescription in our cohort was higher than those reported in some cohorts in developed countries, such as Germany (25%) and Great Britain (33%)[18, 41]. While the finding of a comparatively higher statin prescription in our setting than some other settings in developed countries is encouraging, there is no reason for complacency as more than half of our patients were without CVD protection by statins. Similar to developed countries, one potential explanation for low statin prescribing rates among our patients with diabetes is poor adherence to guidelines[22, 44-46]. While there may be a fear of the association of statin therapy with a slightly increased risk of developing diabetes, the benefits of statins in reducing cardiovascular morbidity and mortality among patients with established diabetes should dispel these concerns[7-9, 47]. Several epidemiological studies have observed a lower proportion of statin prescription in patients with diabetes in Africa (3% to 13%) than in our cohort[21-23]. In addition to poor adherence to guidelines, the main reasons for low statin prescribing in Africa include limited access to these medicines due to their high cost, lack of facilities for monitoring lipid profiles while patients are on treatment, and unavailability of guidelines[22]. The availability of free consultations, tests and medications in Botswana might explain our higher

statin prescribing rates than those in other African settings without universal health access. Irrespective of the reasons, it is imperative that statins are routinely prescribed to reduce the risk of CVD events in patients with type 2 diabetes[7-13, 15, 48].

Our results of increasing statin prescribing with increasing diabetes duration also agree with previous research findings[49]. This is reassuring as a longer duration of diabetes leads to an increased risk of CVD. For this reason, guidelines recommend statins for patients with diabetes for more than ten years[5, 6]. Although this finding may suggest that clinicians correctly recognise a longer duration of diabetes as an indication for statin therapy, the results tend to agree with the fact that transmission of information between clinicians and patients about new medications requires time[50].

Another finding in our study was that the presence of chronic kidney disease increased the likelihood of statin prescribing. This finding is also encouraging as statins reduce mortality by up to 36% in patients with kidney failure[5, 6, 51, 52]. Besides, this finding is consistent with SEMDSA guideline recommendations of a statin for every patient with diabetes and CKD[6]. While the presence of any albuminuria is another marker of renal kidney disease used as an indication of statin use in people with diabetes, dipstick proteinuria was not associated with statin prescribing in our cohort. We can postulate that clinicians do not recognise proteinuria as a predictor of CVD and an indication for statins in patients with diabetes. We will investigate this further as it contrasts with Berthold et al. who reported increased odds of statin prescribing in type 2 diabetes patients with proteinuria in Germany[18]

Our findings that a high baseline LDL-C increased the likelihood of statin prescribing agreed with those of Berthold at al. that showed an 11% increase in statin prescribing rates for every 0.26 mmol/L increase in LDL-C[18]. Besides, this finding confirms the observation from previous studies that prescribers tend to respond more to the pre-treatment LDL-C value than to the patients' overall CVD risk profile as described in clinical guidelines [9, 45]. Although there is a lack of local guidelines, the clinic adopted the SEMDSA guidelines which recommend statins along with lifestyle changes regardless of cholesterol levels for all patients with diabetes aged > 40 with or without CVD[6]. Our findings that there is approximately a 50% increased likelihood

of statin prescription in our cohort may suggest a need for deliberate efforts for improving the understanding and implementation of the adopted guidelines, and we will be taking this further.

In most clinical guidelines, the presence of CVD, CKD, patients age, diabetes and presence of CVD risk factors such as hypertension, albuminuria and cigarette smoking are indicators of prescribing statins among patients with type 2 diabetes[5, 6]. The recommendations are based mainly on the rationale that the presence of any of the above factors is associated with an increased risk of CVD. Except for CKD and duration of diabetes, none of the other indications was a predictor of statin prescriptions in our cohort. Given the high prevalence of hypertension and other indications in our cohort, most participants would have qualified for statins if guideline recommendations were adhered to. As our clinic has adopted the SEMDSA guidelines, this finding is a concern and a call for efforts to improve its implementation for the benefit of this high-risk population. We will be following this up.

We are mindful of the limitations of our study. We estimated the baseline LDL-C levels by a 25% adjustment of measured LDL. There was a risk of either overestimation or underestimation of the baseline LDL-C in case of significant errors in our assumptions of the dosage and the adherence of atorvastatin. Although measured LDL-C results were available for all the included participants, HDL cholesterol results were mostly missing. Guidelines consider HDL as one of the factors for statin prescriptions in patients with diabetes. However, all other indications for statin prescriptions were available in our cohort. We did not document the dosage of statin used in our cohort; hence, we are unable to determine whether moderate to high-intensity statins were prescribed as recommended by the guidelines. The study was also performed in one leading clinic, hence limiting the generalizability of the study findings to other facilities in the country. However, being one of the few specialised diabetes clinics in the country, our results likely represent the ‘best’ quality of diabetes care in Botswana. Consequently, highlighted concerns are likely to be higher in non-specialist healthcare facilities treating patients with type 2 diabetes in Botswana.

Conclusion

In conclusion, we believe this study provides a useful and reliable picture of current statin prescribing behaviour in Botswana despite the limitations mentioned above. There is under-prescribing of statins in this high-risk population. The presence of CKD, high baseline LDL, and an increased duration of diabetes strongly influence statin prescriptions in patients with diabetes. Clinicians did not consider most guideline-recommended indications for statin prescription. By identifying gaps in the prescription of statins to patients with diabetes, the study provides a substantial opportunity for improvement in diabetes quality of care. Furthermore, the study findings suggest a need for further studies to investigate the reasons for statin under-prescription in our setting. We are following this up to provide future guidance for clinicians in Botswana treating patients with type 2 diabetes, with the results likely to be of interest to other sub-Saharan African countries with high rates of type 2 diabetes.

Abbreviations

ASCVD: atherosclerotic cardiovascular disease; BMI: Body mass index; CAD: coronary artery disease; CKD: chronic kidney disease; CVD: Cardiovascular disease; eGFR: estimated glomerular filtration rate; HDL-C: HbA1c: Haemoglobin A1c; HDL-C: High density lipoprotein cholesterol; HRDC: Health Research Development Committee; LDL-C: Low density lipoprotein cholesterol; MDRD: Modification of Diet in Renal Disease PAD: peripheral artery disease; SEMDSA: Society for Endocrinology, Metabolism, and Diabetes of South Africa WHR: Waist-Hip ratio.

Declarations

Ethics approval and consent to participate

The Health Research Development Committee(HRDC) of the Botswana Ministry of Health and Wellness(HPDME:13/18/1) and Stellenbosch University Health Research Ethics Committee (X19/01/001) approved the study. The participating patients provided written, informed consent in the primary study.

Consent for publication

Not applicable

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request and with permission of the HRDC of Botswana Ministry of Health and Wellness.

Competing interests

The authors declare that they have no competing interests.

Funding

No funding was received**.**

Authors' contributions

JCM, BG and EMT conceptualized the study. JCM analysed data and drafted the initial draft. ETM and BG critically reviewed data and reviewed the manuscripts. All the authors read and approved the final manuscript.

Acknowledgements

This research project has been conducted as part of the academic requirements of the MSc in Clinical Epidemiology www.sun.ac.za/clinepi, Stellenbosch University.

References

1. Di Angelantonio E, Kaptoge S, Wormser D, Willeit P, Butterworth AS, Bansal N, O'Keeffe LM, Gao P, Wood AM, Burgess S *et al*.: **Association of Cardiometabolic Multimorbidity With Mortality**. *JAMA* 2015, **314**(1):52-60.
2. Huxley R, Barzi F, Woodward M: **Excess risk of fatal coronary heart disease associated with diabetes in men and women: meta-analysis of 37 prospective cohort studies**. *BMJ* 2006, **332**(7533):73-78.
3. Lloyd-Jones DM, Leip EP, Larson MG, D'Agostino RB, Beiser A, Wilson PW, Wolf PA, Levy D: **Prediction of lifetime risk for cardiovascular disease by risk factor burden at 50 years of age**. *Circulation* 2006, **113**(6):791-798.
4. Reusch JE DB: **Atherosclerosis in diabetes and insulin resistance**. *Diabetes Obes Metab* 2007(9):455-463.
5. American Diabetes Association: **Standards of medical care in diabetes—2017 abridged for primary care providers**. *Clinical Diabetes* 2017, **35**(1):5-26.
6. 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.
7. Colhoun HM, Betteridge DJ, Durrington PN, Hitman GA, Neil HA, Livingstone SJ, Thomason MJ, Mackness MI, Charlton-Menys V, Fuller JH: **Primary prevention of cardiovascular disease with**

atorvastatin in type 2 diabetes in the Collaborative Atorvastatin Diabetes Study (CARDS): a multicentre randomised placebo-controlled trial. *Lancet* 2004, **364**(9435):685-696.
8. Collins R, Armitage J, Parish S, Sleigh P, Peto R: **MRC/BHF Heart Protection Study of cholesterol-lowering with simvastatin in 5963 people with diabetes: a randomised placebo-controlled trial**. *Lancet* 2003, **361**(9374):2005-2016.
9. Sever PS, Poulter NR, Dahlof B, Wedel H, Collins R, Beevers G, Caulfield M, Kjeldsen SE, Kristinsson A, McInnes GT *et al*: **Reduction in cardiovascular events with atorvastatin in 2,532 patients with type 2 diabetes: Anglo-Scandinavian Cardiac Outcomes Trial--lipid-lowering arm (ASCOT-LLA)**. *Diabetes Care* 2005, **28**(5):1151-1157.
10. Baigent C, Blackwell L, Emberson J, Holland LE, Reith C, Bhala N, Peto R, Barnes EH, Keech A, Simes J *et al*: **Efficacy and safety of more intensive lowering of LDL cholesterol: a meta-analysis of data from 170,000 participants in 26 randomised trials**. *Lancet* 2010, **376**(9753):1670-1681.
11. de Vries FM, Denig P, Pouwels KB, Postma MJ, Hak E: **Primary prevention of major cardiovascular and cerebrovascular events with statins in diabetic patients: a meta-analysis**. *Drugs* 2012, **72**(18):2365-2373.
12. Hayward RA, Hofer TP, Vijan S: **Narrative review: lack of evidence for recommended low-density lipoprotein treatment targets: a solvable problem**. *Annals of internal medicine* 2006, **145**(7):520-530.
13. Perk J, De Backer G, Gohlke H, Graham I, Reiner Z, Verschuren M, Albus C, Benlian P, Boysen G, Cifkova R *et al*: **European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). The Fifth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (constituted by representatives of nine societies and by invited experts)**. *European heart journal* 2012, **33**(13):1635-1701.
14. Perreault S, Dragomir A, Blais L, Berard A, Lalonde L, White M, Pilon D: **Impact of better adherence to statin agents in the primary prevention of coronary artery disease**. *European journal of clinical pharmacology* 2009, **65**(10):1013-1024.
15. Kearney P, Blackwell L, Collins Ra, Keech A, Simes J, Peto R, Armitage J, Baigent C: **Cholesterol Treatment Trialists'(CTT) Collaborators. Efficacy of cholesterol-lowering therapy in 18,686 people with diabetes in 14 randomised trials of statins: a meta-analysis**. *Lancet* 2008, **371**(9607):117-125.
16. Eliasson B, Svensson AM, Miftaraj M, Jonasson JM, Eeg-Olofsson K, Sundell KA, Gudbjornsdottir S: **Clinical use and effectiveness of lipid lowering therapies in diabetes mellitus--an observational study from the Swedish National Diabetes Register**. *PLoS One* 2011, **6**(4):e18744.
17. Balder JW, Scholtens S, de Vries JK, van Schie LM, Boekholdt SM, Hovingh GK, Kamphuisen PW, Kuivenhoven JA: **Adherence to guidelines to prevent cardiovascular diseases: The LifeLines cohort study**. *The Netherlands journal of medicine* 2015, **73**(7):316-323.
18. Berthold HK, Gouni-Berthold I, Bohm M, Krone W, Bestehorn KP: **Patterns and predictors of statin prescription in patients with type 2 diabetes**. *Cardiovascular diabetology* 2009, **8**:25.
19. Harrison TN, Scott RD, Cheetham TC, Chang S-C, Hsu J-WY, Wei R, Ling Grant DS, Boklage SH, Romo-LeTourneau V, Reynolds K: **Trends in Statin Use 2009-2015 in a Large Integrated Health System: Pre- and Post-2013 ACC/AHA Guideline on Treatment of Blood Cholesterol**. *Cardiovascular drugs and therapy* 2018, **32**(4):397-404.
20. Simmons RK, Carlsen AH, Griffin SJ, Charles M, Christiansen JS, Borch-Johnsen K, Sandbaek A, Lauritzen T: **Variation in prescribing of lipid-lowering medication in primary care is associated with incidence of cardiovascular disease and all-cause mortality in people with screen-detected diabetes: findings from the ADDITION-Denmark trial**. *Diabetic medicine : a journal of the British Diabetic Association* 2014, **31**(12):1577-1585.

21. 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 Endocrine Disorders* 2011, **11**(1):19.
22. Sobngwi E, Ndour-Mbaye M, Boateng KA, Ramaiya KL, Njenga EW, Diop SN, Mbanya JC, Ohwovoriole AE: **Type 2 diabetes control and complications in specialised diabetes care centres of six sub-Saharan African countries: the Diabcare Africa study**. *Diabetes Res Clin Pract* 2012, **95**(1):30-36.
23. Uloko AE, Ofoegbu EN, Chinenye S, Fasanmade OA, Fasanmade AA, Ogbera AO, Ogbu OO, Oli JM, Girei BA, Adamu A: **Profile of Nigerians with diabetes mellitus - Diabcare Nigeria study group (2008): Results of a multicenter study**. *Indian J Endocrinol Metab* 2012, **16**(4):558-564.
24. 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):240-249.
25. Ofori-Asenso R, Agyeman AA: **Irrational Use of Medicines—A Summary of Key Concepts**. *Pharmacy* 2016, **4, 35**.
26. Kayima J, Wanyenze RK, Katamba A, Leontsini E, Nuwaha F: **Hypertension awareness, treatment and control in Africa: a systematic review**. *BMC cardiovascular disorders* 2013, **13**:54.
27. 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):116-128.
28. **IDF Diabetes Atlas** [https://diabetesatlas.org/IDF_Diabetes_Atlas_8e_interactive_EN/]
29. Adeniyi OV, Yogeswaran P, Longo-Mbenza B, Ter Goon D: **Uncontrolled Hypertension and Its Determinants in Patients with Concomitant Type 2 Diabetes Mellitus (T2DM) in Rural South Africa**. *PLoS One* 2016, **11**(3):e0150033.
30. Hamid S, Groot W, Pavlova M: **Trends in cardiovascular diseases and associated risks in sub-Saharan Africa: a review of the evidence for Ghana, Nigeria, South Africa, Sudan and Tanzania**. *The aging male : the official journal of the International Society for the Study of the Aging Male* 2019:1-8.
31. Rannanheimo PK, Tiittanen P, Hartikainen J, Helin-Salmivaara A, Huupponen R, Vahtera J, Korhonen MJ: **Impact of Statin Adherence on Cardiovascular Morbidity and All-Cause Mortality in the Primary Prevention of Cardiovascular Disease: A Population-Based Cohort Study in Finland**. *Value in health : the journal of the International Society for Pharmacoeconomics and Outcomes Research* 2015, **18**(6):896-905.
32. Rwegerera GM, Moshomo T, Gaenamong M, Oyewo TA, Gollakota S, Rivera YP, Masaka A, Godman B, Shimwela M, Habte D: **Health-related quality of life and associated factors among patients with diabetes mellitus in Botswana**. *Alexandria Journal of Medicine* 2018, **54**(2):111-118.
33. Mwita JC, Francis JM, Omech B, Botsile E, Oyewo A, Mokgwathi M, Molefe-Baikai OJ, Godman B, Tshikuka JG: **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.
34. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, Handler J, Lackland DT, LeFevre ML, MacKenzie TD, Ogedegbe O: **2014 evidence-based guideline for the management of high blood pressure in adults: a report from the panel members appointed to the Eighth Joint National Committee (JNC 8)**. *JAMA* 2014, **311**(5):507-520.
35. White AD, Folsom AR, Chambless LE, Sharret AR, Yang K, Conwill D, Higgins M, Williams OD, Tyroler HA: **Community surveillance of coronary heart disease in the Atherosclerosis Risk in**

Communities (ARIC) Study: methods and initial two years' experience. *Journal of clinical epidemiology* 1996, **49**(2):223-233.
36. Levey AS, Greene T, Schluchter MD, Cleary PA, Teschan PE, Lorenz RA, Molitch ME, Mitch WE, Siebert C, Hall PM *et al*: **Glomerular filtration rate measurements in clinical trials. Modification of Diet in Renal Disease Study Group and the Diabetes Control and Complications Trial Research Group**. *Journal of the American Society of Nephrology : JASN* 1993, **4**(5):1159-1171.
37. Expert Panel on the Identification E, and Treatment of Overweight in Adults,: **Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: executive summary. Expert Panel on the Identification, Evaluation, and Treatment of Overweight in Adults**. *The American journal of clinical nutrition* 1998, **68**(4):899-917.
38. World Health Organization: **Waist circumference and waist-hip ratio: report of a WHO expert consultation, Geneva, 8-11 December 2008**. In.; 2011.
39. Law MR, Wald NJ, Rudnicka AR: **Quantifying effect of statins on low density lipoprotein cholesterol, ischaemic heart disease, and stroke: systematic review and meta-analysis**. *BMJ* 2003, **326**(7404):1423.
40. Expert Panel on Detection E, Adults ToHBCi: **Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III)**. *JAMA* 2001, **285**(19):2486-2497.
41. Chang KC, Soljak M, Lee JT, Woringer M, Johnston D, Khunti K, Majeed A, Millett C: **Coverage of a national cardiovascular risk assessment and management programme (NHS Health Check): Retrospective database study**. *Preventive medicine* 2015, **78**:1-8.
42. Ofori-Asenso R, Ilomaki J, Tacey M, Zomer E, Curtis AJ, Bell JS, Zoungas S, Liew D: **Patterns of statin use and long-term adherence and persistence among older adults with diabetes**. *Journal of diabetes* 2018, **10**(9):699-707.
43. Steen DL, Khan I, Becker L, Foody JM, Gorcyca K, Sanchez RJ, Giugliano RP: **Patterns and predictors of lipid-lowering therapy in patients with atherosclerotic cardiovascular disease and/or diabetes mellitus in 2014: Insights from a large US managed-care population**. *Clinical cardiology* 2017, **40**(3):155-162.
44. Lemstra M BD, Crawley A, Fung R.: **Proportion and risk indicators of nonadherence to statin therapy: a meta-analysis**. *Can J Cardiol* 2012, **28**(5):574-580.
45. Barham AH, Goff DC, Jr., Chen H, Balasubramanyam A, Rosenberger E, Bonds DE, Bertoni AG: **Appropriateness of cholesterol management in primary care by sex and level of cardiovascular risk**. *Preventive cardiology* 2009, **12**(2):95-101.
46. Bai JW, Boulet G, Halpern EM, Lovblom LE, Eldelekli D, Keenan HA, Brent M, Paul N, Bril V, Cherney DZI *et al*: **Cardiovascular disease guideline adherence and self-reported statin use in longstanding type 1 diabetes: results from the Canadian study of longevity in diabetes cohort**. *Cardiovascular diabetology* 2016, **15**:14-14.
47. Sattar N, Preiss D, Murray HM, Welsh P, Buckley BM, de Craen AJ, Seshasai SR, McMurray JJ, Freeman DJ, Jukema JW *et al*: **Statins and risk of incident diabetes: a collaborative meta-analysis of randomised statin trials**. *Lancet* 2010, **375**(9716):735-742.
48. Godman B, Shrank W, Andersen M, Berg C, Bishop I, Burkhardt T, Garuoliene K, Herholz H, Joppi R, Kalaba M *et al*: **Policies to enhance prescribing efficiency in europe: findings and future implications**. *Frontiers in pharmacology* 2010, **1**:141.
49. Casagrande SS, Aviles-Santa L, Corsino L, Daviglus ML, Gallo LC, Espinoza Giacinto RA, Llabre MM, Reina SA, Savage PJ, Schneiderman N *et al*: **HEMOGLOBIN A1C, BLOOD PRESSURE, AND LDL-CHOLESTEROL CONTROL AMONG HISPANIC/LATINO ADULTS WITH DIABETES: RESULTS FROM THE HISPANIC COMMUNITY HEALTH STUDY/STUDY OF LATINOS (HCHS/SOL)**. *Endocrine*

practice : official journal of the American College of Endocrinology and the American Association of Clinical Endocrinologists 2017, **23**(10):1232-1253.

50. Tarn DM, Paterniti DA, Kravitz RL, Heritage J, Liu H, Kim S, Wenger NS: **How much time does it take to prescribe a new medication?** *Patient education and counseling* 2008, **72**(2):311-319.
51. Seliger SL, Weiss NS, Gillen DL, Kestenbaum B, Ball A, Sherrard DJ, Stehman-Breen CO: **HMG-CoA reductase inhibitors are associated with reduced mortality in ESRD patients**. *Kidney international* 2002, **61**(1):297-304.
52. Tonelli M, Keech A, Shepherd J, Sacks F, Tonkin A, Packard C, Pfeffer M, Simes J, Isles C, Furberg C *et al*: **Effect of Pravastatin in People with Diabetes and Chronic Kidney Disease**. *Journal of the American Society of Nephrology* 2005, **16**(12):3748-3754.

Tables

Table 1: Demographic and clinical characteristics of patients with type 2 diabetes at a specialised Diabetes clinic in Gaborone (N= 477)

Characteristics	All (N=477)	Males (n= 160)	Females (n= 317)
Age, mean(SD), years	60.3(10.8)	56.8(11.5)	62.0(10.1)
Age > 40 years n(%)	461(96.7)	150(93.8)	311(98.1)
Diabetes duration, median, IQR, years	7(3-13)	8.9(3-14)	7 (3-13)
Diabetes duration > 10 years	164 (34.4)	63(39.4)	101(31.9)
BMI, mean (SD) kg/m²	30.7(6.0)	29.0(5.2)	31.6(6.1)
Normal weight n(%)	85(17.8)	39(24.4)	46(14.5)
Overweight n(%)	146(30.6)	59(36.7)	87(27.4)
Obese n(%)	246(51.6)	62(38.8)	184(58.0)
Marital status			
Living alone n(%)	247(51.8)	47(29.4)	200(63.1)
Living with a partner n(%)	230(48.2)	113(70.6)	117(36.9)
Education status			
≤ Primary education, n(%)	306(64.1)	82(51.3)	224(70.7)
≥ Secondary or tertiary, n(%)	171(35.9)	78(48.7)	93(29.3)
WHR, mean (SD)	0.94(0.10)	0.97(0.08)	0.93(0.09)
Low WHR n (%)	79(16.6)	67(41.9)	12(3.8)
High WHR n (%)	398(83.4)	93(58.1)	305(96.2)
Hypertension n (%)	404(84.7)	120(75.0)	284(89.6)
Use of antihypertensive n (%)	389(81.6)	110(68.8)	279(88.0)
Smoking n (%)	16(3.4)	12(7.5)	4(1.3)
Lipid-lowering medications n (%)	224(47.0)	70(43.8)	154(48.6)
Statins n (%)	217(45.5)	68(42.5)	149(47.0)
Others n (%)	7(1.5)	2(1.6)	5(1.6)
CVD n (%)	42(8.8)	15(9.4)	27(8.5)
PAD n (%)	11(2.3)	3(1.9)	8(2.5)
Coronary artery disease n (%)	12(2.5)	5(3.3)	7(2.2)
Cerebrovascular disease n (%)	22(4.6)	8(5.0)	14(4.4)
CKD n (%)	54(11.3)	24(15.0)	30(9.5)
Proteinuria n (%)	51(10.7)	27(16.9)	24(7.6)
HbA1c mean (SD), %	8.4(2.4)	8.5(2.6)	8.3(2.3)
Baseline LDL-C, mean (SD), mmol/L	3.1(1.2)	2.8(1.1)	3.3(1.2)
Normal	315(66.0)	113(70.6)	202(63.7)
High	59(12.4)	9(5.6)	50(15.8)
Missing	103(21.6)	38(23.8)	65(20.5)

Legend: BMI- Body Mass Index, CKD – chronic kidney disease, CVD – cardiovascular disease, HbA1c – Haemoglobin A1c, IQR – interquartile range; LDL-C – low-density lipoprotein cholesterol, PAD – peripheral artery disease, SD – standard deviation; WHR – waist-hip ratio.

Table 2: Factors associated with statin prescription among statin-eligible patients with type 2 diabetes at a specialised Diabetes clinic in Gaborone (N= 477)

Characteristics	Statin not prescribed (n= 260)	Statin prescribed (n= 217)	P-value
Sex			
Males, n (%)	92(35.4)	68(31.3)	0.351
Female, n (%)	168(64.6)	149(68.7)	
Diabetes duration, median, IQR, years	6(2 – 12)	8.9(4 – 15)	<0.001
Duration ≤ 10 years	179(68.9)	134(61.8)	0.104
Diabetes duration > 10 years	81(31.1)	83(38.2)	
Age, mean (SD), years	59.2(10.8)	61.5(10.7)	0.018
Age ≤ 40 years, n (%)	12(4.6)	4(1.8)	<0.094
Age > 40 years n (%)	248(95.4)	213(98.2)	
Marital status			
Living alone n (%)	135(51.9)	112(51.6)	0.946
Living with a partner n (%)	125(48.1)	105 (48.4)	
Education status			
≤ Primary education, n (%)	166(63.9)	140(64.2)	0.879
≥ Secondary or tertiary, n (%)	94(36.1)	77(35.8)	
Hypertension n (%)	212(81.5)	192 (88.5)	0.036
Antihypertensive use n (%)	203(78.1)	186(85.7)	0.032
Smoking	13(5.0)	3(1.4)	0.029
CVD, n (%)	20(7.7)	22(10.1)	0.538
PAD, n (%)	7(2.7)	4(1.8)	0.625
Coronary artery disease n (%)	6(2.3)	6(2.8)	0.751
Cerebrovascular diseases n (%)	9(3.5)	13(6.0)	0.190
BMI, mean (SD) kg/m^2	30.3(5.7)	31.2(6.2)	0.113
Normal weight n (%)	50(19.2)	35(16.1)	
Overweight n (%)	79(30.4)	67(30.9)	0.669
Obese n (%)	135(47.9)	115(52.8)	
WHR, mean (SD) kg/m2	0.94(0.08)	0.95(0.10)	0.106
Low WHR n (%)	46(17.7)	33(15.2)	0.467
High WHR n (%)	214(82.3)	184(84.8)	
CKD, n (%)	20(7.7)	34 (15.7)	0.006
Proteinuria, n (%)	30 (11.5)	21(9.7)	0.512
HbA1c mean (SD), %	8.4(2.6)	8.4(2.2)	0.948
Baseline LDL-C mean (SD), mmol/L	2.9(0.9)	3.3(1.4)	0.003
Normal	177(68.1)	120(55.3)	<0.001
High	17(6.5)	42(19.4)	
Missing	66(25.4)	55(25.3)	

Legend: BMI- Body Mass Index, CKD – chronic kidney disease, CVD – cardiovascular disease, HbA1c – Haemoglobin A1c, IQR – interquartile range; LDL-C – low-density lipoprotein cholesterol, PAD – peripheral artery disease, SD – standard deviation; WHR – waist-hip ratio.

Table 3 Adjusted relative risks for associations between various factors and statin prescription among statin eligible patients with diabetes at a specialised diabetes clinic in Botswana

Characteristic	Risk ratio	95% Conf. Interval	p-value
Age	1.006	0.994-1.017	0.362
CKD	1.354	1.055-1.738	0.017
Hypertension	1.336	0.846-2.110	0.213
BMI	1.014	0.994-1.034	0.16
High baseline LDL	1.488	1.173-1.887	0.001
Diabetes duration, years	1.014	1.000-1.027	0.048
Proteinuria	0.979	0.644-1.488	0.922
CVD	0.901	0.623-1.303	0.581

Legend: BMI- Body Mass Index, CKD – chronic kidney disease, CVD – cardiovascular disease, LDL-C – low-density lipoprotein cholesterol.

Part B: Appendices

a. Relevant journal Instructions to Authors:

https://bmcendocrdisord.biomedcentral.com/submission-guidelines

Research article

Criteria

Research articles should report on original primary research, but may report on systematic reviews of published research provided they adhere to the appropriate reporting guidelines which are detailed in our editorial policies. Please note that non-commissioned pooled analyses of selected published research will not be considered.

BMC Endocrine Disorders strongly encourages that all datasets on which the conclusions of the paper rely should be available to readers. We encourage authors to ensure that their datasets are either deposited in publicly available repositories (where available and appropriate) or presented in the main manuscript or additional supporting files whenever possible. Please see Springer Nature's information on recommended repositories. Where a widely established research community expectation for data archiving in public repositories exists, submission to a community-endorsed, public repository is mandatory. A list of data where deposition is required, with the appropriate repositories, can be found on the Editorial Policies Page.

Authors who need help depositing and curating data may wish to consider uploading their data to Springer Nature's Research Data Support or contacting our Research Data Support Helpdesk. Springer Nature's Research Data Support provides data deposition and curation to help authors

follow good practice in sharing and archiving of research data, and can be accessed via an online form. The services provide secure and private submission of data files, which are curated and managed by the Springer Nature Research Data team for public release, in agreement with the submitting author. These services are provided in partnership with figshare. Checks are carried out as part of a submission screening process to ensure that researchers who should use a specific community-endorsed repository are advised of the best option for sharing and archiving their data. Use of Research Data Support is optional and does not imply or guarantee that a manuscript will be accepted.

Preparing **your** manuscript

The information below details the section headings that you should include in your manuscript and what information should be within each section.

Please note that your manuscript must include a 'Declarations' section including all of the subheadings (please see below for more information).

Title page

The title page should:

- present a title that includes, if appropriate, the study design e.g.:
    - "A versus B in the treatment of C: a randomized controlled trial", "X is a risk factor for Y: a case control study", "What is the impact of factor X on subject Y: A systematic review"
    - or for non-clinical or non-research studies a description of what the article reports
- list the full names and institutional addresses for all authors
    - if a collaboration group should be listed as an author, please list the Group name as an author. If you would like the names of the individual members of the Group to be searchable through their individual PubMed records, please include this information in the “Acknowledgements” section in accordance with the instructions below
- indicate the corresponding author

Abstract

The Abstract should not exceed 350 words. Please minimize the use of abbreviations and do not cite references in the abstract. Reports of randomized controlled trials should follow

the CONSORT extension for abstracts. The abstract must include the following separate sections:

- **Background:** the context and purpose of the study
- **Methods:** how the study was performed and statistical tests used
- **Results:** the main findings
- **Conclusions:** brief summary and potential implications
- **Trial registration:** If your article reports the results of a health care intervention on human participants, it must be registered in an appropriate registry and the registration number and date of registration should be in stated in this section. If it was not registered prospectively (before enrollment of the first participant), you should include the words 'retrospectively registered'. See our editorial policies for more information on trial registration

Keywords

Three to ten keywords representing the main content of the article.

Background

The Background section should explain the background to the study, its aims, a summary of the existing literature and why this study was necessary or its contribution to the field.

Methods

The methods section should include:

- the aim, design and setting of the study
- the characteristics of participants or description of materials
- a clear description of all processes, interventions and comparisons. Generic drug names should generally be used. When proprietary brands are used in research, include the brand names in parentheses
- the type of statistical analysis used, including a power calculation if appropriate

Results

This should include the findings of the study including, if appropriate, results of statistical analysis which must be included either in the text or as tables and figures.

Discussion

This section should discuss the implications of the findings in context of existing research and highlight limitations of the study.

Conclusions

This should state clearly the main conclusions and provide an explanation of the importance and relevance of the study reported.

List of abbreviations

If abbreviations are used in the text, they should be defined in the text at first use, and a list of abbreviations should be provided.

Declarations

All manuscripts must contain the following sections under the heading 'Declarations':

- Ethics approval and consent to participate
- Consent for publication
- Availability of data and material
- Competing interests
- Funding
- Authors' contributions
- Acknowledgements
- Authors' information (optional)

Please see below for details on the information to be included in these sections.

If any of the sections are not relevant to your manuscript, please include the heading and write 'Not applicable' for that section.

Ethics approval and consent to participate

Manuscripts reporting studies involving human participants, human data or human tissue must:

- include a statement on ethics approval and consent (even where the need for approval was waived)

- include the name of the ethics committee that approved the study and the committee's reference number if appropriate

Studies involving animals must include a statement on ethics approval.

See our editorial policies for more information.

If your manuscript does not report on or involve the use of any animal or human data or tissue, please state "Not applicable" in this section.

Consent for publication

If your manuscript contains any individual person's data in any form (including any individual details, images or videos), consent for publication must be obtained from that person, or in the case of children, their parent or legal guardian. All presentations of case reports must have consent for publication.

You can use your institutional consent form or our consent form if you prefer. You should not send the form to us on submission, but we may request to see a copy at any stage (including after publication).

See our editorial policies for more information on consent for publication.

If your manuscript does not contain data from any individual person, please state "Not applicable" in this section.

Availability of data and materials

All manuscripts must include an 'Availability of data and materials' statement. Data availability statements should include information on where data supporting the results reported in the article can be found including, where applicable, hyperlinks to publicly archived datasets analysed or generated during the study. By data we mean the minimal dataset that would be necessary to interpret, replicate and build upon the findings reported in the article. We recognise it is not always possible to share research data publicly, for instance when individual privacy could be compromised, and in such instances data availability should still be stated in the manuscript along with any conditions for access.

Data availability statements can take one of the following forms (or a combination of more than one if required for multiple datasets):

- The datasets generated and/or analysed during the current study are available in the [NAME] repository, [PERSISTENT WEB LINK TO DATASETS]
- The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.
- All data generated or analysed during this study are included in this published article [and its supplementary information files].
- The datasets generated and/or analysed during the current study are not publicly available due [REASON WHY DATA ARE NOT PUBLIC] but are available from the corresponding author on reasonable request.
- Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.
- The data that support the findings of this study are available from [third party name] but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of [third party name].
- Not applicable. If your manuscript does not contain any data, please state 'Not applicable' in this section.

More examples of template data availability statements, which include examples of openly available and restricted access datasets, are available here.

BioMed Central also requires that authors cite any publicly available data on which the conclusions of the paper rely in the manuscript. Data citations should include a persistent identifier (such as a DOI) and should ideally be included in the reference list. Citations of datasets, when they appear in the reference list, should include the minimum information recommended by DataCite and follow journal style. Dataset identifiers including DOIs should be expressed as full URLs. For example:

Hao Z, AghaKouchak A, Nakhjiri N, Farahmand A. Global integrated drought monitoring and prediction system (GIDMaPS) data sets. figshare. 2014. http://dx.doi.org/10.6084/m9.figshare.853801

With the corresponding text in the Availability of data and materials statement:

The datasets generated during and/or analysed during the current study are available in the [NAME] repository, [PERSISTENT WEB LINK TO DATASETS].[Reference number]

Competing interests

All financial and non-financial competing interests must be declared in this section.

See our editorial policies for a full explanation of competing interests. If you are unsure whether you or any of your co-authors have a competing interest please contact the editorial office.

Please use the authors initials to refer to each authors' competing interests in this section.
If you do not have any competing interests, please state "The authors declare that they have no competing interests" in this section.

Funding

All sources of funding for the research reported should be declared. The role of the funding body in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript should be declared.

Authors' contributions

The individual contributions of authors to the manuscript should be specified in this section. Guidance and criteria for authorship can be found in our editorial policies.

Please use initials to refer to each author's contribution in this section, for example: "FC analyzed and interpreted the patient data regarding the hematological disease and the transplant. RH performed the histological examination of the kidney and was a major contributor in writing the manuscript. All authors read and approved the final manuscript."

Acknowledgements

Please acknowledge anyone who contributed towards the article who does not meet the criteria for authorship including anyone who provided professional writing services or materials.

Authors should obtain permission to acknowledge from all those mentioned in the Acknowledgements section.

See our editorial policies for a full explanation of acknowledgements and authorship criteria.

If you do not have anyone to acknowledge, please write "Not applicable" in this section.

Group authorship (for manuscripts involving a collaboration group): if you would like the names of the individual members of a collaboration Group to be searchable through their individual PubMed records, please ensure that the title of the collaboration Group is included on the title page and in the submission system and also include collaborating author names as the last paragraph of the “Acknowledgements” section. Please add authors in the format First Name, Middle initial(s) (optional), Last Name. You can add institution or country information for each author if you wish, but this should be consistent across all authors.

Please note that individual names may not be present in the PubMed record at the time a published article is initially included in PubMed as it takes PubMed additional time to code this information.

Authors' information

This section is optional.
You may choose to use this section to include any relevant information about the author(s) that may aid the reader's interpretation of the article, and understand the standpoint of the author(s). This may include details about the authors' qualifications, current positions they hold at institutions or societies, or any other relevant background information. Please refer to authors using their initials. Note this section should not be used to describe any competing interests.

Endnotes

Endnotes should be designated within the text using a superscript lowercase letter and all notes (along with their corresponding letter) should be included in the Endnotes section. Please format this section in a paragraph rather than a list.

References

Examples of the Vancouver reference style are shown below.

See our editorial policies for author guidance on good citation practice

Web links and URLs: All web links and URLs, including links to the authors' own websites, should be given a reference number and included in the reference list rather than within the text of the manuscript. They should be provided in full, including both the title of the site and

the URL, as well as the date the site was accessed, in the following format: The Mouse Tumor Biology Database. http://tumor.informatics.jax.org/mtbwi/index.do. Accessed 20 May 2013. If an author or group of authors can clearly be associated with a web link, such as for weblogs, then they should be included in the reference.

Example reference style:

Article within a journal
Smith JJ. The world of science. Am J Sci. 1999;36:234-5.

Article within a journal (no page numbers)
Rohrmann S, Overvad K, Bueno-de-Mesquita HB, Jakobsen MU, Egeberg R, Tjønneland A, et al. Meat consumption and mortality - results from the European Prospective Investigation into Cancer and Nutrition. BMC Medicine. 2013;11:63.

Article within a journal by DOI
Slifka MK, Whitton JL. Clinical implications of dysregulated cytokine production. Dig J Mol Med. 2000; doi:10.1007/s801090000086.

Article within a journal supplement
Frumin AM, Nussbaum J, Esposito M. Functional asplenia: demonstration of splenic activity by bone marrow scan. Blood 1979;59 Suppl 1:26-32.

Book chapter, or an article within a book
Wyllie AH, Kerr JFR, Currie AR. Cell death: the significance of apoptosis. In: Bourne GH, Danielli JF, Jeon KW, editors. International review of cytology. London: Academic; 1980. p. 251-306.

OnlineFirst chapter in a series (without a volume designation but with a DOI)
Saito Y, Hyuga H. Rate equation approaches to amplification of enantiomeric excess and chiral symmetry breaking. Top Curr Chem. 2007. doi:10.1007/128_2006_108.

Complete book, authored
Blenkinsopp A, Paxton P. Symptoms in the pharmacy: a guide to the management of common illness. 3rd ed. Oxford: Blackwell Science; 1998.

Online document

Doe J. Title of subordinate document. In: The dictionary of substances and their effects. Royal Society of Chemistry. 1999. http://www.rsc.org/dose/title of subordinate document. Accessed 15 Jan 1999.

Online database

Healthwise Knowledgebase. US Pharmacopeia, Rockville. 1998. http://www.healthwise.org. Accessed 21 Sept 1998.

Supplementary material/private homepage

Doe J. Title of supplementary material. 2000. http://www.privatehomepage.com. Accessed 22 Feb 2000.

University site

Doe, J: Title of preprint. http://www.uni-heidelberg.de/mydata.html (1999). Accessed 25 Dec 1999.

FTP site

Doe, J: Trivial HTTP, RFC2169. ftp://ftp.isi.edu/in-notes/rfc2169.txt (1999). Accessed 12 Nov 1999.

Organization site

ISSN International Centre: The ISSN register. http://www.issn.org (2006). Accessed 20 Feb 2007.

Dataset with persistent identifier

Zheng L-Y, Guo X-S, He B, Sun L-J, Peng Y, Dong S-S, et al. Genome data from sweet and grain sorghum (Sorghum bicolor). GigaScience Database. 2011. http://dx.doi.org/10.5524/100012.

b. Questionnaire/data capture instrument(s) (as prepared originally for protocol)

None, as this was a secondary data analysis

c. Ethics consent form(s) (as prepared originally for protocol)

Attached – SU and Ministry of Health and wellness, Botswana

UNIVERSITEIT
STELLENBOSCH
UNIVERSITY

Approval

New Application

06/03/2019

Project ID :8886

HREC Reference # X19/01/001

Title: Statin eligibility, and prescription among patients with Type 2 Diabetes in a specialised public clinic, Botswana.

Dear Dr Julius Mwita,

The **New Application** received on 28/02/2019 11:25 was reviewed by members of **Health Research Ethics Committee** via **expedited** review procedures on 06/03/2019 and was approved.

Please note the following information about your approved research protocol:

Protocol Approval Period: 06 March 2019 to 05 March 2020

Please remember to use your project ID (8886)on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review
Translation of the informed consent document(s) to the language(s) applicable to your study participants should now be submitted to the HREC.
Please note you can submit your progress report through the online ethics application process, available at: Links Application Form Direct
Link and the application should be submitted to the HREC before the year has expired. Please see *Forms and Instructions* on our HREC website (www.sun.ac.za/healthresearchethics) for guidance on how to submit a progress report.

The HREC will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.

Provincial and City of Cape Town Approval
Please note that for research at a primary or secondary healthcare facility, permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Please consult the Western Cape Government website for access to the online Health Research Approval Process, see:
https://www.westerncape.gov.za/general-publication/health-research-approval-process. Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.
For standard HREC forms and instructions, please visit: Forms and Instructions on our HREC website
https://applyethics.sun.ac.za/ProjectView/Index/8886

If you have any questions or need further assistance, please contact the HREC office at 021 938 9677.

Yours sincerely,
Mrs. Melody Shana ,
Coordinator,
HREC1

National Health Research Ethics Council (NHREC) Registration Number:

The Health Research Ethics Committee (HREC) complies with the SA National Health Act No. 61 of 2003 as it pertains to health research. The HREC abides by the ethical norms and principles for research, established by the World Medical Association (2013). Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects; *the South African Department of Health (2006). Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa (2nd edition)*;

as well as the Department of Health (2015). Ethics in Health Research: Principles, Processes and Structures (2nd edition).

The Health Research Ethics Committee reviews research involving human subjects conducted or supported by the Department of Health and Human Services, or other federal departments or agencies that apply the Federal Policy for the Protection of Human Subjects to such research (United States Code of Federal Regulations Title 45 Part 46); and/or clinical investigations regulated by the Food and Drug Administration (FDA) of the Department of Health and Human Services.

PRIVATE BAG 0038
GABORONE
BOTSWANA
REFERENCE:

REPUBLIC OF BOTSWANA
MINISTRY OF HEALTH AND WELLNESS

TEL: (+267) 363 2500
FAX: (+267) 391 0647
TELEGRAMS: RABONGAKA
TELEX: 2818 CARE BD

REFERENCE NO: HPDME: 13/18/1 **23rd May 2019**

Health Research and Development Division

Dr Julius C. Mwita
University of Botswana
Private Bag 00708
Gaborone

Dear Dr Julius C. Mwita

PERMIT: **STATIN ELIGIBILITY, AND PRESCRIPTION AMONG PATIENTS WITH TYPE 2 DIABETES IN A SPECIALISED PUBLIC CLINIC, BOTSWANA**

Your application for a research permit for the above stated research protocol refers. We note that your proposal has been reviewed and approved by University of Botswana Review Board.

Permission is therefore granted to conduct the above mentioned study. This approval is valid for a period of 1 year effective 23rd May 2019.

This permit does not however give you authority to collect data from the selected site(s) without prior approval from the management. Consent from the identified individuals should be obtained at all times.

The research should be conducted as outlined in the approved proposal. Any changes to the approved proposal must be submitted to the Health Research and Development Division in the Ministry of Health and Wellness for consideration and approval.

Furthermore, you are requested to submit at least one hardcopy and an electronic copy of the report to the Health Research, Ministry of Health Wellness within 3 months of completion of the study. Approval is for academic fulfillment only. Copies should also be submitted to all other relevant authorities.

Thank you for your cooperation and your commitment to the protection of human subjects in research.

Yours faithfully

Ms S. Moswetunyane
for /PERMANENT SECRETARY

MINISTRY OF HEALTH RESEARCH DIVISION
2019 -05- 23
P/BAG 0038
GABORONE
REPUBLIC OF BOTSWANA

d. *Selected* tables or figures,

With brief explanatory text that would be useful for the examiner to see as part of the analyses, but which could not be included in the article for reasons of space. This should not simply be a collection of analysis printouts but should be readable as an addendum with reference to the article.

None

e. Any technical appendices needed – for example, laboratory techniques, statistical formulae.

None

f. Acknowledgements

Part of the manuscript. This research project has been conducted as part of the academic requirements of the MSc in Clinical Epidemiology www.sun.ac.za/clinepi, Stellenbosch University.

g. Turnitin report

Attached

Julius Mwita

ORIGINALITY REPORT

23%	12%	19%	12%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	scholar.sun.ac.za Internet Source	2%
2	"Abstracts 2007", Diabetologia, 2007 Publication	2%
3	Heiner K Berthold. "Patterns and predictors of statin prescription in patients with type 2 diabetes", Cardiovascular Diabetology, 2009 Publication	2%
4	"Minutes of the 44th General Assembly of the European Association for the Study of Diabetes", Diabetologia, 2009 Publication	2%
5	"Abstracts", Diabetologia, 2005 Publication	1%
6	"Minutes of The 43rd General Assembly of the European Association for the Study of Diabetes", Diabetologia, 2008 Publication	1%
7	Submitted to University of Glamorgan Student Paper	1%
8	"Abstracts of the EASD, Stockholm 2010", Diabetologia, 2010	1%

	Publication	
9	genomebiology.biomedcentral.com Internet Source	1%
10	thejns.org Internet Source	1%
11	ir.library.oregonstate.edu Internet Source	1%
12	link.springer.com Internet Source	1%
13	www.academia.edu Internet Source	1%
14	"Abstracts of the IDF Congress in Paris 2003", Diabetologia, 2003 Publication	<1%
15	dugi-doc.udg.edu Internet Source	<1%
16	lib.bioinfo.pl Internet Source	<1%
17	Submitted to the University of Edinburgh Student Paper	<1%
	S Pillay, C M Aldous, D Singh, D Pillay,	1

18	"Validation and effect on diabetes control of glycated haemoglobin (HbA1c) point-of-care testing", South African Medical Journal, 2019 Publication	
19	&NA;, . "Abstracts :", Critical Care Medicine, 2012. Publication	<1%
20	bmchealthservres.biomedcentral.com Internet Source	<1%
21	Submitted to Queen Mary and Westfield College Student Paper	<1%
22	"The 2012 SEMDSA Guideline for the Management of type 2 Diabetes", Journal of Endocrinology, Metabolism and Diabetes of South Africa, 2014 Publication	<1%
23	www.cardiachealth.org Internet Source	<1%
24	jphcs.biomedcentral.com Internet Source	<1%

25	Submitted to DeVry, Inc. Student Paper	<1%
26	www.ask4articles.info Internet Source	<1%
27	d-nb.info Internet Source	<1%
28	www.cdc.gov Internet Source	<1%
29	www.j3.jstage.jst.go.jp Internet Source	<1%
30	www.jlr.org Internet Source	<1%
31	res.mdpi.com Internet Source	<1%
32	pharmacotherapynewsnetwork.com Internet Source	<1%
33	www.biomedcentral.com Internet Source	<1%
	www.onlineiacc.org	1

34	Internet Source	
35	Arima, Yuzo, Rachel L. Winer, Ann E. Kurth, Diane P. Martin, James P. Hughes, Michael E. Stern, Qinghua Feng, Nancy B. Kiviat, and Laura A. Koutsky. "Disclosure of Genital Human Papillomavirus Infection to Female Sex Partners by Young Men:", Sexually Transmitted Diseases, 2012. Publication	<1%

36	Ayse L. Mindikoglu, Arie Regev, Stephen L. Seliger, Laurence S. Magder. "Gender disparity in liver transplant waiting-list mortality: The importance of kidney function", Liver Transplantation, 2010 Publication	<1%
37	d-scholarship.pitt.edu Internet Source	<1%
38	"Abstracts from the 30th Annual Meeting of the Society of General Internal Medicine", Journal of General Internal Medicine, 2007 Publication	<1%
39	circ.ahajournals.org Internet Source	<1%
40	journals.plos.org Internet Source	<1%
41	"Posters", Journal of Diabetes, 04/2009 Publication	<1%
42	Dong-Churl Suh, Mark Aagren. "Cost–effectiveness of insulin detemir: a systematic	<1%

review", Expert Review of Pharmacoeconomics & Outcomes Research, 2014

Publication

43 Devaraj Munikrishnappa. "Chronic kidney disease (CKD) in the elderly – a geriatrician's perspective", The Aging Male, 2009 <1%

Publication

Exclude quotes

Of f

Exclude matches

Of f

Exclude bibliography On