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# Diabetes in the Western Cape, South Africa: A secondary analysis of the diabetes cascade database 2015 – 2020

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ABSTRACT

*Aim:* The aim was to describe the demographics, comorbidities and outcomes of care for patients with diabetes at primary care facilities in the Western Cape, South Africa, between 2015 and 2020.
*Methods:* This was a secondary analysis of the diabetes cascade database.
*Results:* The database included 116726 patients with mean age of 61.4 years and 63.8 % were female. The mean age at death was 66.0 years. Co-morbidities included hypertension (69.5 %), mental health disorders (16.2 %), HIV (6.4 %) and previous TB (8.2 %). Sixty-three percent had at least one previous hospital admission and 20.2 % of all admissions were attributed to cardiovascular diseases. Coronavirus was the third highest reason for admission over a 10-year period. Up to 70% were not receiving an annual HbA1c test. The mean value for the last HBA1c taken was 9.0%. Three-quarters (75.5 %) of patients had poor glycaemic control (HbA1c >7 %) and a third (33.7 %) were very poorly controlled (HbA1c>10 %). Glycaemic control was significantly different between urban sub-districts and rural areas. Renal disease was prevalent in 25.5 %.
*Conclusion:* Diabetes was poorly controlled with high morbidity and mortality. There was poor compliance with guidelines for HbA1c and eGFR measurement. At least 7% of diabetic patients were being admitted for complications annually.

## 1. Introduction

Sub-Saharan Africa is challenged by an increase in both communicable and non-communicable diseases [1,2]. The rising prevalence of diabetes has been deemed an international crisis with up to 9.3% of the world's adult population afflicted [3]. Diabetes accounts for 11.3 % of all deaths in the adult population globally, with 46% of these in working-age adults. Once considered a disease of the affluent, diabetes is increasingly common in low- and middle-income countries. The African population is thought to have a lower prevalence of diabetes at 3.9 %, but strained health services result in an estimated 60 % of people remaining undiagnosed [3]. Nevertheless, urbanised populations in Africa have prevalence rates of diabetes more comparable to the rest of the world [1].

South Africa is one of four countries on the African continent with a higher prevalence of diabetes [3,4]. Diabetes accounts for high morbidity and mortality and is the second overall leading cause of death and the first cause of death for women [5]. The South African National Health and Nutrition Survey has highlighted the potential of an even higher burden of disease [6]. It is estimated that 45 % of the South African population remain unscreened for diabetes [7–9].

The Western Cape's (WC) Practical Approach to Care Kit (PACK) guideline provides recommendations for the management and monitoring of people with diabetes in primary care [10] These include 3-monthly follow up for uncontrolled patients, 6-monthly follow up for those well-controlled, and annual investigations such as retinal and foot screening. Patients should be offered human immunodeficiency virus (HIV) testing and family planning at every visit [10]. Ideally HbA1c should be measured every year in patients with HbA1c < 8 %, or every 3 months if > 8 %. The eGFR should be measured at diagnosis of diabetes and then annually.

The Metro Health Services (MHS) have identified the need to

*Abbreviations:* HIV, Human Immunodeficiency Virus; TB, Tuberculosis; HbA1c, Glycosylated haemoglobin; eGFR, Estimated glomerular filtration rate; PACK, Practical approach to care kit; WC, Western Cape; MHS, Metro Health Services; WCDOH, Western Cape Department of Health; PHDC, Provincial Health Data Centre; ICD-10, International Classification of Diseases Version 10; SD, Standard deviation; CI, Confidence intervals; COVID-19, Coronavirus Infectious Disease 2019; USA, United States of America.

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improve the quality of care for people with diabetes [11]. Until recently, the Western Cape Department of Health (WCDOH) performed annual audits to measure the quality of care [12]. Whilst these audits have been helpful in improving some of the clinical processes, they were performed by facilities without external validation and on a small sample of folders, which meant the results were not valid at the level of the facility [12].

The WC Provincial Health Data Centre (PHDC) attempted to improve on this situation by integrating routinely available electronic data on people with diabetes using a unique patient identifier. Data was obtained from sources such as the National Health Laboratory Service, primary care facilities, and hospital discharge summaries. The data was made available for clinicians using a Single Patient Viewer, which collated all data on a single patient into one report. The WCDOH requested an analysis of the database to help them plan future service delivery. No previous audits of health service delivery and clinical outcomes in South Africa have been able to analyse a database of this size and most published studies focus on only one or two facilities and a few hundred patients [13–16].

The aim of the study was to describe the demographics, outcomes of care, co-morbidities and complications of patients with diabetes treated at primary care facilities in the Western Cape Province from January 2015 to December 2020.

## 2. Methods

### 2.1. Study design

A secondary analysis of data obtained from the PHDC for people with diabetes.

### 2.2. Setting

The Western Cape is subdivided into six health districts: Cape Town Metropole, West Coast, Cape Winelands, Overberg, Garden Route, and Central Karoo [17]. The Cape Metropole health district consists of eight sub-districts (Western, Eastern, Southern, Northern, Klipfontein, Mitchells Plain, Tygerberg and Khayelitsha), which are further grouped into four substructures (Khayelitsha-Eastern, Northern-Tygerberg, Southern-Western and Klipfontein-Mitchells Plain). It is estimated 6, 610,920 people reside in the Western Cape, 63.4 % in the Cape Town Metropole and 36.6% in rural districts [17]. The Cape Metro population is estimated at 4,194,178 people and is served by 152 primary care clinics and 8 district hospitals.

In primary care, patients are managed by nurse practitioners and primary care doctors according to the PACK guidelines. Stable or well controlled patients may be seen every 6-months and in between obtain pre-packaged medication from alternative pick-up points, support groups or home delivery. Unstable or uncontrolled patients are seen more regularly, usually every 3-months and collect their medication monthly. In 2020, the coronavirus pandemic disrupted services for people with diabetes and only people with emergencies or very uncontrolled patients were seen at primary care facilities.

### 2.3. Study population

The database included all adults (≥ 18 years) with diabetes, residing in the Western Cape Province, and utilizing public sector primary care facilities between 2015 and 2020.

### 2.4. Data analysis

The data was provided in an Excel spreadsheet and checked for any errors or duplications. Categorical data was numerically coded prior to analysis. Each hospital admission had a primary diagnosis recorded using the International Classification of Diseases version 10 (ICD-10). Categorical variables were summarized using frequencies and percentages. Normally distributed numerical variables were analysed using means and standard deviations.

Associations between dependent numerical variables (usually HbA1c) and independent binary variables were assessed using the independent samples t-test. The associations with independent nominal variables were assessed using analysis of variance and post hoc tests used the Bonferonni method for nominal independent variables.

## 3. Results

### 3.1. Demographic and clinical characteristics

The database included 116,726 patients with a mean age of 61.4 years (SD 13.8) (Table 1). The mean age of females was 62.0 years (SD 13.7) compared to 60.6 years for males (SD 13.3), with a mean difference of 1.5 years (95 % CI 1.3–1.7; $p < 0.001$). Overall, 63.8 % were female and 36.1 % were male. Amongst those that had died (10.0 % of the database), the mean age at death was 66.0 years (SD 12.1). Overall, 98.6 % of patients lived in the Cape Town metropole.

Hypertension was a comorbidity in 69.5 % and mental health disorders in 16.2 % of the study population (Table 1). Overall, 6.4 % had HIV and 88.5 % of these patients were on antiretroviral treatment.

**Table 1**
Demographic and clinical characteristics.

| Variables | n (%) |
|---|---|
| Gender | N = 116,611 |
| Female | 74,431 (63.8) |
| Male | 42,180 (36.1) |
| **Age group** | **N = 116,725** |
| 18 – 19 years | 105 (0.1) |
| 20 – 29 years | 1418 (1.2) |
| 30 – 39 years | 5825 (5.0) |
| 40 – 49 years | 14,137 (12.1) |
| 50 – 59 years | 27,793 (23.9) |
| 60 – 69 years | 34,378 (29.6) |
| 70 – 79 years | 22,280 (19.2) |
| 80 – 89 years | 8822 (7.6) |
| ≥ 90 years | 1580 (1.4) |
| **Age group at death** | **N = 11,681** |
| 18 – 19 years | 3 (0.0) |
| 20 – 29 years | 61 (0.5) |
| 30 – 39 years | 220 (1.9) |
| 40 – 49 years | 679 (5.8) |
| 50 – 59 years | 2311 (32.0) |
| 60 – 69 years | 3735 (27.0) |
| 70 – 79 years | 3153 (27.0) |
| 80 – 89 years | 1353 (11.6) |
| ≥ 90 years | 166 (1.4) |
| **Substructure** | **N = 115,408** |
| Khayelitsha-Eastern | 25,108 (21.8) |
| Northern-Tygerberg | 31,551 (27.3) |
| Southern-Western | 27,004 (23.4) |
| Klipfontein-Mitchells Plain | 30,108 (26.1) |
| Rural Health Services | 1637 (1.4) |
| **Sub-district** | **N = 115,408** |
| Eastern | 12,783(11.1) |
| Khayelitsha | 12,325 (10.7) |
| Northern | 6285 (5.4) |
| Tygerberg | 25,266 (21.9) |
| Southern | 15,468 (13.4) |
| Western | 11,536 (10.0) |
| Klipfontein | 14,318 (12.4) |
| Mitchells Plain | 15,790 (13.7) |
| Rural | 1637 (1.4) |
| **Co-morbidities** | **N = 116,726** |
| Hypertension | 81,070 (69.5) |
| HIV positive total | 7507 (6.4) |
| HIV positive on ART | 6642 (5.7) |
| HIV status unknown | 87,846 (75.3) |
| Ever had TB | 9519 (8.2) |
| HIV and previous TB | 2135 (1.9) |
| Mental health disorder | 18,887 (16.2) |

However, the HIV status was unknown in 75.3 % of the study population. The lifetime prevalence of TB was 8.2 % and in 62.2 % of these patients TB occurred after the diagnosis of diabetes. Of those with HIV, 28.4 % had TB at some point. Overall, the prevalence of TB infection was higher in the HIV infected group (52.0 %) compared to the HIV negative (12.9 %) and HIV unknown (5.3 %) groups.

### 3.2. Process of care

Table 2 shows the last time people were seen at a facility, were admitted to hospital, or had an HbA1c or eGFR investigation. Less than half of the patients were seen in the last 2-years (45.6%). Interestingly, the partial data from 2021 (data was extracted in first quarter) showed that 53.1% of the database had been seen in 2021. Out of the whole database, 63.3% had at least one previous hospital admission. The data available reflects the date of last admission and not all admissions to hospital. On average 6.9% of the database were admitted every year. The average length of admission was 5.3 days (SD 10.4).

A record of an HbA1c test was available for 79.1 % and the mean value was 9.0 % (SD 2.5). Only 60.4 % of the database had an HbA1c done over the period in 2019–2020. An eGFR was recorded for 96.1 % of the study population and 57.1 % had an eGFR in the last two years.

Table 3 presents the most common ICD-10 codes for the last admissions. The commonest reasons for admission were cataracts, complications of type 2 diabetes and coronavirus infectious disease 2019 (COVID-19). The top 25 diagnoses reflected the known complications and comorbidities of diabetes such as heart failure, hypertension, ischaemic heart disease and stroke. Amongst pregnant women, caesarean deliveries were more common than uncomplicated deliveries.

Table 3 further describes the last admissions in terms of ICD-10 categories. Although 4390 (9.7 %) of the diagnoses were missing a category, 20.2 % of all admissions were attributed to cardiovascular diseases. Within the next commonest ICD-10 category (endocrine, nutrition and metabolic disorders), ketoacidosis and hypoglycaemia were the most common specific problems.

**Table 2**
Proportion of patients seen at primary care facilities, admitted to hospital and receiving investigations (HbA1c and eGFR) between 2015 − 2020.

| Variables | n (%) |
|---|---|
| **Last seen at PHC facility** | **N = 54,731** |
| Last seen in the last year (2020) | 157,52 (28.8) |
| Last seen in the last 2 years (2019–2020) | 24,930 (45.6) |
| Last seen in last 3 years (2018 – 2020) | 34,658 (63.4) |
| Last seen in last 4 years (2017 – 2020) | 43,173 (79.0) |
| Last seen in last 5 years (2016 – 2020) | 50,087 (91.6) |
| Last seen in last 6 years (2015 – 2020) | 54,731 (100.0) |
| **Admitted to hospital** | **N = 48143** |
| Admitted in the last year (2020) | 10,694 (22.2) |
| Admitted in the last 2 years (2019–2020) | 20,003 (41.5) |
| Admitted in last 3 years (2018 – 2020) | 28,732 (59.6) |
| Admitted in last 4 years (2017 – 2020) | 36,319 (75.4) |
| Admitted in last 5 years (2016 – 2020) | 42,778 (88.8) |
| Admitted in last 6 years (2015 – 2020) | 48,143 (100.0) |
| **HbA1c done** | **N = 92335** |
| HbA1c in the last year (2020) | 28,224 (30.6) |
| HbA1c in the last 2 years (2019–2020) | 55,698 (60.4) |
| HbA1c in last 3 years (2018 – 2020) | 70,983 (77.0) |
| HbA1c in last 4 years (2017 – 2020) | 81,305(88,2) |
| HbA1c in last 5 years (2016 – 2020) | 87,888 (95.3) |
| HbA1c in last 6 years (2015 – 2020) | 92,335(100.0) |
| **eGFR done** | **N = 96995** |
| eGFR in the last year (2020) | 26,901 (27.7) |
| eGFR in the last 2 years (2019–2020) | 55,376 (57.1) |
| eGFR in last 3 years (2018 – 2020) | 72,832 (75.1) |
| eGFR in last 4 years (2017 – 2020) | 84,622 (87.3) |
| eGFR in last 5 years (2016 – 2020) | 92,085 (95.0) |
| eGFR in last 6 years (2015 – 2020) | 96,995 (100.0) |

**Table 3**
Top 25 diagnoses for all admissions with ICD 10 codes on the database and proportion of admissions per ICD-10 category (N = 40699).

| ICD 10 Code | Description | n (%) |
|---|---|---|
| Admissions per specific ICD-10 code | | |
| H26, H25 | Cataract | 2460 (6.0) |
| E11 | Type 2 diabetes mellitus | 1941 (4.8) |
| U07 | COVID-19 | 1729 (4.2) |
| E10 | Type 1 diabetes mellitus | 1524 (3.7) |
| I50 | Heart failure | 1393 (3.4) |
| O82 | Encounter for caesarean delivery without indication | 1131 (2.8) |
| I10 | Essential (primary) hypertension | 1089 (2.7) |
| R73 | Angina pectoris | 890 (2.2) |
| I64 | Stroke | 889 (2.2) |
| O80 | Encounter for full-term uncomplicated delivery | 866 (2.1) |
| I21 | Acute myocardial infarction | 791 (1.9) |
| I63 | Cerebral infarction | 682 (1.7) |
| E16 | Other disorders of pancreatic internal secretion – including hypoglycaemia | 625 (1.5) |
| I73 | Other peripheral vascular diseases | 624 (1.5) |
| N39 | Other disorders of urinary system | 595 (1.5) |
| R10 | Abdominal and pelvic pain | 578 (1.4) |
| L02 | Cutaneous abscess, furuncle and carbuncle | 532 (1.3) |
| J18 | Pneumonia, unspecified organism | 530 (1.3) |
| L03 | Cellulitis and acute lymphangitis | 529 (1.3) |
| J44 | Other chronic obstructive pulmonary disease | 526 (1.3) |
| K29 | Gastritis and duodenitis | 494 (1.2) |
| I25 | Chronic ischemic heart disease | 474 (1.2) |
| O24 | Diabetes mellitus in pregnancy, childbirth, and the puerperium | 428 (1.1) |
| A41 | Other septicaemia | 389 (1.0) |
| N18 | Chronic kidney disease | 386 (0.9) |
| **Admissions per ICD-10 category** | | |
| **Category number** | **Description** | **n (%)** |
| 1 | Diseases of the circulatory system | 8239 (20.2) |
| 2 | Endocrine, nutrition and metabolic diseases | 4609 (11.3) |
| 3 | Diseases of the eye and adnexa | 3153 (7.7) |
| 4 | Diseases of the digestive system | 3107 (7.6) |
| 5 | Pregnancy, childbirth and the puerperium | 2947 (7.2) |
| 6 | Diseases of the genitourinary system | 2270 (6.8) |
| 7 | Diseases of the respiratory system | 2701 (6.6) |
| 8 | Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified | 2499 (6.1) |
| 9 | Injury, poisoning and certain other consequences of external causes | 1628 (4.0) |
| 10 | Certain infectious and parasitic diseases | |

(continued on next page)

**Table 3** (*continued*)

| ICD 10 Code | Description | n (%) |
|---|---|---|
| Admissions per specific ICD-10 code | | |
| | | 1589 (3.9) |
| 11 | Diseases of the skin and subcutaneous tissue | 1448 (3.6) |
| 12 | Neoplasms | 1267 (3.1) |
| 13 | Mental and behavioural disorders | 1240 (3.0) |
| 14 | Diseases of the musculoskeletal system and connective tissue | 1048 (2.6) |
| 15 | Diseases of the nervous system | 1012 (2.5) |
| 16 | Factors influencing health status and contact with health services | 804 (2.0) |
| 17 | Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism | 301 (0.7) |
| 18 | Diseases of the ear and mastoid process | 135 (0.3) |
| 19 | External causes of morbidity and mortality | 51 (0.1) |
| 20 | Other | 651 (1.6) |

### 3.3. Outcomes of care

Table 4 presents the results for glycaemic control and kidney function. According to the national guidelines 75.5% of the database were uncontrolled and 33.7 % had an HbA1c of ≥ 10 %. The proportion of elderly that were uncontrolled was slightly better at 57.3%. Renal disease was present in 25.5 % of patients who had eGFR's recorded (eGFR < 60 ml/min).

Table 5 presents the relationships between demographic or clinical characteristics and glycaemic control. There was statistically significant better glycaemic control in men, in older patients, in those with hypertension, mental health disorders, and unknown HIV status. There were significant differences between substructures and sub-districts. Those who developed TB after the diagnosis of diabetes had worse glycaemic control.

**Table 4**
Glycaemic control and kidney function.

| Variables | n (%) |
|---|---|
| **Glycaemic control according to provincial (PACK) targets** | |
| **HbA1c %** | **N = 108,350** |
| ≤ 8 | 45,877 (42.3) |
| > 8 | 62,473 (57.7) |
| **Glycaemic control according to national targets** | |
| **HbA1c %** | **N = 108,330** |
| 0 – 6.4 | 16,750 (15.5) |
| 6.5 – 6.9 | 9837 (9.1) |
| ≥ 7 | 81,743 (75.5) |
| **Glycaemic control for elderly (>65 yrs)** | |
| **HbA1c %** | **N = 43,078** |
| 0 – 6.4 | 8634 (20.0) |
| 6.5 – 7.4 | 9753 (22.6) |
| ≥ 7.5 | 24,691 (57.3) |
| **Kidney function** | |
| **eGFR (ml/min/1.73 m)** | **N = 109,955** |
| Normal/High ≥ 90 | 625 (0.6) |
| Mildly decreased 60–89 | 81,280 (73.9) |
| Mild to moderately decreased 45–59 | 10,739 (9.8) |
| Moderately to severely decreased 30–44 | 7255 (6.6) |
| Severely decreased 15–29 | 5374 (4.9) |
| Kidney failure (<15) | 4682 (4.3) |

**Table 5**
HbA1c value by age, substructure, sub-district and comorbidity.

| Variables | Mean HbA1c (95% CI) | p-value |
|---|---|---|
| Gender | | |
| Male | 9.0 | |
| Female | 9.1 | |
| Mean difference | 0.11 (0.08–0.14) | < 0.001 |
| **Age category** | | |
| 18 – 19 years | 11.04 (10.30– 11.80) | < 0.001 |
| 20 – 29 years | 10.18 (10.0 – 10.36) | |
| 30 – 39 years | 9.55 (9.47 – 9.62) | |
| 40 – 49 years | 9.58 (9.54 – 9.63) | |
| 50 – 59 years | 9.63 (9.50 – 9.65) | |
| 60 – 69 years | 9.08 (9.05–9.10) | |
| 70 – 79 years | 8.42 (8.38 – 8.45) | |
| 80 – 89 years | 7.82 (7.78 – 7.86) | |
| ≥ 90 years | 7.40 (7.31 – 7.50) | |
| **Substructure** | | |
| Khayelitsha Eastern | 9.16 (9.13–9.19) | < 0.001 |
| Northern Tygerberg | 8.91 (8.89–8.94) | |
| Southern Western | 8.80 (8.77–8.83) | |
| Klipfontein Mitchells Plain | 9.32 (8.80–9.06) | |
| Rural | 8.93 (8.0–9.05) | |
| **Sub-district** | | |
| Eastern | 8.94 (8.90 – 9.00) | < 0.001 |
| Khayelitsha | 9.40 (9.35 – 9.45) | |
| Northern | 8.75 (8.69 – 8.82) | |
| Tygerberg | 8.95 (8.80 – 8.98) | |
| Southern | 8.72 (8.62 – 8.76) | |
| Western | 8.90 (8.86 – 8.95) | |
| Klipfontein | 9.16 (9.12 – 9.21) | |
| Mitchells Plain | 9.45 (9.41 – 9.50) | |
| Rural | 8.93 (8.80 – 9.05) | |
| **Hypertension** | | |
| With hypertension | 9.00 | |
| Without hypertension | 9.13 | |
| Mean difference | 0.13 (0.10–0.17) | < 0.001 |
| **HIV status** | | |
| HIV positive not on ART | 9.23 (9.02 – 9.44) | < 0.001 |
| HIV positive on ART | 9.09 (9.01 – 9.15) | |
| HIV negative | 9.11 (9.06 – 9.15) | |
| HIV Unknown | 9.01 (8.96 – 9.03) | |
| **TB infection** | | |
| TB after diagnosed DM | 10.26 | |
| TB before diagnosed DM | 8.97 | |
| Mean difference | 1.3 (1.23 – 1.36) | < 0.001 |
| **Mental health disorders** | | |
| Mental health care user | 8.61 | |
| Non-mental health care user | 9.12 | |
| Mean difference | 0.52 (0.47 – 0.56) | < 0.001 |

## 4. Discussion

### 4.1. Key findings

Three-quarters of people with diabetes in the Western Cape had poor glycaemic control (HbA1c >7 %) and a third were very poorly controlled (HbA1c >10 %). Almost every patient (99.4 %) had abnormal renal function, with most being mild, but 9 % had severe renal disease. Glycaemic control was significantly different between most sub-districts in Cape Town as well as rural areas. Improved glycaemic control was observed in patients with comorbid hypertension, mental health disorders, unknown HIV status and those who had TB before the diagnosis of diabetes.

Only 46 % of patients were recorded as seen in the previous two years, although 60 % of them had an HbA1c test taken. Approximately 7 % of patients were admitted to hospital annually, most commonly because of cardiovascular complications (20 %). Diabetic ketoacidosis and hypoglycaemia were the most common direct complications of diabetes.

The majority of people were older adults and almost two-thirds were female. Although this is a database for the whole province, only 1.4 % came from the rural areas. Although HIV is highly prevalent in the population, only 6.4 % of patients were diagnosed with HIV and the HIV status was largely unknown (75 %).

### 4.2. Discussion of key findings

Improved HbA1c with increasing age is consistent with other studies in which older people with diabetes had lower HbA1c levels, but increased cardiovascular risk factors and complications of disease [18,19]. Survivor bias might explain this, whereby the patients with poorest control die sooner and leave those with better HbA1c levels [20]. Health services in the Western Cape had adopted the PACK guidelines and according to these guidelines only 58 % of patients were uncontrolled [10]. Although glycaemic control significantly differed between sub-districts the absolute differences were not large and the reasons for these differences could not be ascertained.

Only 30 % of people were receiving an annual HbA1c test, although previous unpublished clinical audits suggested this might be up to 40 %. Many of the HbA1c results reported in this analysis are therefore not recent. The lack of testing means that most patients were not receiving accurate feedback on their control. However, providing more frequent point of care HbA1c testing has not been shown to improve glycaemic control in the local context, possibly due to clinical inertia [21].

Levels of glycaemic control in the Western Cape were similar or better than other provinces in South Africa [15,22]. South Africa also fared the worst in a comparison of glycaemic control between four low-and-middle income countries [23]. High income countries also appear to be doing better with approximately 53% of people well controlled in USA and Europe [24,25].

The 25.5 % prevalence of renal disease in this population is comparable to the UK (25 %) and USA (36 %) [3]. It is possible that this database underestimated the true prevalence of renal disease as persistent albuminuria was not recorded [26]. The prevalence of chronic kidney disease in patients with diabetes in Sub-Saharan Africa is about 35 %, but might vary as much as 11 – 87.3 %. [1,14,27] Dialysis services in the public sector are severely restricted and many people with severe disease will not be eligible and will be referred for palliative care. Previous studies have recommended a more aggressive approach to screening for microalbuminuria and intervening earlier when there is a possibility of reversing or slowing the loss of kidney function [28].

Retinopathy was not reported in the database although the MHS do have a digital fundal camera service that could feed data into the cascade. Other studies have reported high rates of cataract and retinopathy in the same population [29].

The Western Cape has previously been identified as a province with one of the highest rates of comorbid hypertension and diabetes [30,31]. The national prevalence is closer to 43 %, compared to 70 % in this study [30,31]. The Western Cape province has a high prevalence of obesity and metabolic syndrome, especially in woman, which are important risk factors for both hypertension and diabetes [9,32]. In Sub-Saharan Africa, hypertension and diabetes comorbidity falls within the range of 44–76 %, [33] and similar prevalence rates have been observed in higher income countries [34].

The HIV prevalence in our database was lower than the national average of 19 % amongst the 15 – 49-year age group, however three-quarters of the people in the database had an unknown HIV status [35] Glycaemic control was significantly better in those with an unknown HIV status compared to those that were known to be HIV negative. The underlying reasons for this difference need further investigation. Other studies have suggested that HIV positive individuals might do better because of greater health awareness and lower levels of obesity, while others have suggested that diabetes may cause HIV to progress faster and lead to increased mortality. More studies are needed in South Africa that report diabetes according to HIV status [4,36]. A review of diabetes and HIV prevalence in the African context showed no statistically significant association yet between HIV infection or ART use and the prevalence of type 2 diabetes [37].

The effects of the COVID-19 pandemic became apparent in this study as COVID related admissions in 2020–21 were the third highest reason for admission over a 10-year period. This reflects the high admission rate, mortality and morbidity of patients with diabetes contracting COVID-19 disease, which was observed in district hospitals in the Western Cape and abroad [38,39]. Even without COVID-19, people with diabetes are frequently admitted to hospital with complications and require a substantial commitment of health service resources. Interventions to improve glycaemic control will not only improve peoples' quality of life, but also reduce the strain on the health system.

We had a much higher proportion of female patients with diabetes in our dataset and a recently published systematic review found that the prevalence of diabetes might be as high as 16.8 % in females and 12.4 % in males in South Africa, whereas the rest of the world tends to see a more even distribution, with a slightly higher prevalence in men (9.6 % vs 9.0 %) [3,4]. In South Africa the risk factors for diabetes (metabolic syndrome) are much higher in women than men and this may partly account for the differences [40,41]. Even so the dataset appeared to have a missing group of men when compared to the ratio found in the review. It is possible that employed men struggle to access care in the public sector due to inconvenient opening times [42].

### 4.3. Strengths and limitations

One of the strengths of this study was the size and power of the database. However, by only including people > 18-years we excluded a number of people with type 1 diabetes, although the database did not identify types of diabetes. The proportion of patients with gestational diabetes is also unknown, but 1.1 % of all admissions were for diabetes during the puerperal period. The database is unique in South Africa, as it collates routinely collected electronic data on people with diabetes from multiple sources and links the data with a unique patient identifier. The database is therefore dependent on existing electronic data (e.g. from laboratories) and does not include data that would be important as there is no electronic medical record (e.g. blood pressure readings). The accuracy of data was dependent on the source and reliability of clerical staff. It is probable data was missing for patients living outside of the Metro and that rural health services were not entering data into the database.

### 4.4. Implications and recommendations

The results make a clarion call for action on diabetes that should harness the same focus and energy as has been seen for the HIV and TB epidemics. The South African Diabetes Alliance has recently made such a call for action on diabetes, with a number of recommendations in a Diabetes Charter [43]. The charter highlights action around five themes that relate to awareness and prevention, patient education and counselling, management and access to care, diabetes surveillance, and innovation and research.

This kind of database is a major step forward from the scarcity of information previously available and once the system was established required less effort than the annual clinical audit and feedback conducted by clinical staff. Clinicians are now able to pull reports on their primary care facilities from the data centre whenever they want. Ultimately, however, we will need a more intentionally designed system and an electronic medical record, as anticipated in the implementation of national health insurance. [44].

## 5. Conclusions

People with diabetes who attend public sector primary care facilities in the Western Cape were mostly female and older adults. Comorbidity with hypertension and mental health disorders were common. Three-quarters of people had poor glycaemic control and a third were very poorly controlled. At least a quarter of patients had renal disease.

Glycaemic control was significantly different between most sub-districts in Cape Town as well as rural areas. Improved glycaemic control was observed in patients with comorbid hypertension, mental health disorders, unknown HIV status and in those who had TB before the diagnosis of diabetes. The commonest reasons for admission were cataracts, COVID-19 and complications of diabetes such as ketoacidosis and hypoglycaemia. Approximately 7% of people with diabetes were admitted to hospital annually. These findings are a clarion call to the health services to address the problem of diabetes with the same energy as has been seen for the HIV and TB epidemics.

## Ethics approval and consent to participate

Ethical approval was granted by the Stellenbosch University's Health Research Ethics Committee (Reference No: S20/01/002) prior to commencement of the study. Permission was granted by the WCDOH and City of Cape Town Health Department to conduct the study.

## Consent for publication

Not applicable.

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## Authors' contributions

MB performed the research study for her Master degree under the supervision of RM. RM supervised MB in all aspects of the study from conceptualization, to data collection, data analysis and reporting. RM performed the analysis in SPSS with MB. The final manuscript was prepared by RM and approved by MB.

## Competing interests

The authors declare that they have no competing interests.

## Data Availability

The database was derived from the Western Cape Government: Health and cannot be shared without their permission.

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