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ARTICLE

Diabetes in the Western Cape: an eight-year profile

N Sahadew[a]*, S Pillay[b] and VS Singaram[a]

[a]*Clinical and Professional Practice, School of Clinical Medicine, University of KwaZulu-Natal, Durban, South Africa*
[b]*Department of Internal Medicine, King Edward VIII Hospital, Durban, South Africa*
**Correspondence: nsahadew@gmail.com*

Background: The need for greater information on the burden of diabetes has never been more significant than at present, especially when considering the association between diabetes and the severity of COVID-19. Statistics South Africa has identified diabetes mellitus (DM) as the leading cause of death in the Western Cape (WC) province, South Africa.
Aims: This study aimed to analyse diabetes-related data collected on patient visits, screening frequency, age proportion and distribution of new patients at primary health levels in the WC public healthcare sector.
Methods: An eight-year (2012–2019) audit was conducted of all diabetes-related public health data routinely collected using the WC District Health Information System (DHIS). The data were analysed using Excel® 2016. Time-series and cross-sectional analyses were made possible using pivot tables to gain insight into data trends and incidence rates.
Results: This study found that the eight-year crude incidence rate for diabetes increased by 2% between 2012 and 2019. In addition, the incidence rate of diabetes increased by an average of 21% when private institutions were excluded. The recorded number of patients diagnosed with type 1 DM (T1DM) decreased annually between 2013 and 2017 (796 vs. 217, respectively). This decreasing trend could be due to the late onset of T1DM in patients from the African continent or possible data misinterpretation and inadequate training at a primary collection level. The cumulative number of patients screened for diabetes within the WC public health sector (2016–2019) depicts a compound annual growth rate of 16%. A strong positive correlation ($p = 0.98$) was found between patients screened and the frequency of patients newly diagnosed with DM. The majority (64%) of clinical visits by patients registered with a confirmed diagnosis of diabetes were seen in the metropolitan municipality of 'The City of Cape Town'.
Conclusions: The incidence of DM in the WC province, as in South Africa and globally, is increasing. Intensified screening translates into improved 'pick-up' rates and decreases the overall prevalence of undiagnosed DM with its complications. The findings of this study have implications for the development of public healthcare policies and guidelines. Personnel training and resources are suggested to improve the quality of the clinical data and strengthen the DHIS.

Keywords: diabetes, South Africa, database, public health

Introduction

The novel coronavirus pandemic has highlighted the vicious interaction between communicable and non-communicable diseases globally. People living with diabetes mellitus (PLWD) who contract COVID-19 are at increased risk of a more severe disease process and higher mortality.[1,2] Additionally, DM has been identified as the leading underlying cause of death in the province of the Western Cape (WC), South Africa (SA).[2] The International Diabetes Federation (IDF) estimates that 69% of PLWD in Africa are undiagnosed, with many being identified only after the onset of serious complications.[1] These complications, such as amputations, cardiovascular disease, kidney disease and retinopathy, create both a physical and an emotional burden on patients and their families.[3] Moreover, the disease places a heavy economic burden on the African continent's already overstretched public health systems.

Based on the uniqueness of the African healthcare systems, there is a need for healthcare policies to be based on data collected within Africa instead of adopting policies designed for more developed countries.[4,5] The collection and management of data from the public health sectors of these African countries have been gradually improving; however, data sources are often described as limited and inadequate.[1,4] The importance of a decentralised district-based data collection system was highlighted in the health sector restructure that followed South Africa's first democratic election in 1994.[6,7] A pilot study testing a rudimentary form of the current District Health Information System (DHIS) was implemented as early as 1996, with the final model being accepted for implementation in 1999.[6]

The DHIS aims to create a culture of information among all stakeholders, resulting in enhanced public health data to direct healthcare decision-makers and international donors.[6,7] This extensive electronic database could prove to be an invaluable asset in addressing the data challenges faced in Africa, most especially in the context of chronic diseases such as diabetes and hypertension.[8] However, there remains a scarcity of studies that interrogate the data collected by the DHIS and its relevance within the different provinces of the SA healthcare sector. This retrospective study aims to analyse diabetes-related data collected on patient visits, screening frequency, age proportion and distribution of new patients in the public healthcare sector of the WC province, South Africa.

Method

Context

The coastal province of the Western Cape, home to the country's most highly educated residents, has one of the fastest-growing regional economies in South Africa (SA).[9] Many of the province's local districts are among the least deprived, with relatively low poverty levels. The province is divided into one metropolitan municipality (City of Cape Town) and five district municipalities (see Figure 5).

Since 1998, the DHIS has been collecting primary data compiled by allocated information officers and healthcare workers from each district of the WC public health sector.[7]

Ethical considerations

Ethical clearance was obtained from the University of KwaZulu-Natal (HSS/1835/017D) and the Western Cape Department of Health (DOH) (WC_201711_013). No patient identifiers were used, to ensure anonymity.

Study design

The DHIS is the primary data source for the 257 districts of the nine provinces within the South African Department of Public Health. An audit of the DHIS was conducted to determine the burden of diabetes within the WC's six districts. All diabetes-related data collected for 2012–2019 (eight-year period) were collected, reviewed and analysed.

Data collection

As collected by the Western Cape DOH and analysed for the study, the available diabetes-related data fields comprised the sample. Data collection fields often change in an attempt to improve data quality. For this reason, the different collection fields are represented with varying time periods even though data were requested for the years 2012–2019.

Population and mortality estimates[2] were requested from Statistics South Africa. In addition, medical scheme coverage was retrieved from the 2016 District Health Barometer published by the National Health Trust.[10]

Data analysis

The data were analysed using Microsoft Excel® 2016 (Microsoft Corp, Redmond, WA, USA). Time-series and cross-sectional analyses were made possible using pivot tables to gain insight into data trends and incidence rates. Graphical representation was developed using the software program 'think-cell', version 6 (https://www.think-cell.com/en/).

Results

Incidence

Data on the number of new patients diagnosed with diabetes were recorded using the field 'Diabetes mellitus case put on treatment – new'. Together with the most recent population estimates, this data was used to calculate the eight-year crude incidence rate of diabetes in the WC public health sector (2012–2019). The results are displayed in Figure 1 and as per 10 000 people to compare whole numbers.

As seen in Figure 1, the eight-year crude incidence rate for diabetes increased by an overall 2% between 2012 and 2019.

The population estimates used to calculate the incidence rate are not specific to the public healthcare sector. Therefore, to represent the burden of disease more accurately, the private healthcare sector was excluded by reducing the denominator (total population) by the private medical scheme utilisation specific to each district for the most recent year (2019). The adjusted incident rate can be seen in Figure 2.

Patients younger than 18 years diagnosed with diabetes

Since the year 2013, the WC DHIS has collected data recording the number of new patients diagnosed with diabetes below the age of 18. These figures are reflected in Table 1.

As seen in Table 1, the recorded number of patients diagnosed with type 1 DM has been decreasing since 2013. This collection field was discontinued in March 2017.

Patient screening

In the WC, the data collection field 'Client screened for Diabetes' was introduced into the DHIS for collection in 2016 but was subsequently stopped in 2017. This field was refined in 2017 to record the 'Number of patients screened for diabetes who are 40 years and older'.

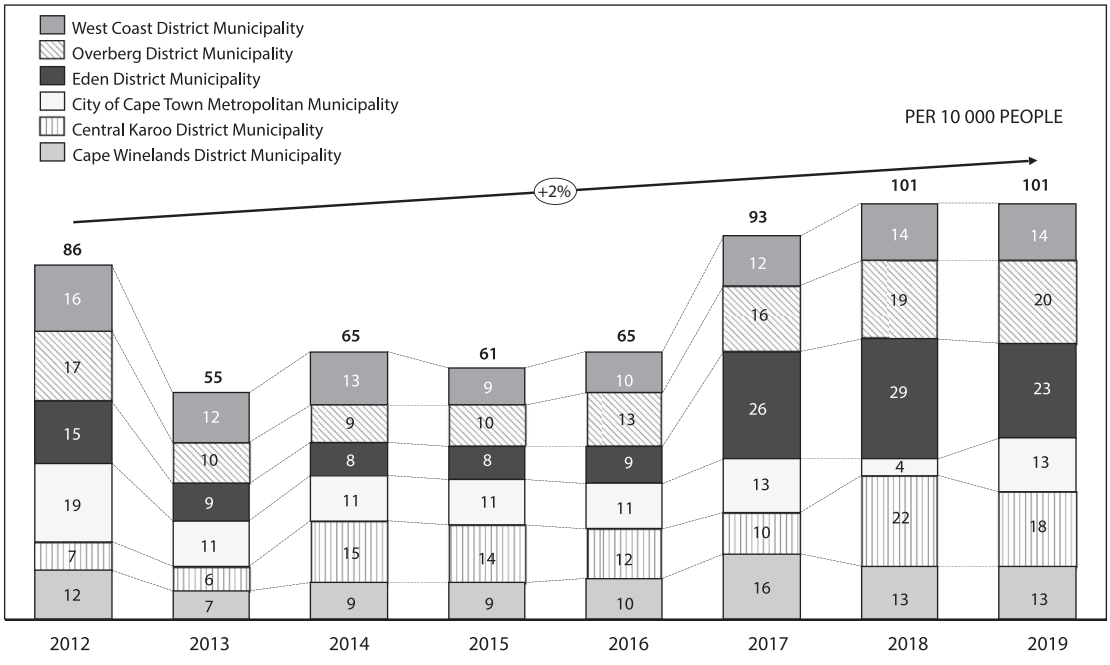

Figure 1: Crude incidence rate of diabetes (eight-year).

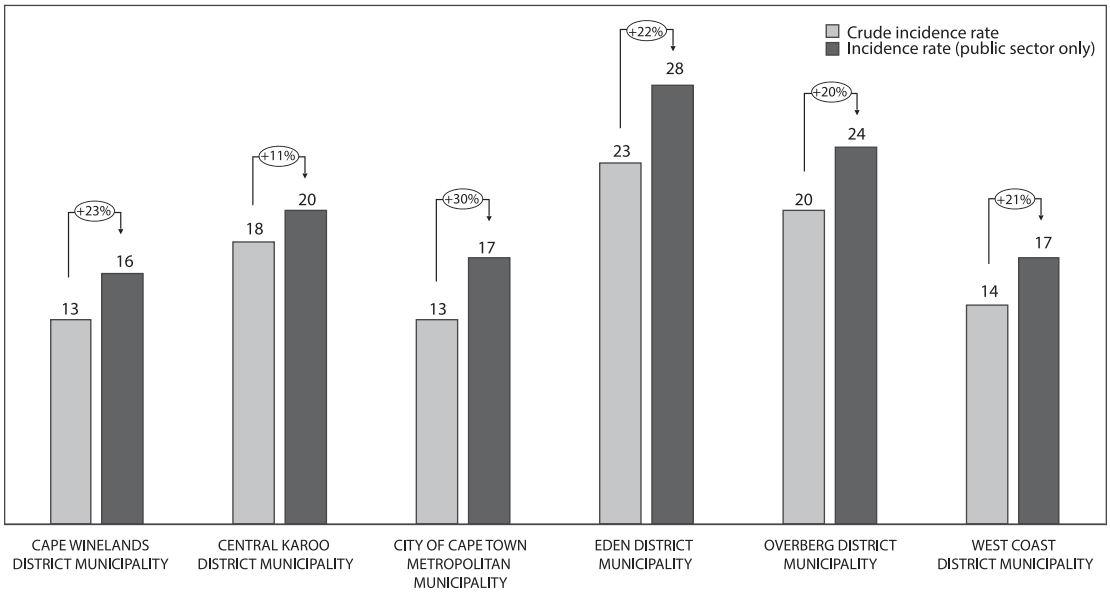

Figure 2: Incidence rate of incidence in the Western Cape public sector (2019).

Table 1: Number of new patients diagnosed with diabetes below 18 in the Western Cape province

Year	2013	2014	2015	2016	2017
Number of patients	796	656	549	492	217

Figure 3 depicts the cumulative number of patients screened for diabetes within the WC public health sector (2016–2019), showing a positive compound annual growth rate (CAGR) of 16%.

$$\text{CAGR} = \left(\frac{\textit{Beginning Value}}{\textit{Final Value}}\right)^{\frac{1}{\textit{time period}}} - 1$$

To gain further insight regarding the location of patients being screened for diabetes within the WC province, the average proportional distribution was calculated and is displayed in Figure 4.

According to the data displayed in Figure 4, a substantial proportion (41%) of patients were screened within the 'City of Cape Town' district.

To investigate the effects of the newly implemented screening for diabetes, the arrays of data on the number of patients screened were correlated with data on the number of new patients recorded for the most recent year (2019).

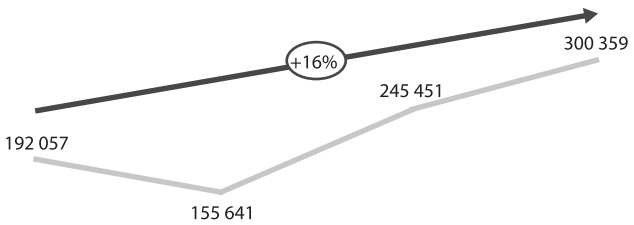

Figure 3: Number of patients screened for diabetes in the Western Cape province.

The correlation coefficient is statistically significant at a 99% confidence interval ($p = 0.0004$).

$$\text{CorrelationCoefficient } \rho = 0.98$$

The above result indicates a very strong, positive relationship between the number of patients screened and the number of new patients recorded in the corresponding year (2019) in the Western Cape province.

Distribution

Figure 5 represents the provincial distribution of clinical visits by patients diagnosed with diabetes (PDWD) within the WC public health sector. This information was contained in the data collection field 'Diabetes mellitus clients on register'. Within the constraints of the study period, the year 2012 remains the

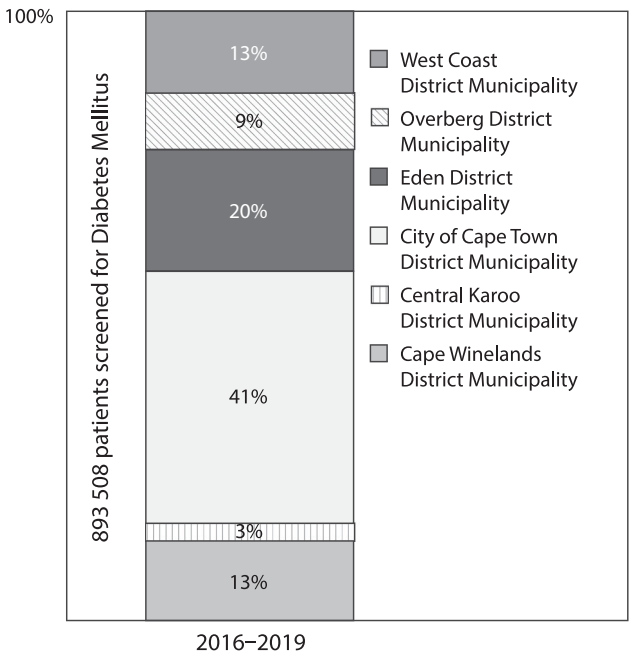

Figure 4: Four-year average distribution of patients screened in the Western Cape province (2016–2019).

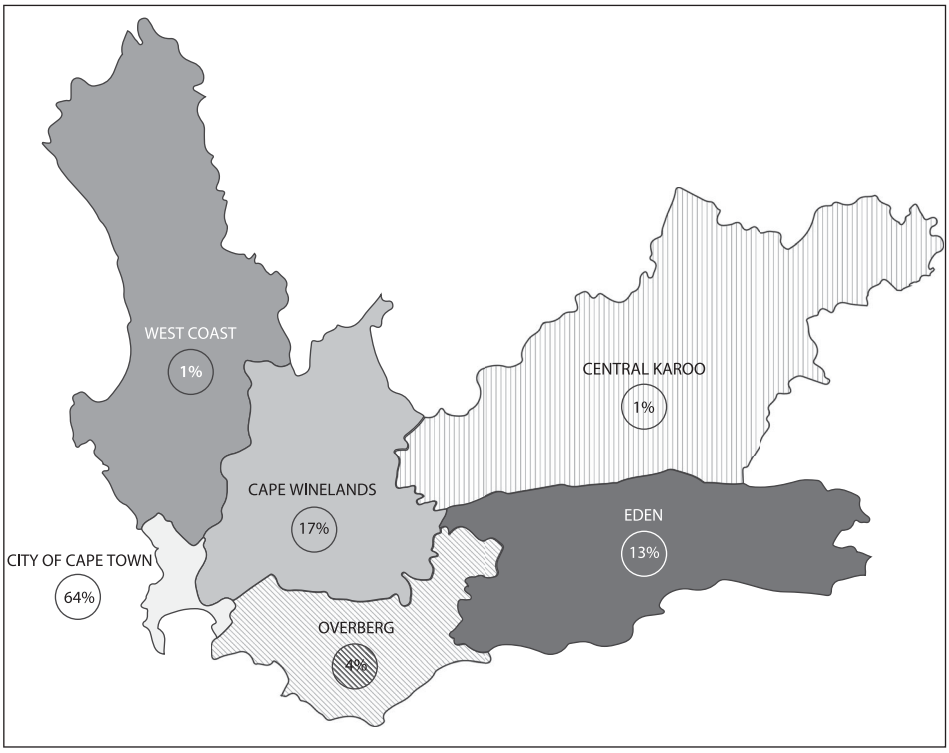

Figure 5: Distribution of diabetes-related consultation (2012).

only sub-sample recording the collection field as mentioned earlier; hence, Figure 5 represents data from 2012 only.

Figure 5 indicates that a large majority (64%) of clinical visits by patients registered with a confirmed diagnosis of diabetes were seen in the district of 'The City of Cape Town'. The geographically larger districts of the 'West Coast' and 'Central Karoo' were shown to have the smallest proportion (1%) of medical consults by PDWD within the public health sector.

Upon further inspection of this data collection field, it was observed that each district had a different number of healthcare facilities collecting and submitting data. Table 2 lists a summary of the number of collection facilities per district.

Discussion

In the past, the burden of infectious diseases such as HIV, malaria and tuberculosis was well documented as comprising the most prominent contributors to the burden of disease and mortality in sub-Saharan Africa.[11] Recent statistics, however, give evidence to an epidemiolocal transition in many low- to middle-income countries as the prevalence of non-communicable diseases (NCDs) increases.[2,11,12] Moreover, the joint strain of infectious diseases and NCDs increases the fragility of venerable health systems and the development of dangerous symbiotic cases.[11,12]

Table 2: Number of data collection facilities for the field 'Diabetes patient on register', by district

District	Number of collection facilities
West Coast	86
Overberg	48
Eden	87
City of Cape Town	225
Karoo	27
Cape Winelands	90

Most of the PDWD registered and consulted in the WC public health sector were within the 'City of Cape Town' district. This is to be expected as the district is the most densely populated, having approximately 80% more citizens than the next most populated district (Cape Winelands).[10] In addition, the City of Cape Town district also had the most significant number (n = 225) of healthcare facilities recording the required data. The strong link between urbanisation and DM has been well documented.[5] According to the United Nations, the traditional demarcations between urban and rural areas have blurred as their integration has become increasingly common.[13] For this study of the Western Cape, an exact measure of urban growth by district was not found. Other measures of socioeconomic status were explored. Using the 2011 SA Census data, a new index of multiple deprivations was developed by Noble *et al.*[14,15] This study utilised a broad spectrum of indicators to provide a comprehensive overview of the relative deprivation levels of SA's wards and districts.[10,14,15] At a district level, the socioeconomic status was represented as Quintiles (1–5). Districts sorted into Quintile 5 were understood as the least deprived, and those in Quintile 1 were among the most deprived districts, i.e. the most impoverished.[10,14,15] According to this measure, the City of Cape Town district is among the least deprived as it falls into Quintile 5. For the purposes of this study, this implies that these districts have a lower-than-average level of poverty and have been assumed to have a higher-than-normal level of urbanisation. Based on this assumption, our finding indicating that the largest number of registered PDWD were from the Cape Town district is in keeping with the traditional association understood between urbanisation and the prevalence of diabetes.[5]

In 2016, the World Health Organization (WHO) estimated the prevalence of DM in South Africa as 9.8%.[16] Global statistics

reveal that approximately 50% of people with diabetes are undiagnosed, and many already show signs of the disease's complications at the time of diagnosis.[17] The WHO defines screening as follows: 'Screening is the process of identifying those individuals who are at sufficiently high risk of a specific disorder to warrant further investigation or direct action'.[17] Authoritative bodies have acknowledged the importance of screening for DM, although the prescribed age, frequency, method and criteria for its initiation are still debated.[17] Although there has been a call for more extensive studies on the precise effects of screening for diabetes, some widely accepted characteristics of the disease support the increasing interest in screening. These include a sizeable undiagnosed population, the global increase in disease prevalence, advanced complications found in newly diagnosed patients and the presence of an asymptomatic detection period.[17] Our audit found that the largest number of patient screenings for DM was performed in the City of Cape Town. It is reasonable to attribute the increased number of people screened in the district of 'the City of Cape Town' to the larger population and the increased number of collection sites. In addition, the City of Cape Town has taken many steps to encourage and educate its citizens on living a healthier lifestyle and controlling chronic diseases. At present, Cape Town is the only city in SA to join the Global Partnership for Healthy Cities,[18] a global network of cities committed to reducing the burden of non-communicable diseases through interventions designed for the unique characteristics of urban city life.[18,19] In 2018, the executive mayor of CT launched an initiative in line with the Global Partnership for Healthy Cities objectives. This initiative provided free diabetes and blood pressure screening and ran a media campaign to educate the public on the risks of junk food and sugary drinks.[19] The Western Cape continues with its proactive approach to diabetes, as recent correspondence with the DOH has revealed that data collection on diabetes screening has remained uninterrupted since 2016.

Further exploration of the data shows that the number of screenings corresponds strongly with the number of new patients diagnosed with DM ($p = 0.92$). Our finding implies that an increase in screening for DM results in increased pick-up rates of the number of early or newly diagnosed patients. Early diagnosis and lifestyle changes are known to reduce the onset of the harmful complications of the disease.[17,20] However, the sizeable undiagnosed population with DM present a hindrance to assessing and recording the actual burden of diabetes globally.[17,21] According to the International Diabetes Federation, the number of adults with DM is projected to have increased since 2013. Statistics show that, by 2035, the number of diabetes cases will have increased by approximately 45.8% in South Africa.[23] These calculations are congruent with those found in this study, observing a rise in the overall incidence of DM.

We showed that the trend for the number of patients below 18 years diagnosed with DM was on the decrease between 2013 and 2017. We postulate that this downward trajectory is due to the age of onset of type 1 occurring later in patients from South Africa and the high proportion of undiagnosed patients.[1,23,24] This finding, coupled with the possibility of misinterpretation or poor understanding of the relevant data collection field, could explain the decreasing trend for diagnosis of type 1 DM observed in our study.

The numerous challenges facing the public health sector are well known. The South African government has launched multiple initiatives to address the poor service delivery and quality of care, but they often fail to yield the desired effect.[25] The resultant lack of patient trust in the public healthcare sector is a cause of stress for most South African citizens, who are unable to supplement their care through the private healthcare sector.[25,26] Research has found that PDWD are no exception. 'Diabetes distress' can be understood as the poor emotional state caused by the burden of the complicated management of the disease.[26] One South African study found that patients attending public health facilities had higher levels of diabetes distress with an associated lack of metabolic control.[26] Our findings suggest a projected increase in the incidence of DM in the public sector. Results like ours should alert the South African government to plan and direct appropriate resources to this healthcare sector to help curb the well-known effects of the disease, and to new and evolving concerns such as 'diabetes distress'.

Although the DHIS can be praised for the evolution of its technical structures, some sources have highlighted the need for refinement from an organisational and a training perspective.[6] According to the aims of the DHIS, provinces should follow a common essential data set but are also encouraged to develop their own additional data-collection fields. This flexibility allows research to develop between and within provinces and provides insight into their uniqueness.[7] Changes in collection fields can prove beneficial, as was the case with the collection field recording data on diabetes screening frequencies in the Western Cape. Until 2016, the number of patients screened was not captured. In 2017, the collection field was further updated to specify that only screened patients above the age of 40 should be recorded, following international screening recommendations.[1] While these changes improve the data from a theoretical sense, their translation at the primary collection stage could prove problematic if training around the new collection field's understanding and importance is neglected.[6,7]

The burden of NCDs can no longer be side-tracked as it might soon surpass that of infectious diseases.[11,12,27] Interventions such as the redistribution of funding and a more integrated approach within the public health sector have been encouraged. These strategies support the practice of preventative medicine and the development of healthcare services rather than treatment aimed solely at a specific disease.[12]

Conclusion

Diabetes mellitus poses a significant challenge to patients, families and global economies.[1,16,28] The disease complications lead to premature mortality and a significantly reduced quality of life.[1,21,25,28] Statistics South Africa reported that in the year 2014, DM overtook HIV and AIDS as the foremost cause of deaths in South Africa, while in 2015 DM became the leading underlying natural cause of death for both women and people above the age of 65.[2]

At a provincial level, DM was also identified as the number one principal natural cause of death in the Western Cape.[2] This finding is consistent with information collected on the Western Cape in this study as it depicts an overall increase in the incidence of diabetes in the province. Furthermore, this study confirms the efforts by the WC DOH to address the rising burden of disease.

The scarcity of electronic patient data has been identified as a primary challenge in the growing health systems of Africa.

The gradual evolution of the DHIS and introducing a more advanced training programme for primary data recorders would enhance the quality of data collected and reduce the unknowns of the elusive undiagnosed population. Reducing the undiagnosed diabetes population, most especially in developing countries with completing burdens of disease, will not only reduce the number of complications but is vital in the face of the current COVID-19 epidemic.[29,30]

Conflict of interest

The authors declare no conflict of interest.

Author contributions

NS was responsible for study design, data collection, data analysis and drafting the manuscript. SP was responsible for contributing to the development of the manuscript and has approved the final version. VSS was responsible for supervising the entire work, study design and manuscript review.

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ORCID

N Sahadew http://orcid.org/0000-0003-0913-8981
S Pillay http://orcid.org/0000-0002-5604-645X

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