Willingness to pay survey for continuous glucose monitoring devices in South Africa and Kenya

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Executive summary

Diabetes is one of the fastest growing global health concerns, resulting in a large public health burden and negative impact on socio-economic development. Continuous glucose monitoring devices (CGMs) present an innovative and efficient tool for self-monitoring of glucose and have transformed the ability of people living with diabetes and their healthcare providers to manage diabetes. However, currently CGMs are largely unaffordable for people living with diabetes in low and middle-income countries due to their high prices.

To accelerate the availability of more affordable CGMs, FIND aimed to understand the out-of-pocket willingness to pay (WTP) of people living with diabetes, which will serve to determine price points that may allow more people to access CGMs in contexts where these devices are not provided through public national health services. We found that the acceptable price range CGMs in South Africa and Kenya is well below current CGM market rates in both countries, indicating that manufacturers need to adjust their pricing structures to enable wider access to CGMs.

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Background

Globally, 537 million people live with diabetes, and this number is projected to rise to **783 million people by 2024** [1]. In Africa, the total number of people with diabetes is 24 million, with a predicted increase by 129% to 55 million by 2045, the highest percentage increase of all International Diabetes Federation (IDF) Regions [1].

Management of diabetes requires regular monitoring of blood glucose by the healthcare provider and thorough self-monitoring of glucose at home. Regular self-monitoring has been shown to improve glycemic control, particularly in people with diabetes using insulin [2, 3]. Adequate glycemic management reduces the risk of micro- and macrovascular complications, with an associated gain in Quality Adjusted Life Years (QALYs) and thus a healthier, more productive population [4–6]. Studies have shown that diabetes-related complications result in substantial economic burden due to the significant costs associated with treatment of complications [7–9].

Self-monitoring of blood glucose (SMBG) for glycemic management traditionally relies on the use of blood glucose meters and test strips, requiring several finger-pricks per day to obtain a blood sample for measurement. The associated pain and inconvenience pose as substantial barriers to self-monitoring [3, 10–13] and have spurred development of new analytical devices that are not based on individual blood measurements, but rather on continuous glucose measurements in non-blood samples [11, 14].

These continuous glucose monitoring (CGM) devices have transformed the ability of people living with diabetes and their healthcare providers to manage the condition by tracking glucose levels in interstitial fluid every few minutes over a period of several days through a small sensor needle inserted under the skin, either on the abdomen or arm. Data indicate that the greatest value of CGMs may be in the high-risk sub-group of people with an increased risk and frequency of hypoglycemic events [15], including people living with type 1 diabetes (T1D), people with a hypoglycemic unawareness and, those who experience nocturnal hypoglycemia [10, 15, 16]. Additionally, there is evidence that chronic hyperglycemia and hypoglycemic events can both be reduced by using CGMs. Studies have shown that CGM use was associated with improvement of clinical outcomes [10, 11] and improved quality of life due to reduced fear of hypoglycemia and elimination of finger stick testing [17]. Concurrently, studies have also shown CGM reduces chronic hyperglycemia with a significant reduction in HbA1c [14, 18, 19]. These improvements in physiological parameters have also translated into psychological benefits. With CGM use, individuals have reported reductions in diabetes-related distress, improved hypoglycemic confidence, and improvements in fear of hypoglycemia (FoH) scores and overall improved quality of life [11, 18, 20, 21].

Whilst these clinical improvements with CGM use are important for the individual, benefits also extend to wider society as diabetes-related complications represent a significant economic burden on all healthcare systems and individuals [8, 9, 22]. Studies have shown that CGM costs are offset by reducing diabetes complications related expenditure. For instance, one study reported CGM use reduced the HbA1c value, the daily test strips use and the frequency of non-severe hypoglycemic events which led to people gaining quality-adjusted life years (QALYs) when these benefits were adjusted to a lifetime of CGM use [11]. A study in Canada demonstrated that real-time CGM, relative to SMBG, was cost-effective within populations of adults with T1DM using multiple daily injections of insulin [15] with a similar study in France showing an incremental gain in QALYs [10].

Current CGM technologies are out of reach for people living with diabetes in Africa. In low- and middle-income countries (LMICs), where CGMs are registered for sale, one month's worth of sensor supplies starts at a cost of around US$120 [23] and, given that CGM devices are not generally provided through government insurance schemes, they are an out-of-pocket expense [24]. With CGM prices being set by manufacturers based on pricing schemes adopted from high income countries, purchasing power in LMICs is low. This will remain the case for the near future, as governments remain reluctant to start covering CGM costs; and with many countries having limited public procurement for SMBG systems, state-provided diabetes care may have other priorities to address first [25].

In Kenya, most of the population living with diabetes are unaware of CGM technology, and those who know about it find it either not accessible or too expensive [24, 26]. To date, an estimated 23’096 people live with T1D in Kenya [27] with only a fraction (<5%) accessing CGMs [28]. People with T2D on insulin may also benefit from CGM use due to the greater need for regular glucose self-monitoring. The total number of people with T2D in Kenya is estimated to be 821’500 [1] with one study estimating that 22.6% use insulin [29].

There is greater advancement in the adoption of CGMs in South Africa, where it is estimated that approximately 16% of the 31’536 people living with T1D [30] use CGMs at least occasionally [28]. Around 27% [31] of the 4’234’000 people living with T2D [1] use insulin, thus also potentially benefitting from CGMs. However, like in Kenya, the awareness of CGM technology and its benefits is still limited in South Africa, due to the lack of access to the devices, driven by high out-of-pocket costs [32, 33].

As current CGM prices in both markets have been set by manufacturers based on high-income market pricing structures, we aimed to understand the out-of-pocket willingness to pay (WTP) of people living with diabetes. This will serve to determine price points that may allow more people to access CGMs in contexts where these devices are not provided through public national health services but are an out-of-pocket expense.

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Methods

Study design

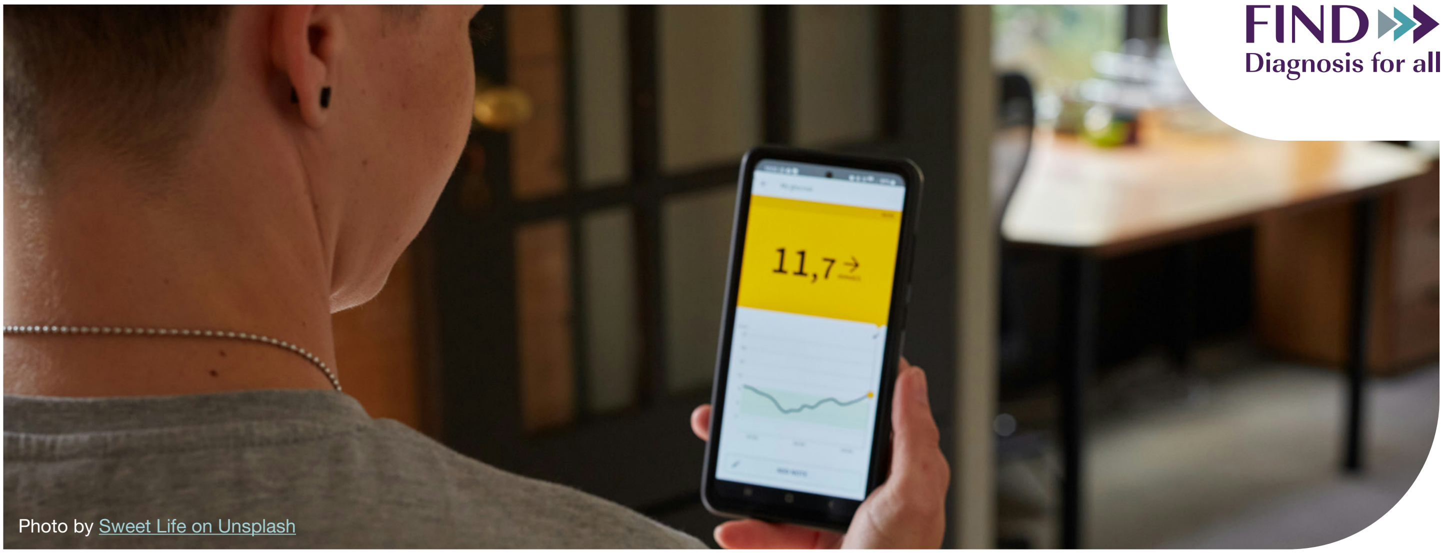
The Van Westendorp's Price Sensitivity Meter (PSM) was applied to determine the acceptable monthly price ranges for CGMs in Kenya and South Africa, for different population groups. Briefly, The Van Westendorp's PSM is a commonly used direct technique to research pricing [34] and the method assumes that respondents have some understanding of what a product or service is worth, and therefore can answer questions explicitly about price. We employed online surveys and face-to-face interviews to analyze willingness to pay (WTP) for CGMs by people living with diabetes or their caregivers. The online survey was sent to diabetes community associations for distribution to their members with Type 1 (T1D) or Type 2 (T2D) diabetes and face-to-face interviews were conducted in areas that were more rural than the average and with a population from a lower-than-average socio-economic status to counter-balance the anticipated bias of the online survey towards the more urban and wealthier segments[34]. Respondents were asked to answer a set of standardized questions to determine price points where the product is "too cheap", "a good deal", "getting expensive" and "too expensive" (cost categories). The cumulative frequency of responses per cost category was plotted against the identified price points and the interval between the intersections of "too cheap" and "getting expensive," and "a good deal" and "too expensive" determines the acceptable price range. As sensor wear times differ between manufacturers, meaning different quantities of sensors needed per month, as well as certain products require transmitters, it was decided to standardize the cost to a monthly amount for CGM supplies.

Study population

An online survey was sent to established diabetes community groups/ associations. We included male and female adults over 18 years and living with either T1D or T2D or caregivers of people living with T1D or T2D diabetes in the survey. To understand the socio-economic level of the participants, standardized questions were included in the survey, and then compared to the 2022 and 2021 Afrobarometer national surveys [35, 36] in each country. No other background information was used to determine inclusion in the study.

Sample size determination

Due to the limited data on national diabetes patient registers in Kenya and South Africa [1, 7], we lacked a comprehensive master list of people living with diabetes to randomly select a sample from. Consequently, we resorted to purposive sampling using online self-recruitment as our primary method for recruiting respondents. It is important to note that self-recruitment is a non-random sampling technique, which means we could not rely on conventional statistical methods to determine the sample size. We adhered to industry best practices for marketing surveys, which recommend a sample size of 250-300 respondents [37]. An ex-post review of the sample characteristics was done by comparing the socio-economic profile of the respondents against the average socio-economic profile of the national population. This analysis helped to understand the degree of bias of our sample vs. the national population on this observable characteristic (Annex 2).



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Data collection procedures

The online survey was circulated through the social media accounts and email lists of diabetes community associations. Participation in the survey was voluntary with informed consent forms administered at the start, outlining the direct and indirect benefits and risks of participation.

In addition, face-to-face interviews were conducted among people living with diabetes and over 18 years of age or their caregivers, in health facilities outside the main urban centers. This was done to recruit participants with poor access to the internet who would have been challenged in accessing the online survey. The identical survey questions were used for the face-to-face interviews. A stratified random sample was taken in areas with similar attributes (Not urban) in randomized counties within the country, to ensure that different segments within the population were equally represented.

There was no direct benefit or monetary compensation of the participants who completed the online survey or participated in the face-to-face interview.

Data management

High quality data standards were maintained by ensuring that data validation, high frequency checks, server encryption, regular data back-ups and data access restriction was upheld to ensure quality reliable and sound data.

Ethical considerations

Ethical approval was sought in compliance with standard procedures and practices of conducting health population research studies. Ethical approval was obtained from Pharma Ethics in South Africa and KNH-UoN Ethics and Research Committee in Kenya. Participant responses were kept confidential and anonymized and personal identification data was not included during the analysis and reporting. The study posed no risk to the participants beyond what they faced in their normal lives.

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Results

A total of 264 respondents living with diabetes participated in the survey in South Africa, between February 16th and March 13th, 2023. Of the total respondents, 171 (64%) participated in the self-recruited online survey while the remaining 93 participants (36%) were recruited at various diabetes clinics for the face-to-face interviews.

In Kenya 314 respondents living with diabetes participated in the survey between November 25th and December 7th, 2022. Of these, 187 (60%) respondents participated in the self-recruited online survey while the remaining 127 individuals (40%) were proactively recruited at various diabetes clinics for face-to-face response to the survey.

Table 1 shows the participants' sample characteristics for the two countries. There was an over-representation of respondents from the urban areas of Nairobi and the Eastern region in Kenya and from Gauteng, Western and Eastern Cape and KwaZulu Natal in South Africa. In Kenya most of the respondents were people living with T2D while in South Africa more than half of the respondents were living with T1D. (**Figure 1**).

COUNTRY	SOUTH AFRICA	KENYA
Total enrolled	246	314
Type of Diabetes:	% of total	% of total
• T1D	59%	35%
• T2D	39%	46%
• Don't know	-	15%
• Other	2%	4%
Socio-economic status	Wealthier than the average South African	Wealthier than the average Kenyan
Proportion of respondents with health insurance	60% vs. national average 15% in the public sector	38% vs. national average 20% in the public sector
Insulin users	84%	59%

TABLE 1: Participants' sample characteristics

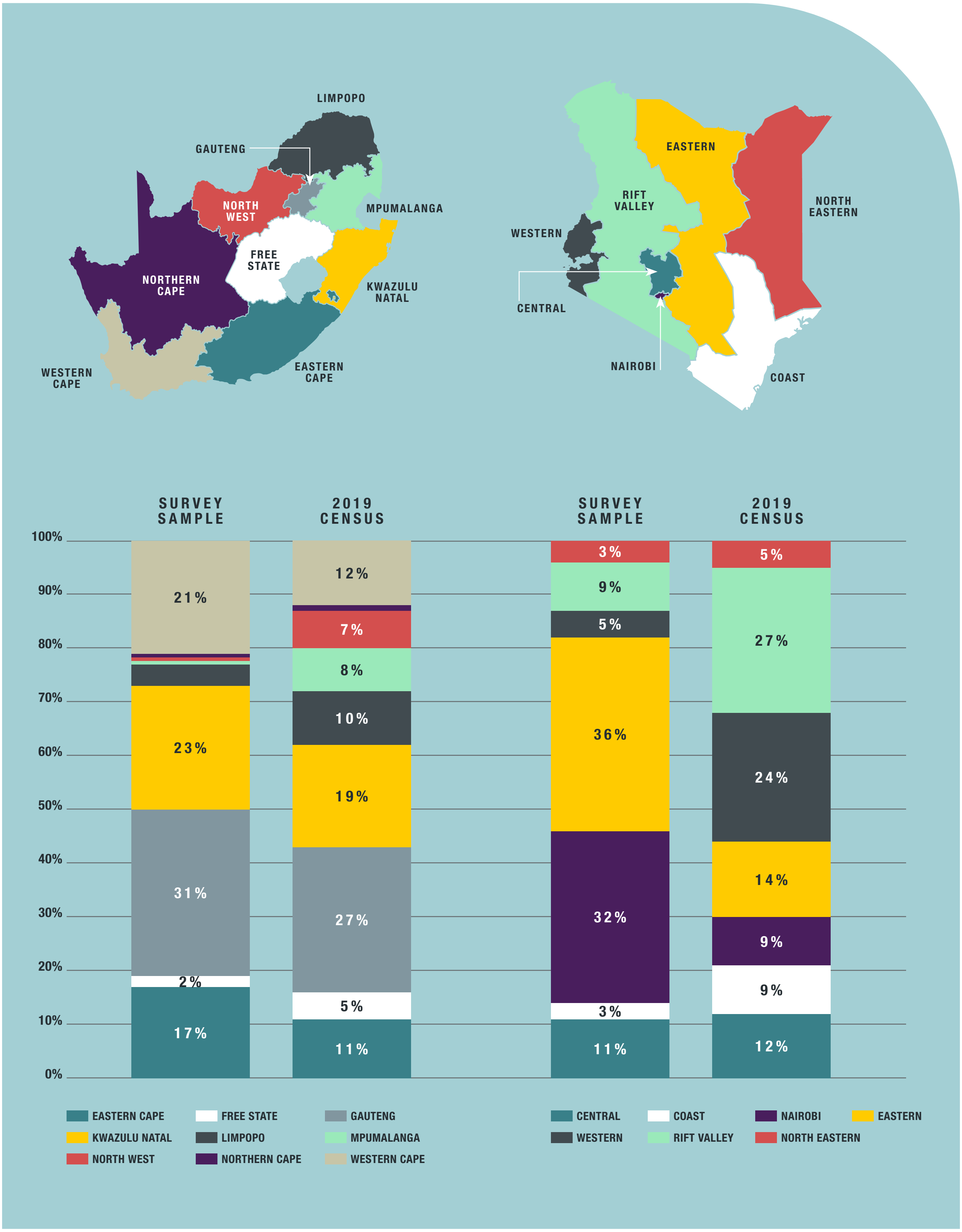


FIGURE 1: Geographic distribution of survey respondents

In both countries, the respondents were wealthier than the national average and were more likely to have health insurance (**Table 1** , **Annex 3**).

SMBG and infrequent monitoring at the clinic/hospital were the main ways respondents monitored their blood glucose levels in Kenya, with CGM use remaining marginal in this sample. On the contrary, the use of CGM devices appear significantly higher in South Africa, especially among people living with T1D, according to **Figure 2**.

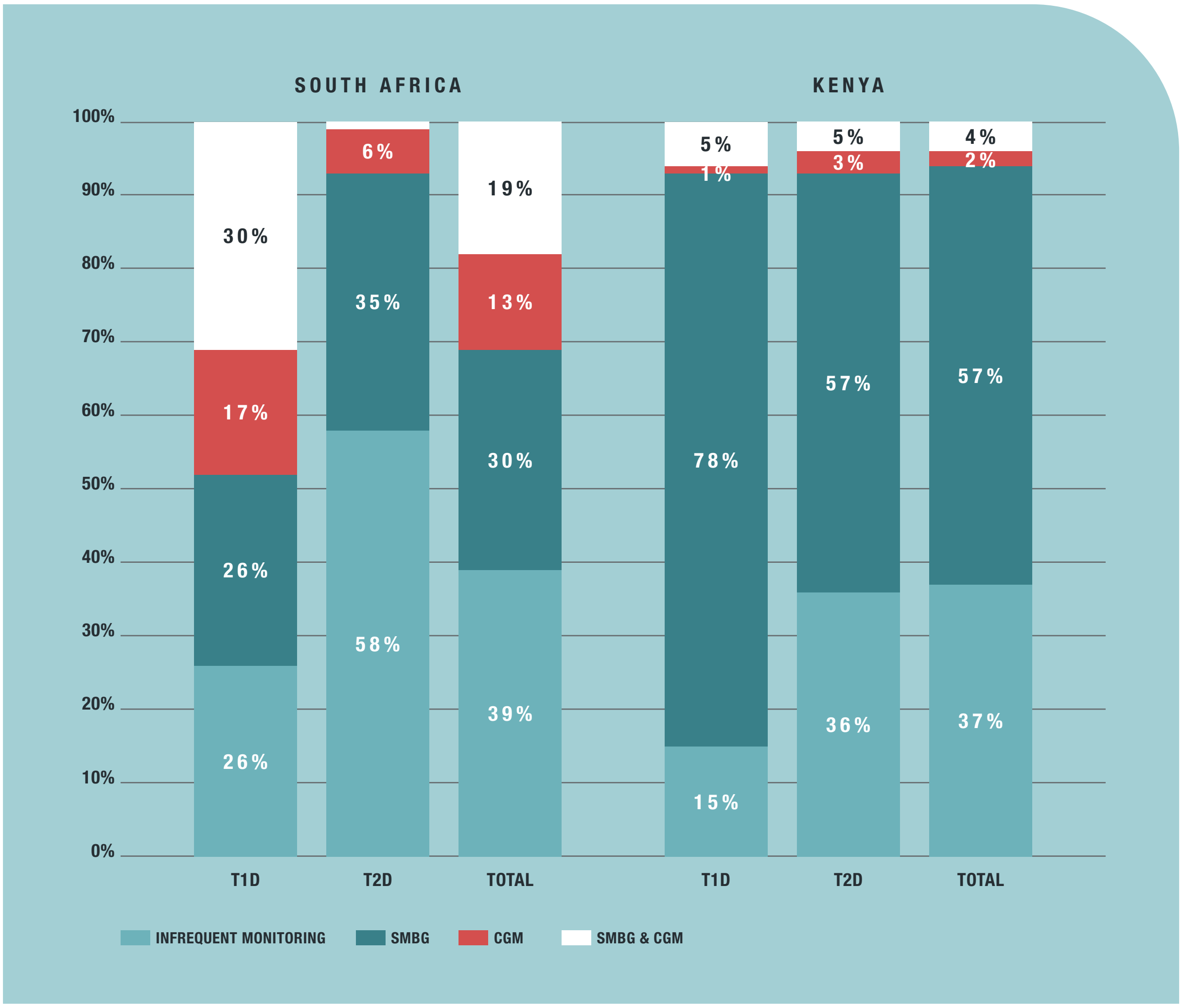


FIGURE 2: Type of blood glucose monitoring used

The Van Westendorp's PSM indicated that the acceptable monthly price ranges for CGMs in South Africa was between US$15-32 (United States Dollars) with an optimal price of US$26 (**Figure 3**) and US$17-32 in Kenya, with an optimal price of US$ 19 (**Figure 4**). The respondents on insulin treatment and those living in urban areas had a higher monthly willingness to pay in both countries compared to non-insulin users and respondents from rural and peri-urban areas respectively (**Annex 4**).

There was a positive correlation between the out-of-pocket expenditure on diabetes supplies and the willingness to pay for CGMs in both countries, with respondents who spent more on monthly diabetes supplies being more willing to spend more on CGMs (**Figure 5**). Interestingly, the correlation showed that people prefer to pay less for a CGM compared to their current expenses for diabetes supplies, suggestion that the latter are too high and CGMs may be seen to economize costs, should they be at their preferred price point.

Finally, our results indicate that respondents who tested their blood glucose (BG) more than 3 times per day (high frequency testers) were more willing to pay higher prices for the CGMs compared to those who tested fewer than three times (**Figure 6**). The respondents who went to get their blood glucose measurements done at a clinic/ hospital skipped this question.

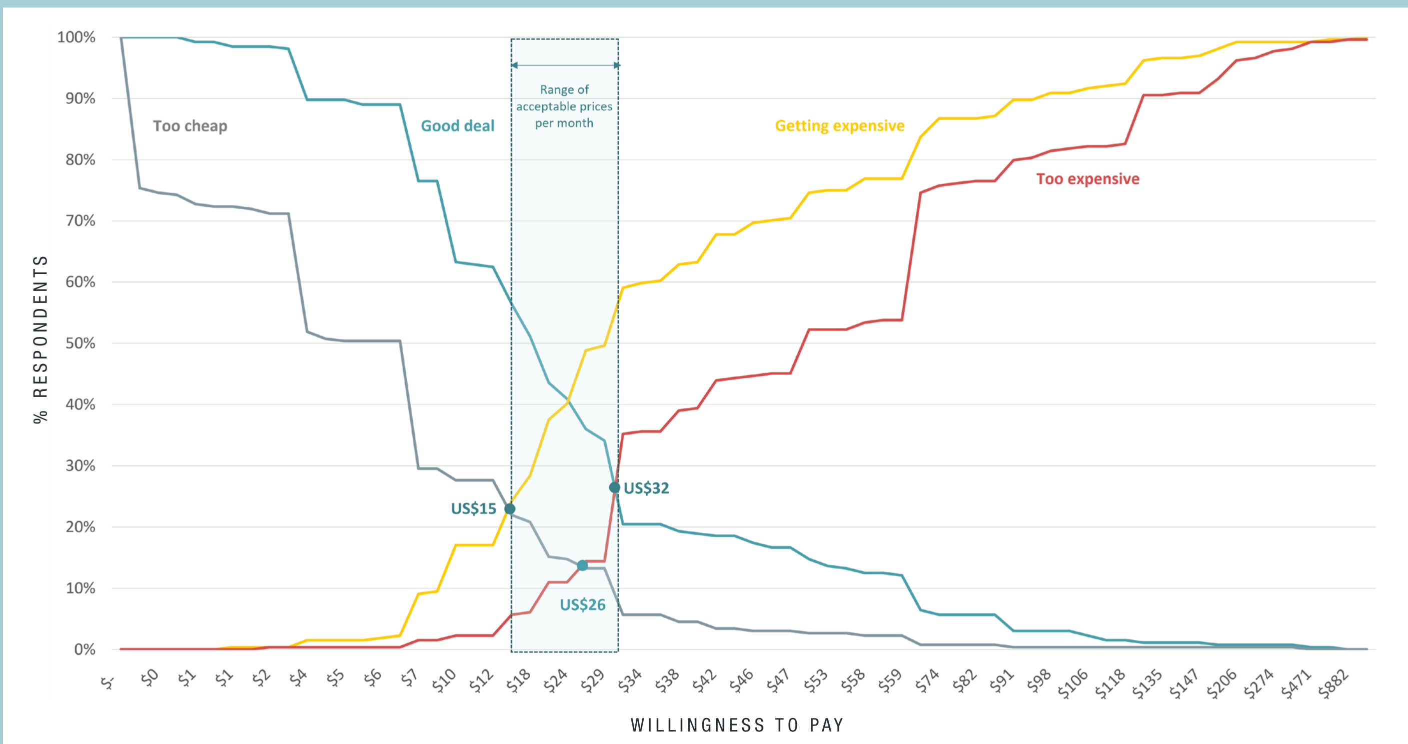


FIGURE 3: Respondents' willingness to pay for CGMs per month; Acceptable price range in **South Africa**

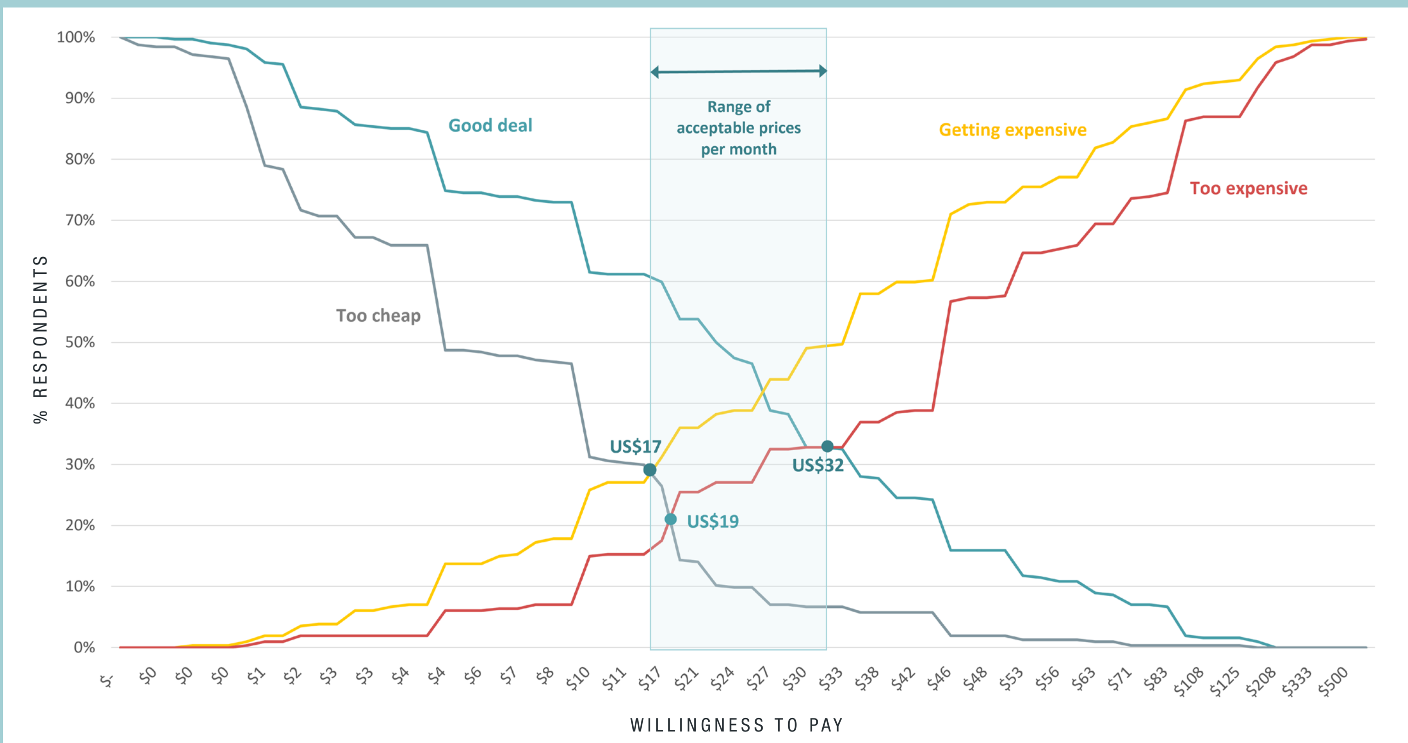
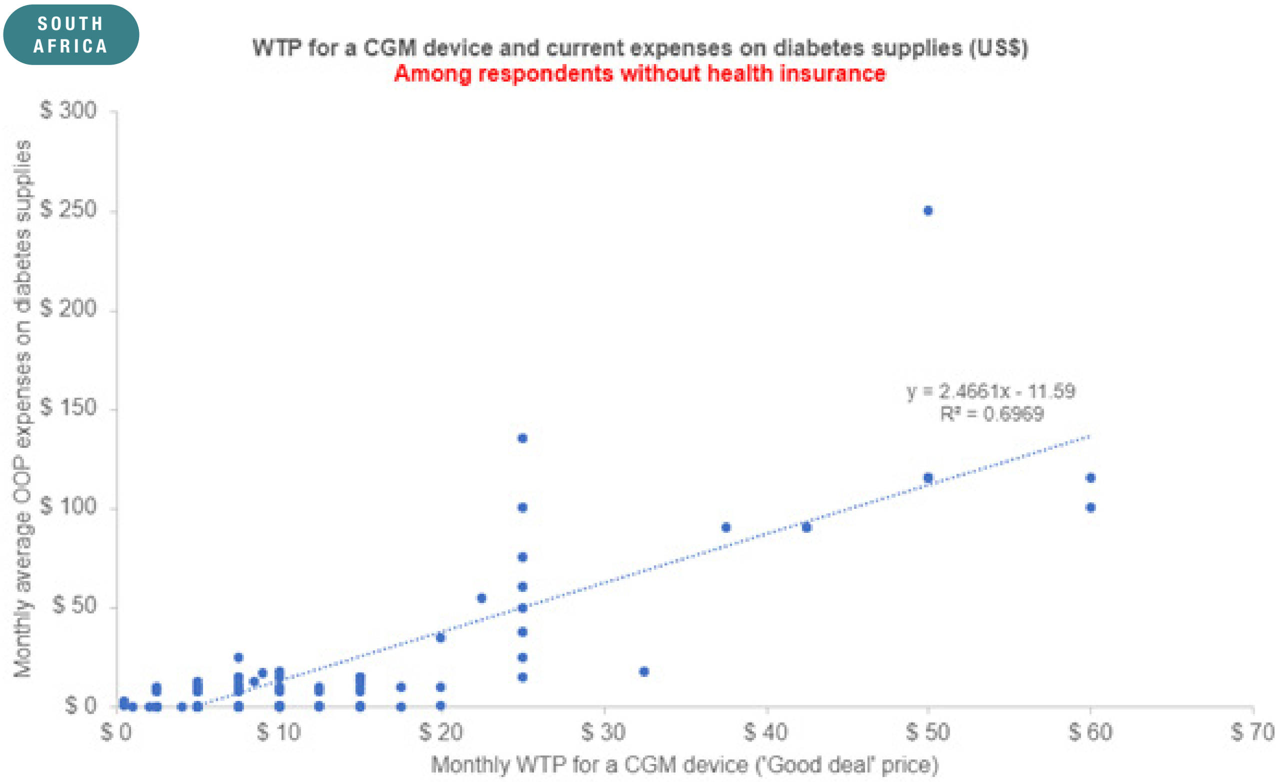


FIGURE 4: Respondents' willingness to pay for CGMs per month; Acceptable price range in **Kenya**



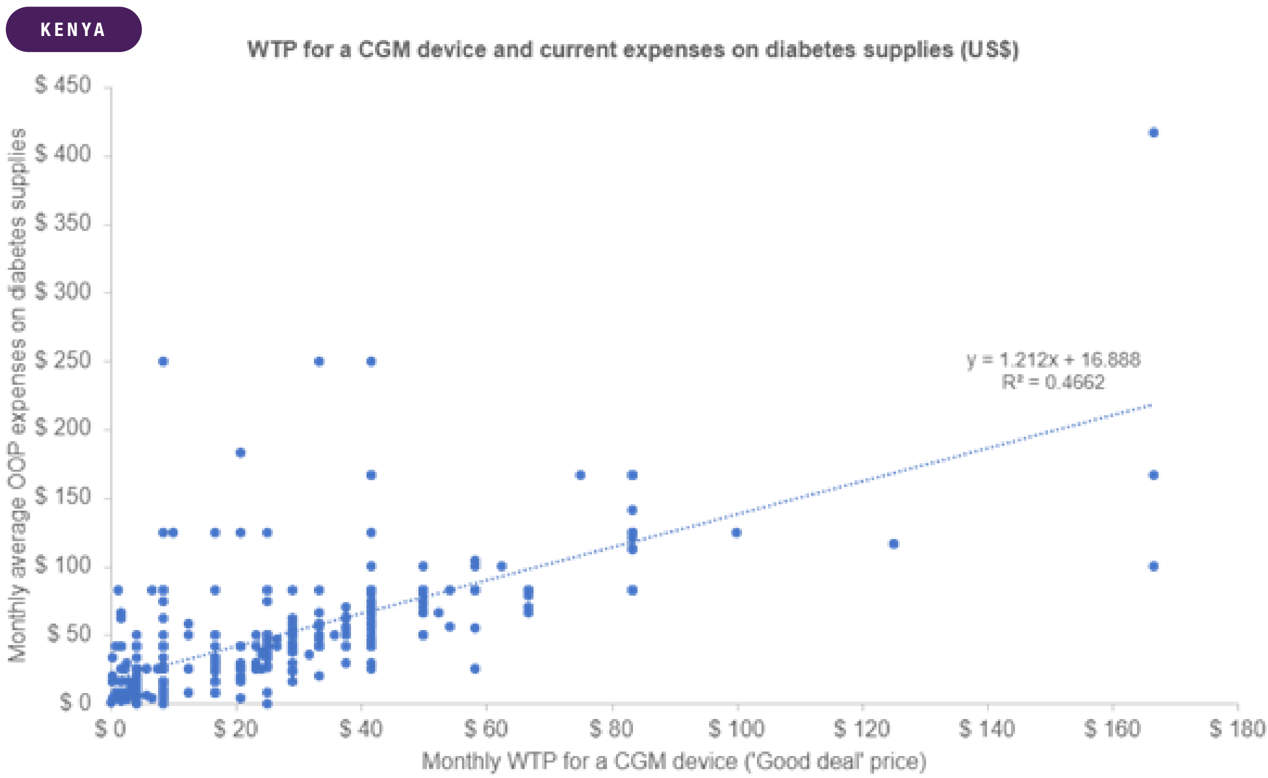
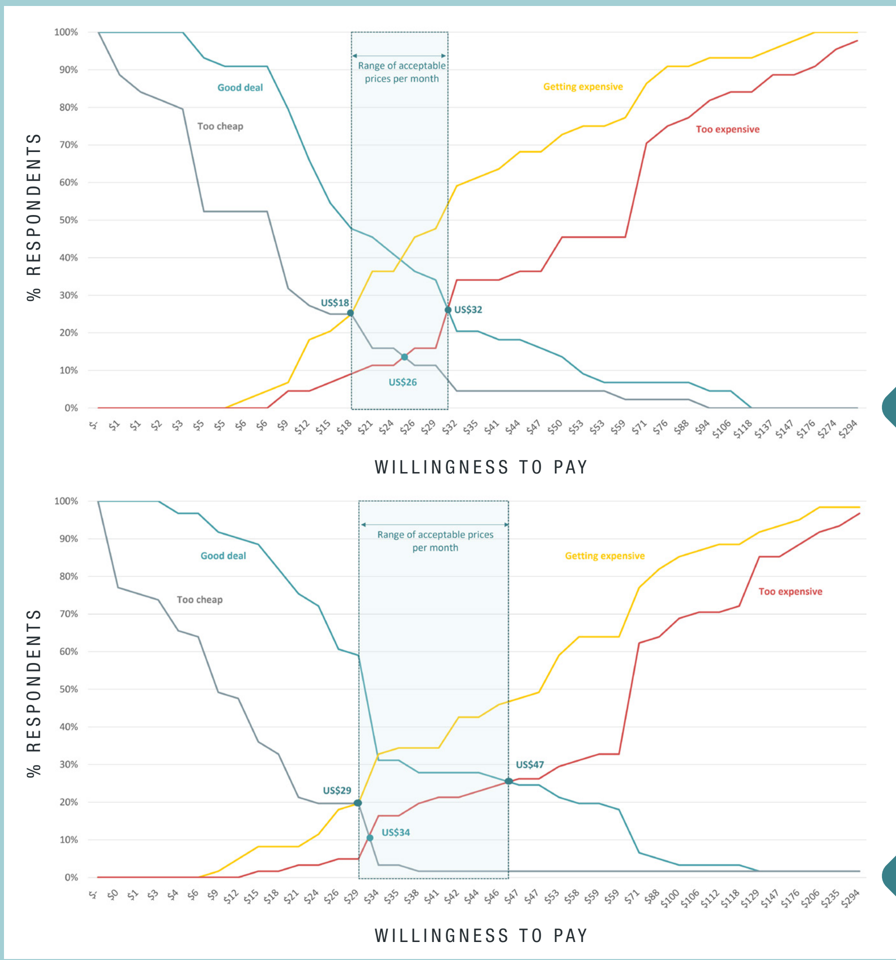


FIGURE 5: Monthly willingness to pay for CGMs in relation to average expenses for diabetes supplies

FIND Diagnosis for all

SOUTH AFRICA

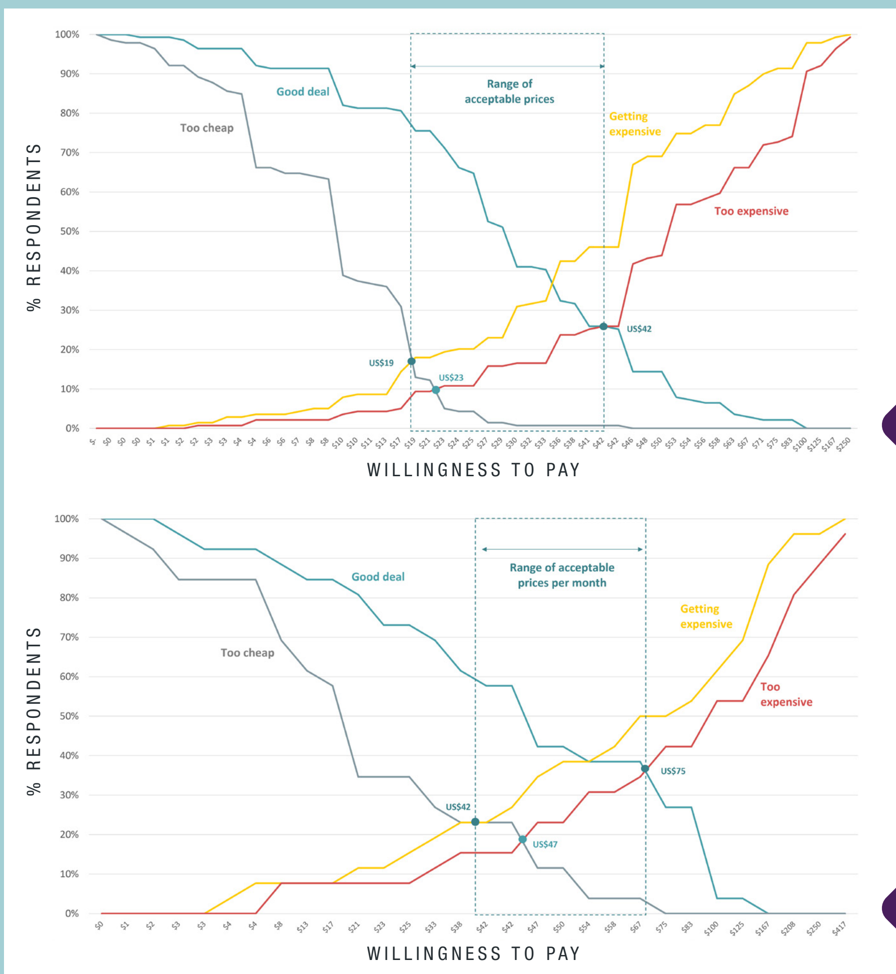


RESPONDENTS WHO TESTED THEIR BG BETWEEN 1 TO 3 TIMES PER DAY (N=44)

HIGH FREQUENCY TESTERS

RESPONDENTS WHO TESTED THEIR BG MORE THAN 3 TIMES PER DAY (N=61)

KENYA



RESPONDENTS WHO TESTED THEIR BG BETWEEN 1 TO 3 TIMES PER DAY (N=139)

HIGH FREQUENCY TESTERS

RESPONDENTS WHO TESTED THEIR BG MORE THAN 3 TIMES PER DAY (N=26)

FIGURE 6: Respondents' WTP according to their blood glucose (BG) monitoring frequency

Limitations

This study is not without limitations. The survey respondents included people living with both T1D and T2D. This may have mis-represented the CGM target group as those with T2D and not on insulin may not use CGMs. In both countries our respondents were wealthier than the average population and this may have skewed the results. Even if prices were in line with current WTP levels, CGMs would remain unaffordable to many. We acknowledge the low familiarity with CGMs among all the respondents. Unlike those recruited through the online survey, respondents in the face-to-face interviews may have had the benefit of getting some additional explanations to the questions in the event of unclarity, which may have impacted the results. Moreover, the non-probability sampling technique employed may have introduced selection bias with inability to assess the magnitude of the bias and the representativeness to the general population. Nevertheless, the strength of this study rests on the large sample size.

Discussion

Diabetes is one of the fastest growing global health concerns characterised by a huge public health burden as well as a burden on the socio-economic development [1, 38]. In 2021, approximately 6.7 million adults between the age of 20–79 were estimated to have died as a result of diabetes or its complications [1] with about 416,000 of these deaths in Africa.[1] Together, Kenya and South Africa represent 21% of the total disease burden in Africa.

CGMs have been available for 15 years now, but market uptake remains low in LMICs due to cost considerations, as the devices are an out-of-pocket expense and not covered by any public government health insurance and only a limited number of private health insurance schemes [39]. According to our findings, people living with diabetes in South Africa and Kenya would find a monthly cost of US$26 (South Africa) and US$19 (Kenya) acceptable for CGMs. This is well below the current market rates for CGMs of around 120$ per month [28]. Considering that the survey respondents were wealthier than the average population, it is likely that the true WTP at the national level is even lower in both countries. Low wages compounded by already high out of pocket payments for healthcare puts pressure on people living with diabetes and their ability to pay for innovative diabetes monitoring devices in LMICs.

Insulin users were more willing to pay for CGMs due to the greater awareness of benefits in glycaemic control and improved care, particularly for T1D in both countries. Consequently, high frequency testers and people with high out of pocket expenditure on their current diabetes supplies, were willing to pay more for CGMs in both countries. We note that the high frequency testers in Kenya were willing to pay more for the CGMs than those in South Africa (US$42-75 Kenya vs US$29-47 South Africa) even though the optimal price for the respondents was lower in Kenya (US$19) compared to South Africa (US$26).

In South Africa, approximately 71% of people seek care in the public sector, and many of whom do not have health insurance [40]. Unless CGM prices are reduced significantly, they will continue to be out of reach for most people with diabetes in the country in the absence of government coverage for the devices in the public sector. A few private insurers cover CGMs for their T1D beneficiaries, often with co-payments [41]; in contrast, the government only provides glucose meters and up to 150 strips per month for glucose monitoring within the basic care bundle [33].

In Kenya CGMs remain a niche market, adopted by the wealthier people living with diabetes who can afford to pay out of pocket; this was notable among the high-frequency testers in our study, who showed a higher WTP. In the absence of third-party payers and to reduce out of pocket expenditures on CGMs, the National Hospital Insurance Fund (NHIF) could be a potential source of funding. NHIF is the preferred insurance scheme covering about 89% of the insurance market versus 11% for other health insurance schemes [42]. However, NHIF coverage remains low with only 24% [43] of the population covered, although the uptake is rapid. Currently, NHIF reimburses for insulin for people living with T1D and some T2D, glucose meters and test strips are not covered [44].

In general, current CGM prices are a deterrent in ensuring equitable access to this self-monitoring technology. Local cost-effectiveness analyses of CGMs would be instrumental in presenting key data to inform policy-level discussion and advocacy for the inclusion and uptake of CGMs at scale. At present, there is a small market for CGMs among certain segments of the population living with diabetes with the CGMs real market potential only being realized with substantial price decreases.

Conclusion

The findings of the Van Westendorp's methodology-based willingness to pay survey conducted in South Africa and Kenya reveal a significant misalignment between current CGM prices and the preferences expressed by individuals with diabetes. The research underscores that prevailing CGM costs surpass the identified willingness to pay among surveyed users. This incongruity emphasizes the potential for enhancing accessibility to CGM technology by adjusting pricing strategies to better align with user expectations. By addressing this pricing disparity, not only can access to CGMs be broadened for a larger demographic, but it also opens avenues for constructive dialogues with health insurers and government funders. Lowering CGM prices could pave the way for these devices to be considered essential benefits, fostering improved diabetes management and overall healthcare outcomes.

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Table of abbreviations

BG	Blood glucose
CGMs	Continuous glucose monitoring devices
FoH	Fear of hypoglycemia
IDF	International Diabetes Federation
KNH-UoN ERC	Kenyatta National Hospital- University of Nairobi Ethics and Research Committee
LMICs	Low- and middle-income countries
NHIF	National Hospital Insurance Fund
PSM	Price Sensitivity Meter
QALYs	Quality Adjusted Life Years
SDC	Swiss Agency for Development and Cooperation
SMBG	Self-monitoring of blood glucose
T1D	Type 1 diabetes
T2D	Type 2 diabetes
US$	United States Dollars
WTP	Willingness to pay

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Annexes

1. Willingness to pay questions

- At what price per month would you consider the continuous glucose monitoring system to be priced so low that you would fear the quality could be bad?

  Response: KSh/ R ___ Per month

- At what price per month would you think the continuous glucose monitoring system is a bargain?

  Response: KSh/ R ___ Per month

- At what price would you begin to think the continuous glucose monitoring system is getting expensive, but you still might consider it?

  Response: KSh/ R ___ Per month

- At what price would you begin to think the continuous glucose monitoring system is too expensive to consider?

  Response: KSh/ R ___ Per month

- At a price between the price you identified as 'a bargain' [insert price_bargain] and the price you said was 'getting expensive' [insert price_expensive], how likely would you be to purchase?

  Response: Very unlikely; unlikely; unsure; likely; very likely

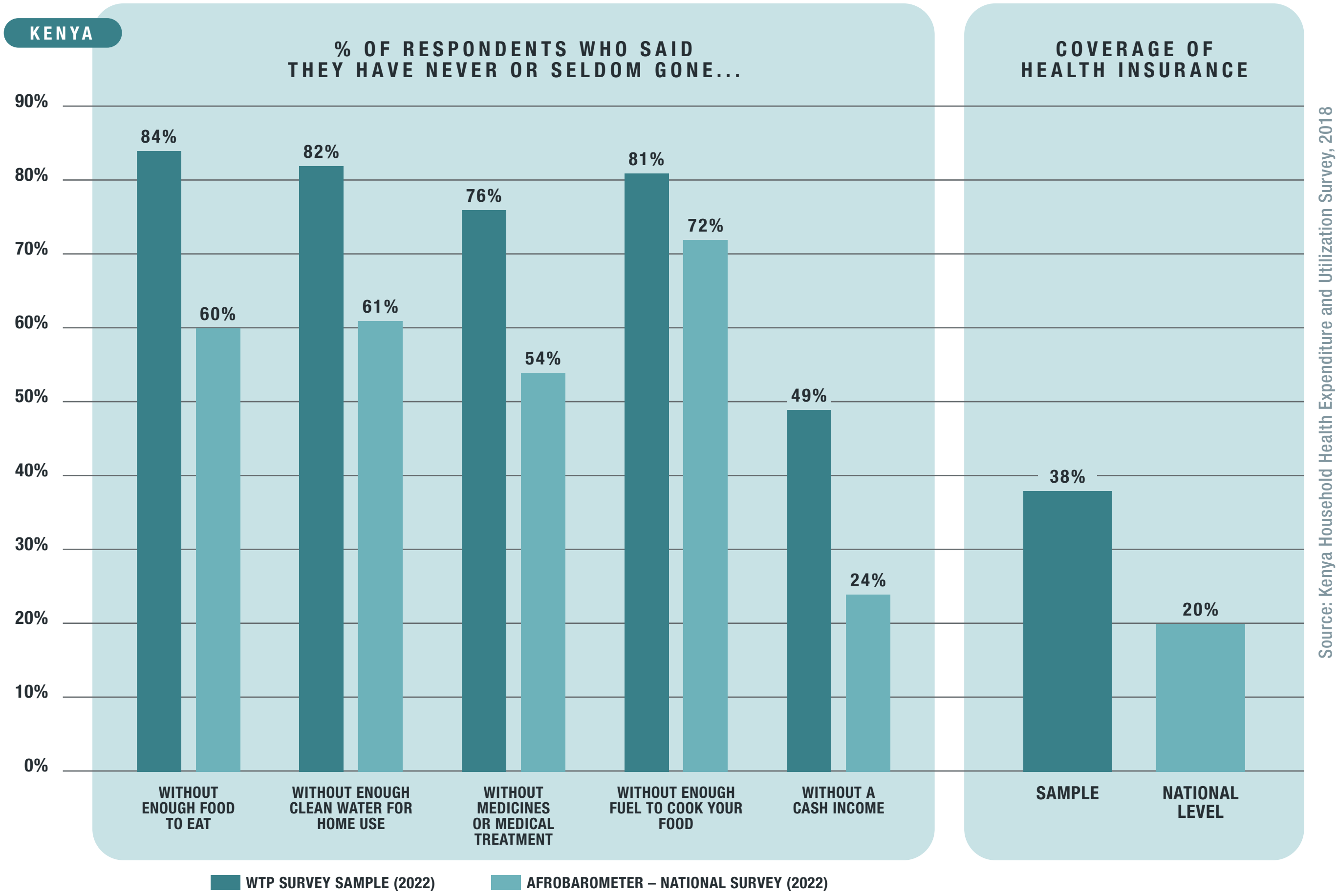
- At a price between the price you identified as 'a bargain' [insert price_bargain] and the price you said was 'getting expensive' [insert price_expensive], how frequently do you think you could afford to purchase the continuous glucose monitoring system?

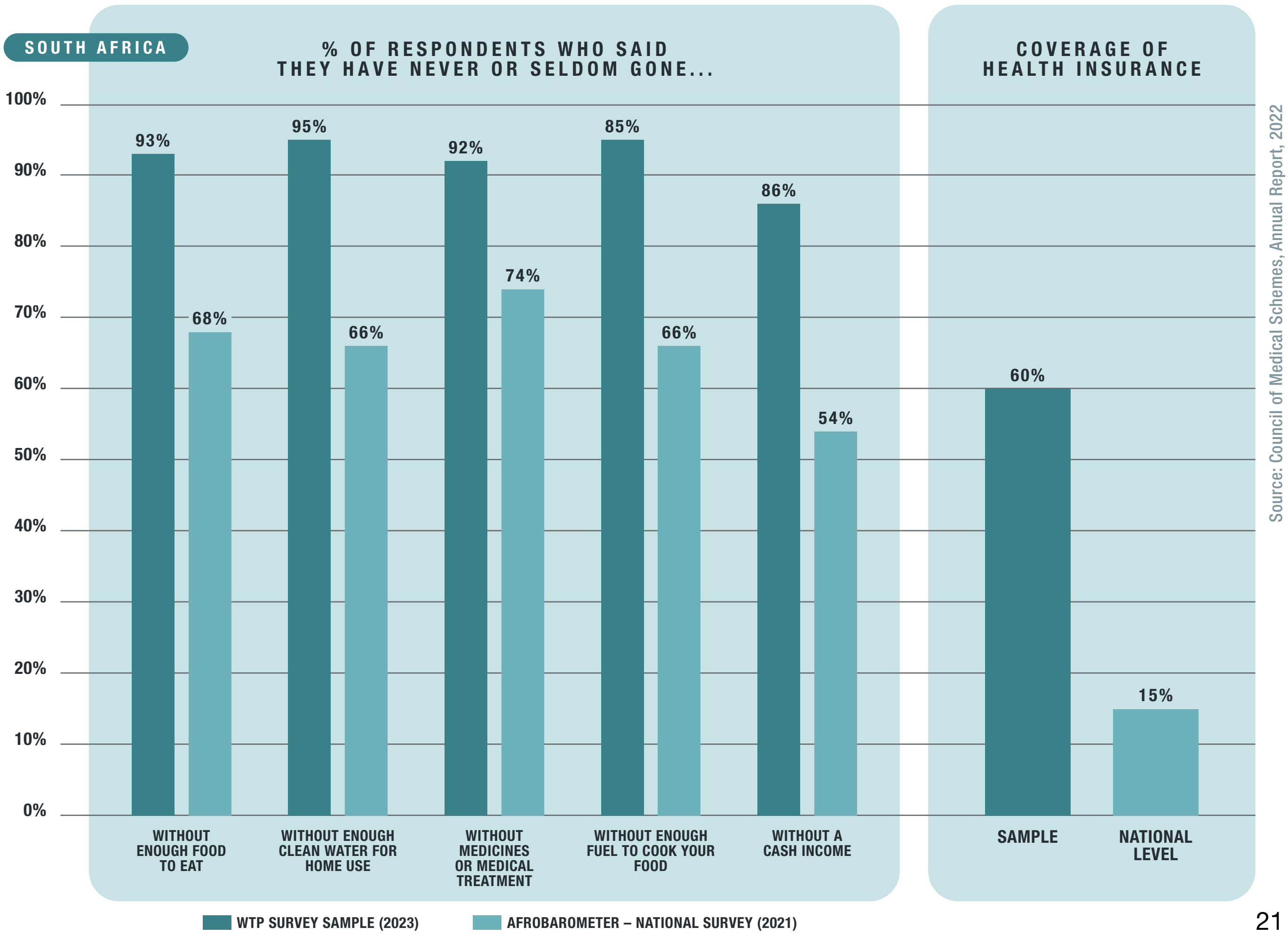
  Response: Every month; 9 months per year; 6 months per year; 3 months per year; once a year; I don't know

2. Reports and the corresponding raw data for the socioeconomic status determination from Afro Barometer

SOUTH AFRICA	REPORT	RAW DATA
KENYA	REPORT	RAW DATA

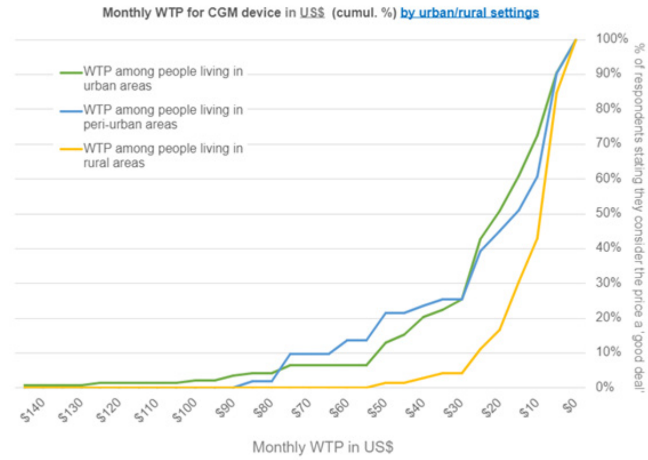
3. Wealth index results

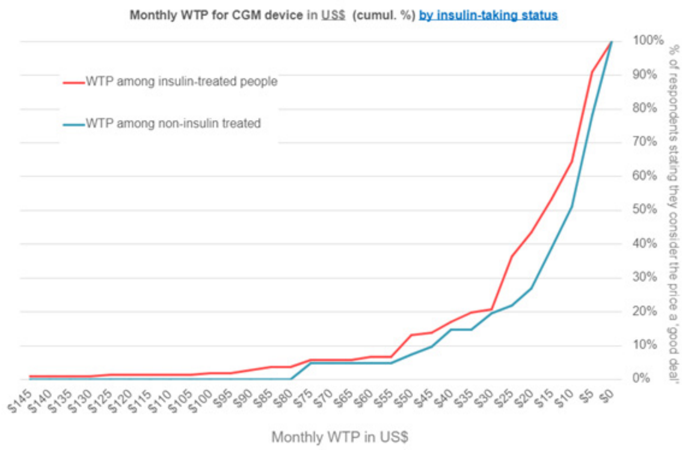




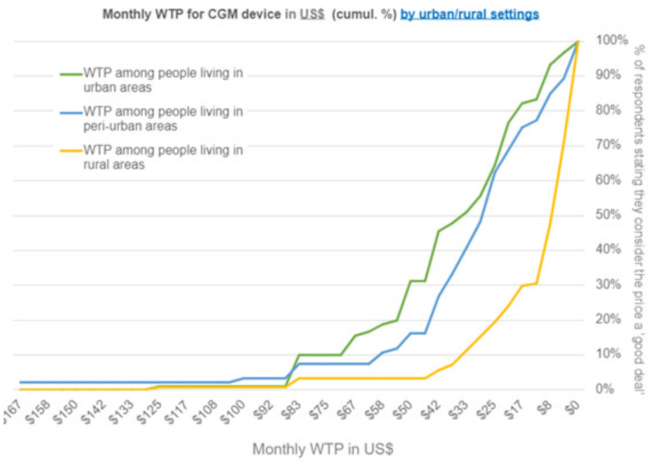
4. Respondents' WTP according to their insulin-treatment status and place of residences

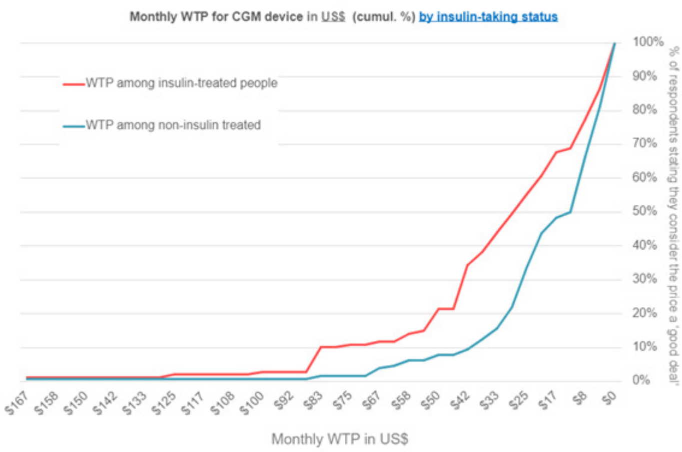
SOUTH AFRICA





KENYA



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