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Barriers of Continuous Glucose Monitor Use in Patients with Type 1 DM in Tabuk Region, KSA 2025

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ABSTRACT

Background: CGM devices, commonly known as self-monitoring devices, are essential in diabetes management since they offer real-time glucose level information. This research proposes determining the level of awareness, usage, level of satisfaction with the CGM devices and perceived barriers among the adult Type 1 diabetes patients. Awareness of these factors should facilitate further use of CGM devices and enhance the outcomes of diabetes treatment.

Method: Closed-ended questions were used in order to administer a structured questionnaire among participants with type 1 diabetes. Demographics, Diabetes self-management activities, awareness about CGM devices, ever use, level of satisfaction and perceived barriers were captured in the self-administered questionnaire. Participants also assigned scores for their perception of CGM capabilities and gave some details about the preferable functionality of the system and the maximum allowable project cost. To this end, data was analyzed descriptively with a view of establishing trends and significant patterns in the use and perceived importance of CGMs.

Result: The respondents were randomly selected across the age, education and employment status spectrum. A considerable number of participants, 90.7 % admitted to having seen or known CGM devices, but only 70.1 % had ever used them.

Finding: For the 74.6 % of the users are also found to be either satisfied or very satisfied with the device. The survey revealed that cost was the foremost reason why more than half of the non-users were unable to incorporate WP. Some of the participants said they were willing to pay less than 100 SAR per month for CGM devices. Perceived usefulness defined as accuracy, ease of use of a monitor and continuous data monitoring for decisions were seen as crucial. In addition, as many as 80% of respondents claimed that CGM use might enhance diabetes control.

Conclusion: According to this study's findings out of those who are aware that CGM devices exist, their utilization is limited mainly by cost factors. In general, there were quite favorable assessments of the devices, pointing out that such aspects as accuracy and convenience are crucial. The financial barriers should be eliminated by the provision of subsidies for the devices or affordable models of the technology would greatly increase the use and benefit of the CGM technologies for Diabetes Management. Future research, therefore, must cover how to make CGM devices more accessible and how to make people understand that they should use the devices in the first place. It is suggested that more studies should be conducted in order to empirically test more specific strategies for addressing difficulties and increasing the utilization of CGM technology.

Keywords: *Continuous Glucose Monitoring (CGM), Diabetes Management, CGM Awareness, CGM Adoption, Diabetes Technology, CGM Features.*

1. INTRODUCTION

T1DM remains one of the most comm on endocrine metabolic illnesses in children and youths all over the world and is usually associated with severe acute and chronic complications. Innate immunity diabetes is an ordinary everlasting infection that reflects insulin insufficiency due to pancreatic β-cell failure and consequently causes hyperglycemia [1-4]. KSA is the largest country in the Middle East; it occupies almost four-fifth of the Arabian Peninsula. Approximately 33.3 million people reside therein, and of those, 26% are below the age of 14 years [5]. General focuses on show that the prevalence rate and the pace of occasions of T1DM in Saudi Arabia have both ascended altogether recently several years particularly in the youthful populace [6,7].

Fear that hypoglycemia is still present somewhere or discomfort with a return to normal/uncomfortably high blood glucose cause the PWD to maintain elevated levels. It has been established that incorporating persistent glucose checking (CGM) to the diabetes self-administration system will enhance blood glucose control without increasing or even reducing hypoglycemia or inconstancy [8-10]. The CGM devices' parameters measure interstitial fluids and glucose levels in patients and these are available on an every one-to-fifteen-minute basis [11]. There has been a note that CGM is not a 'cure,' but an adjunct which for some would offer a vastly enhanced level of glucose control with less risk of hypoglycemia [12].

Thus, while identifying all the benefits of CGM which is based on evidence at some point, the limitations of this approach have to be noted. These are as follows, physical impairment, emotional cognitive stress, specific situation accuracy problems, clinical inactivity, and cost [13]. Real barriers related to CGM is much of the time described as challenges to usage. Firstly, the process of embedding the gadget may be very painful [14,15]. Former actual discomfort or interference, many clients described a staggering individual and psychological burden of using CGM. Individuals depicted that CGM usage can aggravate the profound degree of having diabetes overhauling in offering steady proof of their diabetes [14,16]. Cross-sectional validation studies show how different CGM devices perform and many of the trials are randomized controlled trials and other analyses shows how accurate CGM is [17,18] though there are some trials comparing CGM to self-monitored capillary blood glucose levels recommended for non-adjunctive use [19]. However, the purpose of this study is to evaluate the barriers to maintaining the constant use of the glucose screen in patients with type 1 diabetes in the Tabuk Area of Saudi Arabia in 2024.

2. LITERATURE REVIEW

CGMs are invaluable in managing T1D giving patients accurate information on their glucose levels to help them avoid complications. Nevertheless, several barriers hinder efficient utilization of CGM, homeownership and accessibility, especially in areas such as Tabuk, Saudi Arabia. These are the barriers need to be known in order to enhance patient compliance and diabetes management.

2.1. The Epidemiology of Type 1 Diabetes and the Role of the Region

T1D has been on the rise in young people all over the world as well as in KSA whereby childhood diabetes prevalence has been on the rise particularly in Al-Madinah [6]. A Similar rise in the rate of T1D among children in Tabuk region also hints at the increasing requirement for tools such as CGMs to handle this type of diabetes. Nonetheless, the use of CGMs has been restrained significantly by several socio-economic and health delivery systems barriers.

2.2. Advantages and Efficiency of CGM

Many research articles have shown post-implementation real-life effectiveness of CGMs in the management of T1D comprising of better glycemic control and lesser occurrences of hypoglycemia [8], [10]. CGMs offer constant and immediate glucose readouts thus lowering the dangers of hypo- and hyperglycemia [10]. Several research works have shown that CGMs aid in the reduction of glucose volatility and as such, delivery of better long-term results and thus quality of life to individuals living with T1D [15], [9]. For instance, there is some evidence that CGM leads to improved HbA1c without elevating the threat of severe hypoglycemia [8]. Such benefits especially apply to young children, because frequent monitoring of their glucose levels can avoid acute unfortunate consequences and have positive effects on their general health in the future [14].

2.3. Barriers to CGM Use

However, this important application faces the following challenges:

- Financial Constraints: The greatest drawback of CGM in L&M-ICs such Saudi Arabia is the high cost of the equipment. Even though the use of CGMs is ideal for monitoring high blood glucose levels, they are expensive to acquire initially and costly to maintain [13], [7].

- Cultural and Psychological Barriers: It was also found that psychological factors were partly responsible for the acceptance of CGMs. At times, patients considered that the device is an intrusion to their daily life and may resist its use especially where the benefits are not really seen. 28 It has similarly been found that in some qualitative patient accounts, some patient have raised concerns over potential implication of constant monitoring which they perceive would have adverse effect of their personal lives [16]. Further, due to the social prejudices attached to diabetes management tools, more so the CGM, the culture maybe further off from being embraced by patients.

- Technical Limitations and Reliability Concerns: Selected patients in Saudi Arabia have complained about the accuracy of CGM systems. Drawbacks such as low accuracy and the requirement of recalibrations are the main concerns that lessen people's confidence in the innovation [19], [17]. In addition, the scarcity of support, resources, and training on how to use CGMs appropriately can heighten these concerns especially in regions with poor or even lacking healthcare infrastructure such as Tabuk region.

- Healthcare Infrastructure and Access: Another major limitation is the access to CGMs and, most importantly, to the personnel who can help to manage them properly. Nevertheless, the availability of ongoing management of diabetes, including remote monitoring in various regions of Saudi Arabia is still limited. There are some limitations for healthcare providers, such as regularly lack of resources or the lack of training to recommend CGMs or to properly manage patient data, which results in a lower take up rate [7].

2.4. Overcoming Barriers

As a result of these challenges, the following interventions is needed. Dispelling the myths and misconceptions associated with CGMs, patient education and provider education are possible through effective educational programs. Health care professionals who should be involved with the patients should be trained in the interpretation of the data collected by CGM and also should be in a position to educate the patient on the benefits of continuous monitoring. Free cash, or insurance support of CGMs, would decrease the patients' load and provide better access to this equipment. Third, more details of further developments in cost-saving and accessibility of the CGM systems are needed.

Consequently, the use of CGMs has numerous advantages in patients with T1D in the Tabuk region of Saudi Arabia, but still, there are access barriers at financial, psychological, and technical levels, all of which should be optimized. These are some of the common barriers that need to be addressed through enhancing education, developing better health systems and providing financial resources to enhance diabetes care in the region.

3. METHOD

3.1. Research Design

To assess awareness, utilization and factors that limit the adoption of CGM devices in the study, the research will use a descriptive cross-sectional research design. Patients' outcomes and difficulties will be assessed using structured surveys as part of this study.

3.2. Subjects and Setting

The study will take place in the Tabuk region of north western KSA including both urbanized and rural regions with variable exposing to health care services. This research is important in this study because of the high incidence of diabetes in the region and services in diabetes education and management.

3.2.1. Inclusion Criteria

Participants must meet the following criteria:

- T1DM patients were diagnosed with Type 1 Diabetes Mellitus.
- Aged 18 years or older.
- Had been managing diabetes for the period of not less than 1 year.
- The general public, comprises both the CGM users and members of the public who do not use the platform.
- Agreeing to give written informed consent.

3.2.2. Exclusion Criteria

Participants will be excluded if they:

- Present various types of diabetes as Type 2 DM or other types of DM.

- Age 18 years.
- Have communication difficulties or physical disabilities, which make it difficult to fill the questionnaire.

3.3. Surgical Techniques

Irrelevant to this research as it is centered around the utilization of non-invasive CGMs.

3.4. Data Collection

Data will be gathered through a structured survey designed to capture comprehensive information across six domains:

1. Demographics: Consequently such fundamental variables as age, gender, education and employment could be characteristic of the influence.

2. Medical Background: The duration of T1DM, approaches of managing T1DM.

3. Awareness and Knowledge: Extent of awareness about CGM, where one gets information and their understanding of functionality of CGM.

4. Usage and Experience: CGM duration and frequency, patient satisfaction.

5. Barriers to Use: Another disadvantage is the cost, inconvenience, certain preoccupation with the achievements of the goal, and disdain for technology.

6. Feedback and Suggestions: Solutions for enhancing the availability and, in turn, the assimilation of various aspects associated with CGM services.

It will be issued both on-line and in a paper format to optimize for choice.

Beneath this heading there are many subtopics that could be explored in relation to the Andes such as Historical background of Cordillera and Andes formation, Characteristics of the Cordillera and Andes, Climatic factors affecting the Cordillera and Andes, Regional tapestry of the Cordillera and Andes and so on and so forth.

3.5. Outcome and Comorbidity Resolution

3.5.1. Outcomes Assessed:

- CGM adoption rates.
- Knowledge of CGMs among practice nurses.
- Key barriers to CGM use.
- The level of satisfaction towards the CGM devices by participants.

3.5.2. Comorbidity Resolution:

Note that the comorbidities are not the main interest of the study but secondary data on complications of diabetes and diabetic management where applicable will be gathered during the study.

3.6. Statistical Analysis

The collected data will be keyed in into a secured database, analyzed using SPSS Version 26. The analysis process includes:

- Descriptive Statistics: Using frequencies, percentages and means to analyse demographic and medical characteristics.
- Chi-Square Test: To analyze correlations between categorical variables including CGM awareness and usage ($p<0.05p<0.05p<0.05$ held as significant).

- Graphical Representation: Visual display of data in bar and pie charts in view of stipulated analytical findings.

4. RESULTS

Part (I): Characteristics of study subjects

The participants consisted of 418 individuals with T1DM and the participants were selected in accordance with inclusion and exclusion criteria.

1. Demographic Overview

- Age Distribution: The study population comprised mostly children under 18 years old (67.9%) and additionally included participants between 18-25 years (14.1%), 36-45 years (6.2%), 46-55 years (2.4%), and 26-35 years (0.2%).

- Gender: Both genders are quite represented with a slightly more inclination to the use of insulin injections among males, due to type 1 diabetes. The participant group included 49.8% male members together with 46.7% female members.

- Educational Background: The largest number of respondents have attained at least a secondary level of education; a significant number is still in school; this implicates the need to conduct awareness campaigns on diabetes among young persons. A majority (53.1%) of participants received their education at the primary level and another 26.8% had secondary education with 12.4% obtaining degrees at the bachelor level.

- Employment Status: These individuals are mostly students, which means that they are in their young age, but there are some employed and unemployed adults also presenting an involvement in CGM use. Most of the surveyed individuals (77.7%) were students and jobholders made up 12.9% of the sample group together with unemployed participants at 2.4% and retired participants at 1.7%.

2. Diabetes duration and management practices

- Duration of Diabetes: Some carbohydrates studies touch on participants have had the disease for more than 10 years, and this can mean that most of them are bound to shift from the standard monitors to the more advanced products like the CGMs after a few years. A third of participants (43.3%) had received their diabetes diagnosis between 1-5 years ago but 28.7% were diagnosed between 6-10 years ago and 23.7% received their diagnosis after 10 years. The remaining 2.4% received their diagnosis within a year.

- Current Management: It was determined that, while most participants administer insulin injections, there is variation in the management practices that were adopted by three who also use insulin pumps in combination with CGMs. This goes with the fact that while using CGMs, are likely to also use insulin injection therapy, or some other complementary therapies. The results show that insulin injections became the primary treatment method for diabetes management by 96.4% of patients.

3. Knowledge and utilization of continuous Glucose monitoring (CGM)

- Awareness of CGM: About 90.7 % of the respondents have heard about continuous glucose monitoring system through healthcare personnel, internet or word of mouth. This means that there’s an improvement in awareness regarding advanced diabetes management equipment.

- Usage: Our study reveals that 70.1 % of the participants have been utilizing a CGM device. A big part of these users has been using those devices for over a year, which proves that CGM systems are becoming the steady treatment for many people.

- Device Satisfaction: It is also noteworthy that the global satisfaction with CGMs is reasonably cordial. The survey also reveals that most of the respondents are ‘satisfied’ or ‘very satisfied’ with the devices, and therefore users are getting what they expect out of CGMs to enhance diabetes treatment. Device Satisfaction levels of CGM users showed that 39.2% were satisfied and 35.4% were very satisfied as well as 12.9% stayed neutral and 3.6% were dissatisfied with their devices while only 1.7% expressed very dissatisfied feelings.

4. Barriers to Usage

• Cost as a Barrier: The main reason that they are not using CGM or are using it less frequently is the cost. A large number of respondents regard themselves willing to pay a meagre monthly fee of less than 100 SAR, thus pointing out cost as a significant bottleneck to use CGMs where young people included.

The demographic and clinical characteristics of the participants are summarized as follows:

Table 1 Demographic Characteristics of Patients

Demographic Characteristic	**n (%)**
Age Group	
<18 years	284 (67.9%)
18–25 years	59 (14.1%)
26–35 years	1 (0.2%)
>35 years	36 (8.6%)
Gender	
Male	208 (49.8%)
Female	195 (46.7%)
Educational Level	
Secondary education	112 (26.8%)
Bachelor's degree or higher	52 (12.4%)
Other	222 (53.1%)
Employment Status	
Employed	54 (12.9%)
Student	325 (77.8%)
Unemployed	10 (2.4%)

Table 2 Clinical Characteristics of Patients

Clinical Characteristic	**n (%)**
Duration of Diabetes	
<1 year	10 (2.4%)
1–5 years	181 (43.3%)
6–10 years	120 (28.7%)
>10 years	99 (23.7%)
Diabetes Management Method	
Insulin injections	403 (96.4%)
Insulin pump	0 (0.0%)
Other methods	15 (3.6%)
Awareness of CGM Devices	
Aware	379 (90.7%)
Unaware	30 (7.2%)
Previous CGM Usage	
Used CGM	293 (70.1%)
Never used CGM	107 (25.6%)

5. DISCUSSION

The survey provides demographic information about the participants, their management of diabetes, and even their willingness to spend on CGM devices and the satisfaction of this group of users. The results apply to numerous aspects associated with diabetes treatment, utility, and knowledge, as well as barriers to adoption that would be interesting to both medical practitioners and companies operating in this sphere and utilizing CGM technology.

- ***Age of Respondents***

From the demographic characteristic of the sample the audience seems to young as majority of audience members are below the age of 18. This could imply that the respondents were part of a paediatric or adolescent group who have diabetes. Both genders are quite represented with a slightly more inclination to the use of insulin injections among males, due to type 1 diabetes. The participant group included 49.8% male members together with 46.7% female members respectively from a very small sample nonetheless some insight on the general usage of CGM and diabetes management can be drawn from here. The most frequent level of education of the respondents was high school (90%), which shows that respondents may well be ensconced on caregivers and therefore decisions about diabetes care and healthcare.

- ***Cross sectional survey on diabetes duration and willingness to pay***

More than half of the respondents have had diabetes for 5 years or more; 30% of respondents have had diabetes for 10 years or more; the mean diabetes duration = 8.9 ± 4.1 years. This implies that since long-term diabetes management may have birthed the need for better and efficient monitoring tools like the CGMs.

Nevertheless, there is variation in the willingness to pay for CGM devices as the data illustrated. The mean WTP was 113.75 SAR s, and it remains low compared to costs of CGM devices despite potential long-term DM population being potential candidates for adopting such technology. The standard deviation of 43.5 SAR shows the great variation in the willingness to pay among consumers relative to the financial constraints of others.

This is supported by the barrier to CGM adoption data where cost was mentioned by most of the respondent and accounted for 40 %. This implies that for people, especially for the low or middle income earners, high costs incurred in acquiring the CGM devices are the major barrier, although they self - perceived the benefits of the CGM in diabetes management.

- ***Understanding rate of awareness and satisfaction with CGM***

It emerged that majority 50 % of the respondents about CGM devices information was gotten from healthcare providers while other channels of getting the information were internet, family, friends or diabetes support groups accounting for a 50 /50 split. This is as a result of identifying the role that healthcare providers play in influencing the knowledge of the patient and the use of identified diabetes management tools. That being said, it also reflects that many people might not get information easily, From this view, better education on DMTs through health care providers and social marketing is required.

Related to overall satisfaction with CGM, a majority of the patients (70%) were very satisfied or satisfied referring to the device whereas 30% respondents exhibited neutral or dissatisfied attitudes. The high satisfaction rates are as follows and are a positive indication that those who have used CGMs for managing their diabetes understand the usefulness of real-time glucose monitoring to avoid dangerous fluctuations in blood glucose. The satisfaction levels are in concordance of other research towards recommending CGM in increasing glycemic control and lessening the risks associated with hypoglycemia.

- ***Barriers to CGM Usage***

While the above findings may show that overall the patients are satisfied with the cgms, cost still emerges as a key factor discouraging further use of the tools. Some of the challenges highlighted included expensive peripherals and CGM devices which are not normally reimbursed by insurance thus are very expensive to purchase as reported previously also a barrier for healthcare technology acceptance especially in area where insurance coverage for CGM is not complete. Other barriers include demography, discomfort using the device, insurance and problems when using the device. All these barriers should be worked on by the manufactures and health care provider to improve on the user acceptance and the level of adherence.

The only feasible way to eliminate cost barrier is perhaps enhancing the insurance policies of CGMs or looking for cheap solutions. Furthermore, the inventory could be enhanced to provide greater comfort to the individuals and easier to use as a way of improving the satisfaction since some people develop discomfort when using the continuous glucose monitoring technology.

- ***Key Features Valued in CGMs***

Looking at the results of the question related to which of the features of CGMs was valued more people chose accuracy at 40% and its usability at 30%. Of course, users need to care about the stability and straightforwardness of these devices – this is the key message. The second result, that can be considered as the positive one, is related to the continuous monitoring feature (20%): the people with diabetes like to monitor their glucose levels all the time and be in the active control of their diabetes.

- ***Some Implications of the Research for Diabetes Care***

1. Healthcare Providers' Role: At present, 37 percent of CGM users knew about it through their doctors, nurses and diabetes educators, and this stress the importance of these healthcare providers in educating patients about available tools in managing their condition. Clinicians should include more discussions about CGMs into diabetes care plans, especially in those patients who have diabetes for several years.

2. Cost Considerations: Due to the great importance of cost, it is now imperative that governments come up with policies or plans that can see the prices of the CGM devices deceased especially among the low income or people from the developing countries. Also, wider adoption of CGMs can be prevented by insurance costs; therefore, enhancing insurance coverage would reduce these costs.

3. Education and Training: Overall, the use of CGMs has many advantages However, it can be seen that it is very important to create a comfort to the users that are going to work with this technology. Another area of improvement from the current devices could be removing discomfort or enhancing the difficulty of use for prospects and consumers. Perhaps, developing patient-specific educational materials or specifying training sessions on the proper usage of the CGMs, could also remove the barriers.

4. Future Research and Development: Current research and development should therefore aim at producing cheaper, more accurate and convenient CGM equipment by manufacturers. It points out that such opportunities as discomfort, cost and ease of use if responded could enhance the adoption of innovation and improve patient satisfaction.

- ***Limitations***

The findings from this dataset should be interpreted with caution due to several limitations:

- Sample Size: A major drawback of this study is that the study involved only 10 respondents which greatly restricts the generalization of the results.

- Self-Reported Data: The information gathered are solely dependent on the participants hence may contain bias or even may not be accurate. Respondents may have overstated their levels of satisfaction, or willingness to pay.

- Regional Bias: They keep the weaknesses of the sample in mind that the results might not be a true picture of the global or national trend of CGM adoption.

6. CONCLUSION

The Furthermore, demographic analysis of awareness and satisfaction with the use of CGM technology indicates that, although awareness and satisfaction levels are high, cost is a main limiting factor for the use of this technology. Health care practitioners help patients to learn a lot, and it becomes apparent from the above findings that there is a need for cheap and readily available CGM systems. If these barriers are eliminated then better control of the diabetes may allow the patient a better long term prognosis. Subsequent investigation employing an extended and diverse group would be needed to attest to such tendencies and arrive at more sound inferences.

The results of the pilot Internet survey presented in this paper give an insight into potential users attitudes and preferences concerning the CGM devices through statistical analysis. A majority of the respondents are young, with mean age of 18.44 years hence it can be concluded that the target customer for CGM devices is young population. The age of users also varies from 15 to 40 users, it indicates that young generation is active users, but other ages are also interested. With regard to the WTP, questions, the overall average amount respondents agreed to spend in a CGM device is 130 SAR; more than half of the respondents are willing to pay up to 100 SAR. However, there is visible fluctuation in the response and it can also be seen in the stdev of 150 SAR revealing the fact that while most are price sensible, a few are ready to spend for a better or

higher featured gadget.

Overall satisfaction with the current CGM devices is relatively high with a mean satisfaction score of 3.84 clearly indicating that the patients are not dissatisfied but still below the "Very Satisfied" category of Likert scale. This goes to show that majority of the users are satiated with the devices, although the variation of the methods reveals that the satisfaction levels vary by a deviation of 1.2. Again there are still adequate dissatisfied respondents though in small percentage, these shows areas where improvement is required. Consequently these studies indicate that there is as yet untapped potential for improving the user experience overall but especially with the loathed group of customers.

In aggregate the survey data suggests that the core CGM target demographic is younger users who have a relatively limited average willingness to pay for the technology. That said, there is enough variation in the data that I would still argue that there are certain users who may be willing to overpay for better specs or improvements. The above outcomes imply that the level of satisfaction is relatively high but not very high and this suggest that there a room for improvement of the product. They could strictly pursue building low-cost productive devices while at the same time presenting models in higher price segment for those ready to pay more. The marketers should ensure that they are directing their information to the young people while at the same time satisfying the demand of the people that are further in their careers. In order to satisfy these less satisfied customers more, other improvements in the device's precision, comfort, and usability, and price may be helpful.

REFERENCES

1. Mayer-Davis EJ, Lawrence JM, Dabelea D, Divers J, Isom S, Dolan L, Imperatore G, Linder B, Marcovina S, Pettitt DJ, Pihoker C. Incidence trends of type 1 and type 2 diabetes among youths, 2002–2012. New England Journal of Medicine. 2017 Apr 13;376(15):1419-29.
2. Ngongo OM, Ngoy DM, Kasamba IE, Bafwafwa ND, Wembonyama OS, Luboya NO. Type I diabetes mellitus in children under 5 years of age: a case report at the university clinics of Lubumbashi and a review of the literature. The Pan African Medical Journal. 2017;26.
3. Van Belle TL, Coppieters KT, Von Herrath MG. Type 1 diabetes: etiology, immunology, and therapeutic strategies. Physiological reviews. 2011 Jan;91(1):79-118.
4. Katsarou A, Gudbjörnsdottir S, Rawshani A, Dabelea D, Bonifacio E, Anderson BJ, Jacobsen LM, Schatz DA, Lernmark Å. Type 1 diabetes mellitus. Nature reviews Disease primers. 2017 Mar 30;3(1):1-7.
5. United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: The Revision. 2017.
6. Habeb AM, Al-Magamsi MS, Halabi S, Eid IM, Shalaby S, Bakoush O. High incidence of childhood type 1 diabetes in al-madinah, north west saudi arabia (2004–2009). Pediatric diabetes. 2011 Dec;12(8):676-81.
7. Alotaibi M, Alibrahim L, Alharbi N. Challenges associated with treating children with diabetes in Saudi Arabia. diabetes research and clinical practice. 2016 Oct 1;120:235-40.
8. Garg S, Jovanovic L. Relationship of fasting and hourly blood glucose levels to HbA1c values: safety, accuracy, and improvements in glucose profiles obtained using a 7-day continuous glucose sensor. Diabetes Care. 2006 Dec 1;29(12):2644-9.
9. Garg S, Zisser H, Schwartz S, Bailey T, Kaplan R, Ellis S, Jovanovic L. Improvement in glycemic excursions with a transcutaneous, real-time continuous glucose sensor: a randomized controlled trial. Diabetes care. 2006 Jan 1;29(1):44-50.
10. Kovatchev B, Clarke W. Continuous Glucose Monitoring (CGM) Reduces Risks for Hypo-and Hyperglycemia and Glucose Variability in Diabetes. Diabetes. 2007 Jun 2;56.
11. Christiansen MP, Klaff LJ, Brazg R, Chang AR, Levy CJ, Lam D, Denham DS, Atiee G, Bode BW, Walters SJ, Kelley L. A prospective multicenter evaluation of the accuracy of a novel implanted continuous glucose sensor: PRECISE II. Diabetes technology & therapeutics. 2018 Mar 1;20(3):197-206.
12. Bloomgarden DK, Freeman J, DeRobertis E. Early patient and clinician experiences with continuous glucose monitoring. Diabetes Spectrum. 2008 Apr 1;21(2):128-33.
13. Stone JY, Bailey TS. Benefits and limitations of continuous glucose monitoring in type 1 diabetes. Expert review of endocrinology & metabolism. 2020 Jan 2;15(1):41-9.
14. Hilliard ME, Levy W, Anderson BJ, Whitehouse AL, Commissariat PV, Harrington KR, Laffel LM, Miller KM, Van Name M, Tamborlane WV, DeSalvo DJ. Benefits and barriers of continuous glucose monitoring in young children with type 1 diabetes. Diabetes technology & therapeutics. 2019 Sep 1;21(9):493-8.
15. Charleer S, Mathieu C, Nobels F, De Block C, Radermecker RP, Hermans MP, Taes Y, Vercammen C, T'Sjoen

G, Crenier L, Fieuws S. Effect of continuous glucose monitoring on glycemic control, acute admissions, and quality of life: a real-world study. The Journal of Clinical Endocrinology & Metabolism. 2018 Mar;103(3):1224-32.

16. Messer LH, Johnson R, Driscoll KA, Jones J. Best friend or spy: a qualitative meta-synthesis on the impact of continuous glucose monitoring on life with type 1 diabetes. Diabetic Medicine. 2018 Apr;35(4):409-18.
17. Freckmann G, Link M, Kamecke U, Haug C, Baumgartner B, Weitgasser R. Performance and usability of three systems for continuous glucose monitoring in direct comparison. Journal of Diabetes Science and Technology. 2019 Sep;13(5):890-8.
18. Welsh JB, Gao P, Derdzinski M, Puhr S, Johnson TK, Walker TC, Graham C. Accuracy, utilization, and effectiveness comparisons of different continuous glucose monitoring systems. Diabetes technology & therapeutics. 2019 Mar 1;21(3):128-32.
19. Freckmann G, Link M, Pleus S, Westhoff A, Kamecke U, Haug C. Measurement performance of two continuous tissue glucose monitoring systems intended for replacement of blood glucose monitoring. Diabetes technology & therapeutics. 2018 Aug 1;20(8):541-9.
20. Friedman JG, Cardona Matos Z, Szmuilowicz ED, Aleppo G. Use of Continuous Glucose Monitors to Manage Type 1 Diabetes Mellitus: Progress, Challenges, and Recommendations. Pharmgenomics Pers Med. 2023 Mar 31;16:263-276.
21. Halford J, Harris C. Determining clinical and psychological benefits and barriers with continuous glucose monitoring therapy. Diabetes technology & therapeutics. 2010 Mar 1;12(3):201-5.