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Short Communication

Patient-reported barriers to continuous glucose monitor use in a pediatric diabetes center in Oregon

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ABSTRACT

Continuous glucose monitor (CGM) use has been shown to improve glycemic control and diabetes adherence. However, individual and systemic level barriers to CGM use may influence a patient's decision to use this technology. Thus, understanding these barriers can lead to development of strategies to overcome potential obstacles. Our study was performed at the Harold Schnitzer Diabetes Health Center (HSDHC) in Portland, Oregon, the largest academic medical center in Oregon. Patients or caregivers of patients with type 1 diabetes ≥ 6 months completed a survey including both qualitative and quantitative sections regarding the patient's current glucose monitoring system and general attitude toward CGM use. The survey included the validated glucose monitoring system satisfaction survey (GMSS-T1D) in addition to qualitative sections focused on self-identified barriers to CGM use. A total of 69 out of 114 patients completed the survey. Participants ranged from 3-19 years old, with mean age of 12.6 years. Of those surveyed, 70% were CGM users and 30% were standard glucose monitor (SGM) users, with 64% of SGM users having previously used a CGM. Reported barriers to CGM use were grouped into categories for comparison. Notably, a similar percentage of current (40%) and previous (33%) CGM users reported healthcare system-related barriers to CGM use as a major barrier. Prior CGM users (40%) reported issues with the device itself, while only 20% of current CGM users identified this as a barrier. Despite these identified barriers, current CGM users in our cohort reported higher device satisfaction and had significantly better glycemic control compared to SGM users. This study identifies potentially actionable barriers to CGM use that can be addressed proactively by healthcare providers to promote increased utilization in the pediatric population.

KEYWORDS: continuous glucose monitor, barriers, pediatrics, diabetes.

ABBREVIATIONS

CGM	:	Continuous glucose monitor
SGM	:	Standard glucose monitor
GMSS-T1D	:	Glucose monitoring system satisfaction survey

INTRODUCTION

As the frequency of diabetes in children continues to increase, so too has the development of diabetes technology to improve quality of life and health outcomes. Over the past decade alone, advancements in diabetes devices including the continuous glucose monitor (CGM) increased adherence while offering flexibility and improved treatment satisfaction. In the pediatric population, the utilization of CGM has allowed for reduced

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finger sticks, remote monitoring, and detecting glucose trends to better predict adverse events such as severe hypoglycemia [1]. Beyond improving quality of life measures, CGM use has also been shown to improve glycemic control which has downstream effects on complication rates and overall health outcomes [2]. Given this, there has been a push to consider CGM as the standard of care for blood glucose monitoring from onset of diabetes diagnosis.

Previous studies have demonstrated that despite reported benefits of CGM use, various systemic and individual barriers may limit device utilization [1]. Hilliard et al. in 2019 surveyed parents of children ranging from 1 to 8 years of age and found that device issues including painful insertion sites, lost signal data, and frequent device alarms were reported challenges [1]. Other studies have since demonstrated race-related barriers to CGM utilization with lower CGM use and continuation in non-Hispanic black children compared to non-Hispanic white children [3]. There remains a gap in the understanding of patient-identified barriers to CGM usage and decision to discontinue device use. Thus, the aim of this study was to measure patient satisfaction and identify patient reported barriers to CGM usage in patients of a large pediatric diabetes center in Portland, Oregon. In addition, we explored the correlation of glycemic control with the type of glucose monitor used.

MATERIALS AND METHODS

This was a cross-sectional study which utilized patient survey responses and retrospective chart review. Patients with type 1 diabetes ≥ 6 months were recruited at the Harold Schnitzer Diabetes Health Center and asked to complete a survey which incorporated the validated glucose monitoring system satisfaction survey (GMSS-T1D), a fifteen-item quantitative scale investigating four domains including openness, emotional burden, behavioral burden, and trust in user's current glucose monitor system [4]. In addition to the GMSS-T1D survey, additional qualitative sections focused on assessing patient satisfaction and barriers to CGM and standard glucose meter (SGM) use were included. Dexcom G6 model was used by 95% of current CGM users with the remainder utilizing Freestyle Libre or Dexcom G5 model. Exclusion criteria was defined as patients with newly diagnosed diabetes with less than 6 months of glucose monitoring to ensure that the newly diagnosed patients have enough time to adjust to using a new device.

The original plan was for the authors to gather surveys from patients and family members during their scheduled diabetes visits. Due to the COVID pandemic, the study design was changed to include electronic survey distribution as well.

A total of 69 out of 114 eligible patients were recruited between September 2020 and June 2021. Survey return rate was 97% for in-office distribution and 67% for online distribution. All data was stored in a secure database in Excel spreadsheet form. Statistical analysis by two-sample t-test was performed where appropriate. In addition, qualitative data was independently reviewed by two members of the team (JP and IGB), and it was stratified based on relevant thematic categories they represented.

RESULTS AND DISCUSSION

Study participant demographics are outlined in Table 1. Using the 4 clinical subscales of the GMSS, patient's responses were as follows:

1. Openness: 66% of CGM users compared to 25% of SGM users reported feeling more open to new experiences with current monitors. Similarly, 81% of CGM users vs 30% of SGM users felt current monitors allowed for more spontaneity in life, and 85% of CGM users vs 40% of SGM users felt less restricted by their diabetes and blood sugar monitoring device. In response to the question of satisfaction with current monitors and how things are going with diabetes, 89% of CGM users compared to 55% of SGM reported device satisfaction.
2. Emotional burden: Responses indicated neither monitor was burdensome. However, SGM users reported more frustration (25%) and worry (5%) compared to CGM users (6% and 0%, respectively).
3. Behavioral burden: 15% of SGM users reported SGM was too much of a hassle to

Table 1. Participant demographics at baseline.

Baseline characteristic	N	%
Total participants	69	---
Current CGM users	47	68%
Current SGM users	22	32%
Past CGM user (among current SGM users)	15	22%
Age range	3-19 years	
Sex		
Male	37	53%
Female	32	47%
Insurance		
Medicaid	45	65%
Commercial	24	35%
A1C range	6.1-15.3%	
Mean A1C		
CGM users	8.2%	
SGM users	9.8%	

Participant demographics of CGM and SGM users, N = 69.
Abbreviations: CGM = Continuous glucose monitor, SGM = Standard glucose monitor.

use compared to 0% of CGM users. Similarly, 15% of SGM users felt their monitors were time consuming compared to 0% of CGM users.

4. Trust: 10% of SGM vs 6% of CGM users felt their current blood glucose monitor did not seem accurate with 10% of SGM vs 4% CGM users identifying their current monitor reported untrustworthy numbers. However, 4% of CGM users vs 0% of SGM users felt their current monitor reported numbers that "don't make sense" highlighting slight differences between the two groups.

Analysis of the qualitative data showed that common barriers to CGM use could be grouped into the following categories: healthcare system-related issues, device problems, physical difficulties, annoyance, and lack of trust in the device.

Healthcare system barriers included difficulty in obtaining the device due to limited insurance coverage and high costs, coordinating prescriptions, and reliability of durable medical equipment companies. Of the 47 current CGM users, 19 (40%) reported having difficulties using CGM. Out of those 19, 13 participants (68.4%) identified healthcare system barriers as the issue. In regards to device problems, eight responses (42.1%) indicated issues with transmitter disconnection, failure of sensors, and sensors falling off. Seven responses (36.8%) were related to physical difficulties such as pain, bleeding, adhesive reactions, skin breakdown and limited placement sites.

Four responses (21.0%) were related to being annoyed with CGM use; however none of the responses cited alarms as a reason. Lastly, three

respondents (15.8%) reported lack of trust with the CGM as a barrier.

Of the 15 previous CGM users who are currently using SGM, 5 participants (33.3%) reported healthcare system barriers in the past. Five (33.3%) reported trying CGM in the past but cited issues with the sensor falling off as a deterrent to use. Five (33.3%) reported physical reasons of pain and not wanting a device on the body as reasons for not using CGM. Participants whose families cited physical barriers as a primary barrier were mostly under the age of 8. Six responses (40.0%) were related to user difficulty and annoyance. This included calibration, insertion, time consumption, and inefficiency. Three (20.0%) responded they did not trust the device.

Due to the small sample size, none of the described inter-group differences reached statistical significance. However, our study analysis demonstrated a significant difference (p-value 0.005) in mean A1c between CGM and SGM users with values of 8.2% vs 9.8%, respectively.

Limitations of this study include smaller sample size, lack of stratification of CGM use based on racial background, and data gathered from a single diabetes center limiting generalizability. Due to small sample size meaningful statistical analysis was limited. Future directions could also include stratification by race, socioeconomic status, and age group.

CONCLUSION

Our study provides further insight into the patient perceived barriers to CGM utilization in a pediatric population in Oregon. Specifically, our results highlight the healthcare system challenges that exist with CGM use, and they describe other actionable barriers that can be addressed by the health care team.

Prior studies including that by Messer *et al*. in 2020, found that non-modifiable factors including device cost and insurance coverage issues were most frequently reported amongst adolescent patients [5]. Within our study, both current and previous CGM users reported difficulties with navigating the healthcare system, including obtaining device supplies as a challenge. This is a critical barrier to understand given that healthcare disparities can be further widened if patients feel overwhelmed by the steps required to obtain a CGM device in the first place.

Our results demonstrated a significant difference in the mean A1c for CGM users versus SGM users, further highlighting the positive impact on glycemic control in those utilizing CGM technology. Thus, this finding adds to the argument for making CGM monitoring as a standard of care for pediatric patients.

Current SGM/previous CGM users group expressed more ‘annoyance’ with the CGM device itself compared to current users. We propose that this is an actionable barrier that highlights the importance of proper training to troubleshoot some of these challenges. It is also of note that the CGM users in this study reported the use of Dexcom G6, Dexcom G5, or Freestyle Libre. With newer devices currently available (i.e. Dexcom G7 or Freestyle Libre 3), some of the previous barriers cited may become less burdensome.

In conclusion, despite reported challenges, CGM users still reported higher satisfaction with their device overall as well as better glycemic control. CGM use in pediatrics became more prevalent across the US in the past several years, and it is positively impacting glycemic control [6]. Identifying and understanding actionable barriers to CGM uptake in pediatrics can help to promote increased utilization of this technology.

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

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