Real-Time Continuous Glucose Monitoring in Type 1 Diabetes: A Qualitative Framework Analysis of Patient Narratives

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OBJECTIVE

This study analyzed narratives about experiences of real-time continuous glucose monitoring (CGM) in people with type 1 diabetes.

RESEARCH DESIGN AND METHODS

People with type 1 diabetes using CGM and caregivers completed an online survey. Questions included duration of CGM, frequency of sensor wear, funding, and a free narrative about experiences or views about CGM. We used qualitative framework analysis to analyze 100 responses; 50% of participants were aged ≥18 years.

RESULTS

Most participants (87%) used CGM with insulin pump therapy, 71% used sensors ≥75% of the time, and 66% received funding for CGM from the National Health Service. Four themes were identified: *1*) metabolic control, *2*) living with CGM (work and school, sleep, exercise, nutrition, frequency of self-monitoring of blood glucose [SMBG]), *3*) psychological issues and patient/caregiver attitudes, and *4*) barriers to CGM use (technical issues, financial issues, attitudes of healthcare professionals toward CGM). Despite some hassles, experiences were overwhelmingly positive, with improved glycemic control, diet and exercise management, quality of life, and physical and psychological well-being, as well as reduced frequency of SMBG. Technical problems included sensor inaccuracy and unreliability, and "alarm fatigue." The advantages of CGM used with an insulin pump with automatic suspension of insulin delivery during hypoglycemia were recorded by several participants, noting reduced hypoglycemia frequency and fear of nocturnal hypoglycemia.

CONCLUSIONS

Patient and caregiver narratives indicate that CGM is a valuable addition to diabetes care for many with type 1 diabetes.

Continuous glucose monitoring (CGM) involves a subcutaneously implanted enzyme electrode that senses interstitial fluid as a proxy for blood glucose levels. CGM can be used for short-term, retrospective analysis of glycemic control by healthcare professionals ("professional" or "diagnostic" CGM), or the signal can be wirelessly transmitted to a wearable or hand-held receiver or to a compatible insulin infusion pump ("personal" or "real-time" CGM) (1,2). In recent years, CGM has also been

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coupled to an insulin pump that can automatically suspend the basal insulin infusion for up to 2 h in the event of sensor-detected hypoglycemia (3,4).

Meta-analysis of randomized controlled trials (RCTs) comparing CGM versus conventional self-monitoring of blood glucose (SMBG) indicates that HbA_{1c} is lower with CGM (5). There is also emerging evidence for reduced mild-to-moderate (5,6) and severe hypoglycemia (7,8) when CGM is used with multiple daily insulin injections, insulin pump therapy, or low-glucose insulin-suspend (LGS) pumps.

Although patient satisfaction and quality of life with CGM have been explored through questionnaire-based studies (9–14), much less is known about patients' and caregivers' lived experiences of real-time CGM, when described in their own words ("narratives"). Such information informs the debate on achieving quality in healthcare by adding patient-centered data on perceived treatment satisfaction, quality of life, well-being, adverse effects, problems, complications, and ease-of-use to the objective evidence of clinical effectiveness.

The purpose of this study was to understand the range of user perceptions and experiences of real-time CGM use in type 1 diabetes, using qualitative framework analysis of patient narratives.

RESEARCH DESIGN AND METHODS

Participants

An online survey (Supplementary Table 1) was designed to capture experiences of people or caregivers of people with type 1 diabetes using real-time CGM. The survey was advertised via various sources, including INPUT Patient Advocacy (a patient-led charity supporting access to diabetes technology), Insulin Pumpers UK (an online community promoting insulin pump therapy), Children with Diabetes UK (a carer-led support group for families of children with diabetes), and JDRF UK (a type 1 diabetes charity). We analyzed 100 anonymous responses, based on sampling saturation (no new themes emerged for responses 90–100). The study was conducted according to agreed ethical principles for good practice in service review (15).

Survey Questions

Questions 1–8 of the survey asked about participant age, sex, duration of diabetes, duration of CGM, reasons for starting CGM, average days of sensor wear per month, current funding (i.e., National Health Service [NHS] or self-funding), and CGM manufacturer and model (if known). The main basis of this report is the responses to question 9, containing self-reported views of the patient/caregiver:

> Please describe in your own words your personal experience with CGM, including any benefits, problems or drawbacks to using the glucose sensor. Feel free to go into as much or as little detail as you wish. (These might be concerned with your diabetes, aspects of your life or relationships at home, with the family, with the hospital or healthcare professionals or at work, your health and well being, what you feel or what others feel, or any other positive or negative aspects of CGM that you would like to mention.)

Survey Analysis

We analyzed responses to question 9 using framework analysis (16), a rigorous five-stage method for analyzing qualitative data (16–18). This was performed by a clinical diabetologist with extensive experience in diabetes technology, including CGM (J.C.P.), a person with type 1 diabetes who had been using CGM for several years and who (to avoid bias) did not herself complete the survey (M.F.H.), and a social scientist with extensive expertise in qualitative data analysis (K.S.).

The five stages to framework analysis (16) were:

1. Familiarization—we familiarized ourselves with the responses by reading completed questionnaires.
2. Identifying a thematic framework—key themes contained within responses were delineated. A priori issues focusing on benefits and problems and study aims were also used to develop the thematic framework.
3. Indexing—responses were indexed by copying all relevant participant quotes from questionnaires into a Word document under appropriate themes/subthemes, identified by participant number.
4. Charting—we then iteratively reviewed and revised the initial framework (e.g., abandoning initial benefit/problem themes because participants viewed some themes as either benefits or problems; for example, alarms) and agreed on a final four-theme framework with subthemes.
5. Mapping and interpretation—we then charted the themes with a summary of the main descriptive comments and developed an explanatory account.

The index of all responses and framework history is available from the authors on request.

RESULTS

Table 1 reports the characteristics of people responding to the survey. There were equal numbers of adults (≥18 years of age) with type 1 diabetes (n = 50) and caregivers of children with type 1 diabetes (n = 50), with a similar sex distribution. CGM duration did not differ between children and adults (median [range]: 1.71 [0.1–7.4] vs. 2.10 [0.1–7.5] years, respectively). Most participants used CGM in conjunction with insulin pump therapy (87%), and 71% used the sensor for 75–100% days/month. Two-thirds received partial or full NHS funding for CGM; the remainder were self-funding.

We identified four main CGM themes from the responses (Table 2): *1*) metabolic control, *2*) living with CGM (work and school, sleep, exercise, nutrition, frequency of SMBG), *3*) psychological issues and patient/caregiver attitudes, and *4*) barriers to CGM use (technical issues, financial issues, and attitudes of healthcare professionals).

Theme 1—Metabolic Control

All respondents who mentioned diabetes control (37% of participants) noted that CGM helped them achieve better control than with SMBG, with lower HbA_{1c} and/or blood glucose levels. Some also noted reduced blood glucose variability:

> *Parent of female child aged 4 years; duration of CGM 2.1 years:* "Her HbA_{1c} has dropped a little (probably 0.5–1% on average [5–9 mmol/mol]), but we are happier that it is achieved with much less variation in blood glucose levels."

Participants (22%) also mentioned the value of detecting or predicting hypoglycemia using CGM and a reduction in frequency and/or severity of hypoglycemic events:

> *Female patient aged 65 years, duration of CGM 1.8 years:* "I have not had a severe hypo for 4 months and only one when I needed medical help in 18 months of usage, previously I was in hospital 2 to 3 times a month."

Table 1—Characteristics of patients responding to the survey

Age (years)	
Children (*n* = 50, 48% male)	10.1 ± 4.1 (3–17)
Adults (*n* = 50, 46% male)	44.4 ± 13.9 (18–76)
Duration of diabetes (years)	
Children	4.4 (1.1–14.7)
Adults	26.7 (1.7–40.9)
Duration of CGM (years)	
Children	1.7 (0.1–7.4)
Adults	2.1 (0.1–7.5)
Insulin regimen (% patients)	
CSII	87
MDI	2
CSII and MDI	11
Sensor usage (% patients)	
75–100% days/month	71
50–75% days/month	12
25–50% days/month	7
<25% days/month	10
CGM system used (% patients)	
Medtronic Veo/Enlite	38
Medtronic Guardian Real-Time/Enlite	16
Medtronic 522/722/Enlite	11
Medtronic Veo/Sof-Sensor	10
Dexcom G4 Platinum	10
Dexcom Seven Plus	6
Animas Vibe/Dexcom	5
Abbott Navigator (I)	2
Medtronic 522/722/Sof-Sensor	2
Funding (% patients)	
NHS (at least partial)	67
Self-funding	33

Data are mean ± SD or median (range), unless otherwise stated. CSII, continuous subcutaneous insulin infusion; MDI, multiple daily insulin injections.

With respect to how patients use CGM to improve glycemic control, the most frequent comments related to how participants assess patterns in glycemia, together with alerts, trend arrows, and computer downloads, to understand the causes of poor diabetes control and the effects of alterations to their basal and bolus insulin doses. Complete accuracy of individual readings was regarded as less important than trends. CGM was thought to "fill in the gaps" between intermittent SMBG and provide greater understanding of the complexities of diabetes:

> *Parent of child aged 11 years, duration of CGM 1.2 years:* "And it is nice (big time) to be able to look and see if the levels are flat or going up/down without a fingerprick. Total accuracy (is) not the thing, the trending/direction is the thing."

Theme 2—Living With CGM

Work and School

The hypoglycemia warnings and alerts of CGM were thought by several respondents to be particularly useful and to give users confidence while driving a motor vehicle or while at work (16% of adults):

> *Female patient aged 56 years, duration of CGM 4.1 years:* "Also good protection when driving, as I don't always have hypo warning signs. Much easier to work effectively, as no (longer) need to keep stopping and checking BG (blood glucose) via blood tests—also makes my condition more 'invisible' for this reason, which is useful socially."

There were, however, mixed reports from parents about the use of CGM at school. Most reported it could help at school, giving children more self-confidence and independence, and helping with managing sleepovers, parties, and sick days:

> *Parent of female child aged 7 years, duration of CGM 1.75 years:* "For my daughter it gives her the confidence to do all the things that any normal 7-year-old would be doing. For example, going to parties or friends' houses WITHOUT mum tagging along. It gives our friends (other parents) the confidence to look after her. It also gives the school confidence when caring for her."

Others, however, noted it might disrupt school life because the school can think the child's diabetes is problematic when alarms sound:

> *Parent of male child aged 8 years, duration of CGM 2.5 years:* "Cons—school thinking diabetes worse, as they (are) aware of alarms when they wouldn't be if (he) had no sensor, as lots of highs and lows would be missed."

Sleep

Most participants who mentioned sleep (81%) wrote that they were able to sleep more easily, with less disturbance and a feeling of safety, with CGM. Indeed, some were unable to sleep properly if not using CGM. The advantages of the LGS pump used in combination with CGM were recorded by several participants, who felt that detection of hypoglycemia during the night and suspension of the basal rate by this technology had saved their life or that of their child and had taken away the fear of hypoglycemia:

> *Parent of female child aged 12 years, duration of CGM 6.1 years:* "If for any reason we have no sensor in overnight, I don't sleep (I'm a single mum). The low suspend is a life-saving piece of equipment and I would never be without that. It is a no-brainer really that this is superior to anything else, at the moment, on the market—it saves lives. I have slept through alarms and woken to find my daughter's pump suspended for a few hours whilst her levels come up from the very low levels. It is fantastic."

Some participants mentioned that alarms could disturb sleep (10% of those mentioning sleep) and that sleep could produce technical problems, notably, occasional sensor cutout or false-low values if lying on the sensor in bed.

Exercise

Participants reported that CGM facilitated maintenance of target-range blood glucose levels during sport or physical exercise, without the use of extra SMBG tests, and it allowed children to do sport more independently. The need to avoid damage to the sensor/transmitter during sport was noted. The effects of sport and

Table 2—Themes and subthemes, with summary of main views expressed by respondents for each theme

1. Metabolic control
   - Better control with lower HbA_{1c} and reduced blood glucose variability
   - Detection or prediction of hypoglycemia and reduced frequency and/or severity of hypoglycemia
   - Patients use CGM to detect trends and patterns, "total accuracy not the thing," fuller picture than SMBG, helps adjustment of basal and bolus insulin
2. Living with CGM
   - Work and school
     - Hypoglycemia alerts give confidence while driving and at work
     - Usually gives confidence and independence at school, but for some might disrupt school life
   - Sleep
     - Easier to sleep and feel safe at night. CGM with LGS can be a "life-saver" and reduces fear of nocturnal hypoglycemia
     - Alarms can disturb sleep, lying on sensor can produce aberrant readings
   - Exercise
     - Better control during exercise and sport, enables competitive sport, and independent sport in children
     - Need to avoid damage to sensor during exercise
   - Nutrition
     - Seeing effect of foods on blood glucose motivates dietary habits, encourages less snacking, use of different bolus options and dose timings
     - Helps reduce postprandial blood glucose
   - Frequency of SMBG
     - Reduced number of SMBG tests usually needed
3. Psychological issues and patient/caregiver attitudes
   - Reduced stress for patient and caregiver, reassurance and security, more confidence and independence, improved energy, mood, and quality of life
   - Negatives for some are stress of viewing poor control and perceived failures to manage diabetes and obsession with data
   - Most understand and accept limitations
   - Positives thought to outweigh negatives, considered hard work but worth it
   - Most have overwhelmingly positive view of CGM
   - Frequent descriptions are: "I love my CGM," "would not be without it," "invaluable," "best thing that happened to me," "life changing," "should be available to all who want it"
4. Barriers to CGM use
   - Technical issues
     - Accuracy and reliability
       - Most believe sensors are not accurate and reliable enough
       - Contribution of lag time usually known and acknowledged
       - Sensor lifetime can be less than expected
       - Time of calibration important
     - Alarms and alerts
       - Most would like louder alarms
       - Predictive alarms and trend arrows very valuable but too many alarms are annoying and intrusive, some turn off alarms
     - Other technical issues
       - Insertion uncomfortable/painful for some
       - Some sensitive to tape
       - Adhesion problems sometimes occur
       - More kit to wear
       - Difficulty of interpreting data/graphs
       - Time needed to review and think about data
   - Financial issues
     - Expensive for those self-funding
     - Lack of standardized NHS commissioning for ongoing use of CGM is frustrating
     - If less expensive, would be used more
   - Healthcare professionals' attitudes
     - Many hospital staff are supportive and helpful, but others have poor knowledge about CGM and training can be poor
     - Some HCPs have negative reactions, consider it to be "waste of money," "untested," or "unsuitable for under 18s"
     - GPs need to be better informed

GP, general practitioner; HCP, healthcare professional.

exercise on blood glucose levels were felt to be more easily seen with CGM, the trend indications being particularly useful:

> *Female patient aged 63 years, duration of CGM 1.7 years:* "One of the advantages is managing my BG during exercise—I am able to monitor while at the gym without fingersticks every 5 minutes and can come out of the gym with virtually the same BG as when I went in."

Nutrition

Participants were positive about the value of CGM when managing diet. They could see the effect of different foods on blood glucose levels, encouraging them to snack less frequently and providing motivation for better control at meals and the freedom to experiment with food types, bolus timings, and profiles:

> *Male patient aged 26 years, duration of CGM 0.8 years:* "Being able to see exactly what impact different foods have on my blood sugar over several hours. I have

gone from spiking over 20 (mmol/L) 2 hours post-breakfast to a high of ~12 about 90 minutes after eating, with a 2-hour reading of <10."

Frequency of SMBG

Ten percent of all participants wrote that CGM allowed them to reduce the frequency of SMBG (1% increased frequency):

Parent of child aged 9 years, duration of CGM 3.6 years: "It also cuts down on the number of finger tests I do as I can see if the blood sugar level is steady, heading upwards or downwards without having to keep testing."

Theme 3—Psychological Issues and Patient/Caregiver Attitudes

Positive and negative psychological issues related to CGM use were both reported. Beneficial psychological features were mentioned by 52% of all participants (9% negative). Reduction in stress and anxiety for both patients and caregivers was common, with many reporting a feeling of reassurance and security and being "more normal." "Peace of mind" was mentioned frequently. CGM users also reported more confidence in managing their diabetes, more freedom and independence in their lives, and improved mood, energy, and general quality of life:

Parent of male child aged 5 years, duration of CGM 1.25 years: "The psychological impact was huge for us and our son. We feel that we can listen to our son's needs much better and he feels more in control of his own body. He loves it and says it is his best friend. It gives him freedom to be in another room at home and not feel 'watched,' which helps him gain confidence. When we don't have sensors on, it feels so much more terrifying for us all and my son hates feeling that out of control. It gives him a 'voice,' if that makes sense."

On the other hand, some respondents noted the stress of always being aware of diabetes results and sometimes the perceived failures to control diabetes. Some felt that CGM puts a child under more pressure and causes the child to feel different from other children. Several participants mentioned the risk of becoming obsessed with CGM data:

Parent of male child aged 3 years, duration of CGM 2.5 years: "It can be quite draining having sensors. You are always aware of BGs and worry more about levels."

Most participants and caregivers understood and were realistic about the limitations of the system and thought that the positives outweighed the negatives. Typically, most thought that, despite the hard work involved, the "benefits were more than the sum of the parts":

Female patient aged 19 years, duration of CGM 4.2 years: "However, despite many of the disadvantages, the benefits are so key to managing my diabetes that I cannot imagine not using sensors and have come to depend on them greatly for managing my diabetes."

There were numerous comments from participants that they "loved" their CGM, that it was "wonderful" or "fabulous," "invaluable," and was "the best thing that happened to me." Many noted the effect on lifestyle—thinking that it was "life changing," or had given them or their child their "life back." One person said that it was "like her guardian angel" and that it "should be available to all who want it":

Female patient aged 39 years, duration of CGM 3.1 years: "CGM has changed my life. Prior to starting it I could not be left on my own for fear of an unpredictable hypo. Since starting it, my life has changed totally for the better."

Only one person had a less positive view in this theme:

Male patient aged 46 years, duration of CGM 1.25 years: "Hated being on (the) sensor, (and) don't wish to be reminded of diabetes."

Theme 4—Barriers to CGM Use

Technical Issues

Accuracy and Reliability. A minority thought CGM was generally accurate. Most remarked that reliability was inconsistent, with inaccuracy at times, incorrect alarms, and sensor failure occurring before the expected lifetime of 6–7 days (86% of those mentioning this issue, 32% of all participants). Several people also reported the need for appropriate calibration (when the blood glucose is not changing rapidly). Many acknowledged the time lag between blood glucose and sensor changes as one reason for apparent inaccuracies:

Female patient aged 57 years, duration of CGM 2.1 years: "The principle of CGM is wonderful but sometimes the results do not always relate to my BG levels on testing or how I feel, i.e., my BG can be much lower and I have a symptomatic hypo which does not reflect the result on the sensor. Even though there is a time delay between peripheral BG testing and interstitial BG results."

Several who wrote about CGM inaccuracy and unreliability, nevertheless, enjoyed a positive experience with improving control.

Alarms and Alerts. There were several comments on the advantages of predictive alarms for hypoglycemia, but many would like the alarms to be louder, at least at night (8% of all respondents and 28% of alarm issues). There were also many negative comments about alarms being annoying, the intrusion of alarms, disturbed sleep, and a life "living by alarms" (15% of all respondents and 52% of alarm issues):

Female patient aged 58 years, duration of CGM 3.1 years: "Predictive low alerts (are) great for preventing hypos."

Parent of female child aged 6 years, duration of CGM 0.75 years: "Can't always hear the alarms during the night when we are sleeping and daughter will sleep through them."

Other Technical Issues. Some participants found insertion of the sensor uncomfortable, painful, or "fiddly" and reported itchiness or sensitivity to sensor mount adhesives, adhesion problems, and dislodgement or catching the sensor on clothing. Some pump users disliked wearing an additional device:

Parent of female child aged 9 years, duration of CGM 1.7 years: "The negative side of it is wearing an extra piece of equipment and also the insertion of the sensor (for our daughter)."

Several users also commented on the complexity of interpreting CGM data and the time required to do so.

Financial Issues

Those self-funding usually commented that CGM was too expensive, whereas some NHS-funded participants were worried that funding might be withdrawn because of cost. Some felt that, if it were less expensive, CGM would be more commonly used. There was also dissatisfaction from some respondents that (for them) the NHS would not fund it:

> *Male patient aged 23 years, duration of CGM 3.2 years:* "I love CGM, but I am frustrated that the NHS won't fund it for me. I worry that I may have to stop using my CGM when finances get tight."

Healthcare Professionals' Attitudes

Although many healthcare professionals were thought by patients/caregivers to be supportive and helpful, some participants reported that they had met a negative reaction from diabetes care professionals, with the endocrinologist thinking it a waste of money or even giving patients or caregivers erroneous information ("untrialled and unlicensed in under 18s"):

> *Parent of child aged 6 years, duration of CGM 0.25 years:* "Met very, very negative reaction from hospital who are angry we purchased and are using (the) system."

Although many hospital staff were said to give good support and training in CGM, more often diabetes teams were thought to not know enough about the technology, to express negative attitudes, and to offer inadequate training:

> *Female patient aged 63 years, duration of CGM 1.7 years:* "My diabetes team know absolutely nothing about sensors and I am currently helping them to understand the benefits and how they work."

CONCLUSIONS

We report here a large-scale qualitative analysis of unprompted patient narratives on real-time CGM, based on routine home use rather than clinical trials. Through themes related to metabolic control, life on CGM, and barriers to CGM, patients and caregivers recorded, despite various hassles, an overwhelmingly positive response, with noted improvements in HbA_{1c} and hypoglycemia frequency, psychological state, quality of life and well-being, sleeping, diabetes management during exercise, understanding of glycemic effect of food, and in social participation at home, work, and school.

A striking finding was the dichotomy of responses sometimes elicited for the same experience or CGM feature. For instance, positive and negative responses were both noted for alarms—helpful when signaling hypoglycemia but annoying when repeatedly sounding during the night.

The reduction in HbA_{1c} and hypoglycemia with CGM mentioned by participants is consistent with recent RCTs (5,6). Several publications have reported treatment satisfaction or quality of life during CGM in trial and clinic participants (9–14) by using scales rather than soliciting narratives. On one hand, quality of life in prior reports was often found to be similar to that during SMBG (10), perhaps because trial volunteers tended to have a good quality of life and reasonable glycemic control at baseline (19). On the other hand, patients and caregivers surveyed for this analysis generally reported improved quality of life, perhaps because they were using CGM because of persistent problems with diabetes control that were unmanageable with SMBG, and thus, their initial quality of life, diabetic state, and response to CGM are arguably more representative of patients likely to present in everyday practice.

Although typical comments were that CGM was "life-changing" and participants "would not be without it," anxieties were often reported, such as the risk of obsession with the data and the stress of seeing poor results ("no hiding place"), and technical and psychological problems, such as perceived sensor inaccuracy or unreliability and alarm fatigue, were both recorded. Others have listed similar hassles (irritations and annoying issues) associated with current-generation CGM technologies (14). Several participants in our survey reported that they understood and allowed for the limitations of CGM: many commented that they liked CGM even if it was perceived to be inaccurate—sensor accuracy was not the primary factor in CGM satisfaction. Managing expectations during device training is likely to play a role in achieving treatment goals with CGM.

Participants reported that they use sensor data to improve control by noting patterns and trends rather than individual point-in-time glucose values to alter basal and prandial insulin. Concerning training procedures, some noted a poor level of understanding of CGM among their diabetes care teams and a lack of training offered by some healthcare professionals. Topics that led them to this conclusion might have included inadequate or misleading information about clinical indications and/or benefits and costs/funding mechanisms. Some physicians were described as hostile to the technology and reported as promulgating erroneous information; for example, saying CGM was untrialled in patients under 18 years of age. Improved education among healthcare professionals is therefore a priority for the more appropriate and effective use of CGM.

Our study has some limitations. Responses were based on perception. The concept of "accuracy," for example, was neither prompted nor defined. We do not know whether all patients were aware of the lag time between capillary blood and interstitial glucose and the expected difference in the readings (2), nor do we know how effectively and accurately they performed SMBG or what difference between sensor and SMBG readings they considered "inaccurate." It would be useful in further studies to interview in depth participants, and possibly healthcare professionals, about their views on CGM, including the nature and frequency of reported inaccuracies and unreliabilities.

Participants were partially selected, in that some were informed about the survey because they were associated with, or visited the Web site of, or received communications from a diabetes support group, charity, or patient advocacy organization that might be considered to promote or advise about new technology. There might thus have been bias toward those hoping or expecting CGM to help their problems, although, as we mention above, this population is possibly more representative of real-life clinical practice.

There is also a risk of negative and positive bias with self-report, open-ended surveys. Recall of a problem is likely to be better than for a positive feature (20), so on the one hand, participants might have overemphasized negative issues, such as sensor inaccuracies, at the expense of, say, improved control. On the other hand, participants who were funded, perhaps after lengthy negotiation and appeal, might tend to be biased toward the positive features of CGM to justify the funding.

An additional limitation is that, because our survey was anonymous, we could not verify reported changes in metabolic control against objective measures such as HbA_{1c}. We also acknowledge that our possible preconceptions about CGM (e.g., J.C.P. has previously reported improved HbA_{1c} and hypoglycemia with CGM [5,7], and M.F.H. lives with diabetes and has used CGM) might influence the analysis, but we have aimed to maintain transparency by making all responses and the framework history available for audit.

In conclusion, participants in this survey reported that, although some technical issues and hassles persist with current-generation CGM systems, the user experience is on the whole extremely positive. From the survey results, we hypothesize that improved healthcare professional knowledge of CGM and provision of patient training will improve access to CGM in appropriate groups, and attention to some of the more frequently cited technical issues, such as sensor inaccuracy, will improve patient outcomes.

Duality of Interest. J.C.P. has received speaker and/or consultancy fees from Medtronic, Roche, CeQur, Cellnovo, Eli Lilly, and Novo Nordisk. M.F.H. is chief adviser at INPUT Patient Advocacy, a charity supporting patients' access to diabetes technology (www.inputdiabetes.org.uk), and has received consulting fees from Dexcom and Cellnovo. No other potential conflicts of interest relevant to this article were reported.

Author Contributions. J.C.P. conceived the study and wrote the initial draft of the paper. J.C.P. and M.F.H. led the design of the online survey. K.S. was lead advisor on the framework analysis. All authors analyzed the data, contributed to discussion about the results, and approved the final draft. J.C.P. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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