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Received: 9 February 2023 | Accepted: 18 June 2023

DOI: 10.1111/dme.15168

DIABETIC Medicine

RESEARCH ARTICLE

Do-it-yourself continuous glucose monitoring in people aged 16 to 69 years with type 1 diabetes: A qualitative study

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Funding information
Health Research Council of New Zealand; New Zealand Society for the Study of Diabetes

Abstract

Aims: In many countries, real-time continuous glucose monitoring (rt-CGM) is not funded, and cost presents a barrier to access. A do-it-yourself conversion of intermittently scanned CGM (DIY-CGM) is a cheaper alternative. This qualitative study aimed to explore user experiences with DIY-CGM in people aged 16 to 69 years with type 1 diabetes (T1D).

Methods: Convenience sampling was used to recruit participants for semi-structured virtual interviews exploring experiences of DIY-CGM use. Participants were recruited after completing the intervention arm of a crossover randomised controlled trial that evaluated DIY-CGM versus intermittently scanned CGM (isCGM). Participants were previously naive to DIY-CGM and rt-CGM but not isCGM. The DIY-CGM intervention consisted of a Bluetooth bridge connected to isCGM, adding rt-CGM functionality over 8 weeks. Interviews were transcribed, then thematic analysis was performed.

Results: Interviews were with 12 people aged 16 to 65 years, with T1D: mean age ± SD 43 ± 14 years; baseline mean HbA1c ± SD 60 mmol/mol ± 9.9 (7.6 ± 0.9%) and time in range 59.8% ± 14.8%. Participants perceived that using DIY-CGM improved both glycaemic control and aspects of quality of life. Alarm and trend functionality allowed participants to perceive reduced glycaemic variability overnight and following meals. The addition of a smartwatch increased discrete access to glucose information. There was a high degree of trust in DIY-CGM. Challenges while using DIY-CGM included signal loss during vigorous exercise, alarm fatigue and short battery life.

Conclusions: This study suggests that for users, DIY-CGM appears to be an acceptable alternative method of rt-CGM.

KEYWORDS
continuous glucose monitoring, do-it-yourself, glycaemic control, qualitative, type 1 diabetes

1 | INTRODUCTION

Continuous glucose monitoring (CGM) has overcome the limitations of and largely replaced capillary self-monitoring of blood glucose (SMBG) as the recommended mode of glucose monitoring for type 1 diabetes (T1D) in all major guidelines.[1–3] There are two main types of CGM: intermittently scanned continuous glucose monitoring (isCGM) and real-time CGM (rt-CGM). With the evolution of glucose monitoring technology, rt-CGM is now non-adjunctive, enabling treatment decisions without SMBG confirmation and providing continuous data and glucose alerts. Similarly, isCGM is non-adjunctive but only offers on demand sensor glucose values when scanned.[4] Following the introduction of first-generation isCGM, glycaemic control measured by time in range (TIR) and Hba1c improved and hypoglycaemia frequency decreased compared to SMBG.[5–7] Second-generation isCGM offers an improvement in accuracy and with added glucose threshold alerts. The recently published FLASH-UK study reported this second-generation isCGM system improved HbA1c, TIR and time below range.[8] A recent meta-analysis found CGM users of any form experienced a clinically significant 0.26% HbA1c improvement and 5.4% improvement in TIR when compared to SMBG, the improvement in TIR was most marked for non-adjunctive CGM.[9] isCGM has been compared to rt-CGM in several randomised controlled trials.[10,11] These have shown that rt-CGM users experience an improvement in TIR and reduction in time in hypoglycaemia compared to isCGM.[10,11]

Despite this evidence for the superiority of rtCGM, the dissemination of rt-CGM remains slow globally, due to a variety of cost and regulatory barriers. In response, DIY-CGM is a solution that has evolved from the #WeAreNotWaiting movement. A third-party device (MiaoMiao, MM version 2, Smart Reader, AWX Bio Co. Ltd.) is available[4,12,13] and provides many of the benefits of commercial rt-CGM at a reduced price of US$149.00 per device (which is reusable).[12–14] The device uses Bluetooth to transmit data from a first-generation isCGM sensor to a paired smart device such as a phone or smartwatch (Figure 1). The MM battery life is advertised as 14 days and must be recharged and reset in conjunction with each application of a new isCGM sensor.[4]

While a qualitative meta-synthesis on the impact of continuous glucose monitoring on life with T1D concluded that CGM impacts physical, emotional and relational aspects of life, limited paediatric and no adult studies report on experiences with DIY-CGM.[13,15] In addition, the use of wearable technologies for accessing glucose metrics, such as a smartwatch, is playing an increasing role in diabetes care, but little is known about whether they provide additional benefits to users.

What's new?

- Do-it-yourself continuous glucose monitoring (DIY-CGM) is a user-initiated form of continuous glucose monitoring whose clinical impact in adult patients remains unknown. From this study, DIY-CGM use in adults appears to offer improved quality of life and reduced disease burden.
- The addition of a smartwatch facilitated discrete access to glucose information. There was a high degree of trust in DIY-CGM and a reduced disease burden; however, all participants experienced technical issues that impacted DIY-CGM acceptability.
- This study suggests that DIY-CGM may be an acceptable and convenient form of real-time continuous glucose monitoring for adults in a cost-constrained environment.

Therefore, the aim of the present qualitative study was to explore the lived experience of adults aged 16 to 69 years with T1D who used DIY-CGM (including a smartwatch), their perceived advantages and disadvantages of this device, as well as reasons participants choose to continue or not continue using DIY-CGM.

2 | RESEARCH DESIGN AND METHODS

2.1 | Design

This qualitative descriptive study evaluates the lived experiences of a subsample of participants in a multicentre, randomised, controlled, cross-over trial. The clinical trial aimed to evaluate the clinical efficacy of smartwatch integrated DIY-CGM compared with isCGM, and the protocol has been previously published.[4]

As part of the 8-week intervention arm, participants received and wore DIY-CGM (a MM device attached over consecutive generation 1 Free Style Libre sensors). Glucose information was transmitted to an Android smartphone app (xDrip+) via the MM Bluetooth functionality. A range of Android devices were used by users: the minimum system requirement was to be able to operate xDrip+ and this app then displayed standard CGM data, provided optional safety alerts for hypo- and hyperglycaemia, and relayed information about the rate of rise and fall in an equivalent manner to the trend arrows used with isCGM. Xdrip+ was also connected via Bluetooth with the Fit Bit Versa 2 smartwatch (Fit Bit Inc). The use of an open-source watch face to facilitate

FIGURE 1 How DIY-CGM works.

CGM data transmission added a novel aspect of the primary RCT. The Glance (Ryan Mason 2019) open-source watch face was installed on the smartwatch to conveniently display glucose levels detected by the DIY-CGM system. Intervention group participants also received additional verbal and written xDrip+ installation and troubleshooting instructions, monitoring guidelines, subsequent DIY-CGM training that focused on safety and emphasised regular calibration for accuracy. Initial alarm settings were set to those used in previous DIY-CGM studies,[13,14] but participants could alter the settings to their preference. Participant glucose data were provided to the study team via the opensource app Tidepool (Palo Alto, California) with information being shared with their diabetes care team and care partners with the participant's consent. Figure 1 illustrates how the study devices were connected to each other, as well as to follower devices and cloud-based glucose information storage.

2.2 | Participants and recruitment

Sixty New Zealanders aged 16 to 69 years with T1D for at least 6 months and already using isCGM were recruited to the RCT and sequentially invited via email to participate in the present qualitative study after completion of the DIY-CGM intervention. Recruitment continued until data saturation was reached, defined as no new insights arising in the final two interviews.

Participants received a questionnaire in advance of the face-to-face interview. The questionnaires were developed by authors SS, OP and BW and were piloted with two non-participants (members of the wider research team working as health professional between the ages of 30 and 50 years, identifying as NZ European and including a person with diabetes). The role of the questionnaires was to be used as a guide to facilitate in depth conversation by encouraging participants to reflect on their lived experiences with DIY-CGM.

A question guide for semi-structured interviews was developed from a literature review which included a prior qualitative study regarding DIY-CGM use in children[13] and consensus between study investigators. Interview guides were adapted based on literature review, consensus between investigators with experience of adult and adolescent endocrinology and individual patient's responses to pre-interview questionnaires (Appendices S1 and S2).

Given the nature of the researchers' clinical and research interests in maximising the benefits of diabetes technology, our intention was to generate research findings that were actionable and pragmatic.

2.3 | Data collection

Two authors, OP and SS (Shekhar Sehgal), who are not associated with the participants' usual clinical care, conducted semi-structured interviews via Zoom™ which were audio-recorded and transcribed verbatim. Both authors had completed comprehensive University of Otago qualitative interviewing training. Transcripts were checked for accuracy and were anonymised. All participants were invited to review their transcript: no participants requested changes to their transcripts.

2.4 | Data analysis

Data analysis included both deductive and inductive frames. The first frame focused on participants' experiences in relation to pre-identified areas of interest. This was informed by research team's aim to identify insights of relevance to clinicians. The second frame followed the general inductive approach by Thomas[16] seeking additional topics beyond those captured within the deductive analysis. All interviews were analysed by SS and OP. Both authors read the transcripts independently to familiarise themselves with the data. NVivo11 (QSR International Ltd), a qualitative software package, was used to code the transcripts. SS and OP separately coded to the deductive frame and developed inductive codes based on sections of text that were interpreted as having related meanings. Following this, SS and OP met to compare codes and developed a combined coding framework (see supporting information). Differences in interpretation were resolved via consensus. A small subset of interview transcripts ($n = 3$) were reviewed by co-author (BW) to consolidate and review the accuracy of coding.

3 | RESULTS

From the randomised controlled trial, 12 participants (23% of total) were invited to participate, and all 12 completed the qualitative sub-study, giving a response rate of 100%. Participant demographic and clinical characteristics are shown in Table 1.

Three core categories summarised the key findings: Evolution of DIY-CGM use, Device trust and Challenging user experiences. These were further divided into seven subcategories: Learning to use the device; smartwatch utility and the use of discrete glucose monitoring; disease management informed by DIY-CGM data; Technological malfunction negatively impacting user experience (Device connectivity, Alarm fatigue); Short battery life and workarounds to complete charging; Information sharing; and Trust in DIY-CGM. Tables 2 and 3 present codes within each category, as well as participant quotations.

TABLE 1 Participants' baseline demographic and clinical characteristics.

Gender	
Male	58.3% (7)
Ethnicity	
New Zealand European	91.7% (11)
Other (British)	8.3% (1)
Age (years), range	42.8 ± 14.3 (16 to 69)
Education level	
Postgraduate qualification	16.7% (2)
Tertiary education/undergraduate	33.3% (4)
High school	50.0% (6)
Marital status	
Married	50.0% (6)
Partner/civil union	33.3% (4)
Separated	8.3% (1)
Single	8.3% (1)
Employment status	
Full time	75.0% (9)
Part time	16.7% (2)
Unemployed/retired	8.3% (1)
Mean HbA1c +/−SD	58.9 mmol/mol ± 9.9 (7.6% ± 3%)
Mean time in range	59.8% ± 14.8%
NZ Dep 2018	5.5 ± 3.8 (1–10)
Insulin regimen	
Insulin pump users	58.3% (7)
Multiple daily injections	41.7% (5)

Note: Data are reported as percentage (n), mean ± SD or median (IQR). Age also reported with range. The New Zealand deprivation index is an area-based measure of socio-economic deprivation and has a value from 1 (low deprivation) to 10 (high deprivation).

3.1 | Evolution of DIY-CGM use

3.1.1 | Learning to use the device

Most participants found setting up the DIY-CGM technology relatively straight-forward and reported that the

TABLE 2 Evolution of DIY-CGM use.

Category	Quotes (gender, age)
Device easy to use and set up Using Internet for troubleshooting	1. 'I was able to work through it and I could follow the instructions'. (Male, 40) 2. 'It's fool proof and then you know just have a little tinker around and then the videos online too which is going to Facebook community pages. There was a MiaoMiao page and then there's a Libre MiaoMiao page'. (Male, 39) 3. Like my husband did say yesterday he said oh I'm just 'why do not you just Google it?' and I thought oh well I'm talking to you today so I will not (Female, 54)
Watch utility and use	4. 'I loved it. Especially because I do a lot ... driving to work. I did not have to get my phone out to scan all the time'. (Female, 24) 5. 'I've set for a two-hour meeting with customers and I'm just able to quickly look down at my watch and see where I'm at'. (Male, 40) 6. 'Yes, although I would have preferred if they had integration with a Garmin watch'. (Male, 40) 7. 'I do not even use the watch now because it was so annoying, I could just check my phone'. (Male, 30 years) 8. 'The watch, I cannot wear watches at work because I'm a nurse'. (Female, 24)
Disease management informed by DIY-CGM data Insulin management informed by real-time CGM Increased hypo/hyperglycaemia awareness	9. 'My HbA1c is like 50 now, and having a lot less hypos'. (Female, 24) 10. 'I went from 75% in target range to generally around 95% in target range'. (Female, 54) 11. 'I probably got a little bit less grumpy, because I wasn't as high, as what I, you know like that roller, you know that roller coaster of ups and downs'. (Male, 39) 12. 'So, I had fish and chips and I worked out what would be my split, so I do a 60/40 split within 2 h of eating and that the CGM was awesome to track to see if I had the right sort of mix'. (Male, 39) 13. 'The good side is that it would give you sort of insight to highs and lows before they happened, which is useful to know'. (Male, 40)

TABLE 3 Challenging user experiences calibration and device trust.

Category	Quotations (gender, age)
Device connectivity Signal loss	14. 'I know there was regular issues between connectivity between the phone and the MiaoMiao as well as the phone and the watch' (Male, 30) 15. 'But like thinking about it I found that my smartwatch dropped out quite a bit'. (Male, 38) 16. 'it's the watch would cut out so even if I exercise and I'd have the phone quite close together the watch would still cut out' (Male, 30)
Alarm fatigue	17. 'Alarm fatigue is a bit of an issue, it'd be a nice to have more ability to snooze things, that kind of thing'. (Male, aged 38) 18. 'Like alarms going off and I could not stop them and having a hypo the alarm goes off and it keeps going off and you know you have a hypo, and you are in a bad way anyway. And you just feel like throwing it all out the window'. (Male, 67)
Short battery life Work arounds to complete charging	19. 'Like it never lasts 14 days... But it never lasted as long. By day 6 or 7 days I need to charge but, yeah, it's still better than like you know...' (Female, 54) 20. 'It's still good like we got we got given a charging cable... I sometimes hooked it up while working'. (Male, 38)
Information sharing Calibration Reduced fingerpricking	21. 'I've always been self-managed. And my wife knows what the high and the low is. There's never been any need'. (Male, 69) 22. 'With the MiaoMiao I calibrated it every day in the morning, like I was supposed to, and it was like pretty much on point with my blood sugars'. (Male, 40) 23. 'But I mean, one finger prick you know at least one finger-prick. It's a good day, rather than 10 finger-pricks a day is going to be so much easier anyway'. (Male, 38)
Trust in the device to some degree Trust always Trust occasionally	24. 'It like settles my mind yeah, I'm a lot more stressed when I am without it'. (Female, 24) 25. 'Whereas with the MiaoMiao it's, I like, overall, like totally trust it'. (Male, 38) 26. 'In the first 24 to 48 h do not trust it at all'. (Female, 54)

training and instructions provided by the main RCT study authors were sufficient (quote 1).

Two main challenging areas identified in the set-up process were when participants were installing the xDrip+ application on the smartphone and Glance smartwatch apps. xDrip+ required careful attention when completing the installation steps as the app was not available for download in the Google Play store.

3.1.2 | Using the Internet/alternative sources for troubleshooting

As disconnection and loss of signal were common, some noted not all potential causes were covered in the resources provided in the main RCT (quote 2). As a supplement to the troubleshooting information, half of the participants conducted their own Internet searches to find troubleshooting information to help either the watch or the phone reconnects to each other. While some participants reported that this information was relatively accessible and reliable, others required a significant search through Reddit threads, Facebook MiaoMiao support groups and YouTube videos. Other participants found the Internet less reliable and found the troubleshooting guides and in person contact more user-friendly (quote3).

3.1.3 | Smartwatch utility and use: Discreet glucose monitoring

Participants' experiences using the smartwatch to view glucose data were mostly positive. The primary advantage of using a watch was the ability to check glucose information discretely at work and in meetings (quotes 4 and 5).

Two participants who were recreational runners, thought a wider range of compatible watches would be useful so that they could view glucose and training data on the same device (quote 6).

Some participants reported negative experiences including difficulty with Bluetooth connectivity leading to a preference to use the phone alone (quote 7), while one participant reported not being able to wear a watch at work for safety reasons (quote 8).

3.1.4 | Diabetes management informed by real-time glucose data

All participants reported making changes to their diabetes management using information gathered from the DIY-CGM or Tidepool. Half of the participants reported that they felt that glucose information was more easily accessible on their watches, and as a result, they felt both more aware of their glucose levels and more in control of their diabetes when using DIY-CGM. This increased control was supported by a perceived improvement HbA1c, TIR results and measures of subjective well-being for some participants (quotes 9 and 10). In addition glycaemic variability, referred to by one participant as the 'rollercoaster of highs and lows', was also perceived to be reduced (quote 11).

Four participants stated that they changed their insulin dosing due to information from DIY-CGM. This included changing the timing of their insulin doses, using the DIY-CGM to inform pump suspension (having confirmed hypoglycaemia beforehand by SMBG) and using DIY-CGM to monitor the effect of advanced insulin dosing adjuncts like a split bolus (quote 12). One participant found that she consistently went low after dinner and altered the macronutrient composition of her evening meal following advice from a dietician (quote 13). A small number of participants reported increased hypo- and hyperglycaemia awareness. Most users felt that they had gained more insight or understanding into their glucose patterns as the information provided was continuous and in real-time (quote 14).

3.1.5 | Technological malfunctions negatively impacted user experience

All participants reported DIY-CGM technological difficulties including disrupted connectivity between mobile devices, mobile and watch apps. While these issues were inconvenient, no participants reported serious diabetes-specific incidents because of technological malfunctions.

Many participants reported issues with device connectivity. Loss of connectivity between DIY-CGM and Xdrip+/phone was equally as prevalent as loss of connectivity between smartwatch and phone. Having to reboot or reset the Bluetooth connection was an ongoing issue which hindered performance (quote 15). Three participants reported experiencing signal loss, particularly with their smartwatch, during high-intensity exercise (e.g. Running, Tennis and CrossFit). This was particularly frustrating as they believed more comprehensive glucose information would help them better anticipate their insulin needs during and after exercise (quote 16).

Most participants reported alarm fatigue when wearing the smartwatch during the day and at night. Several participants tried to minimise the frequency of alarms by minimising or snoozing the alarm settings (quote 17). Furthermore, many participants found the alarms related to stale data (no new data have been received from the parent phone device for over 5 min) from the watches disrupted their sleep. As a result, some chose not to wear the smartwatch at night (quote 18).

3.1.6 | Short battery life and workarounds to complete charging

Most participants reported a battery life of less than 14 days (quote 19). All participants reported that the MM communicated better with the other devices when the battery level was 50% and above. This led to several participants finding solutions such as attaching a charging cable when seated at a workstation; however, this solution was not ideal because it reduced mobility and productivity of the user (quote 20).

3.1.7 | Information sharing comfortable with independent management

All participants chose not to use remote monitoring/sharing of their blood glucose information. Motivations for this decision varied between participants. Some participants (3) gave the reason that their spouse trusted them to independently manage their T1D (quote 21).

3.2 | Calibration

Unlike isCGM, DIY-CGM was calibrated once a day by conducting two capillary blood glucose tests separated by 5 min. Many participants felt that the calibration resulted in a reasonably good correlation with both isCGM and SMBG values (quote 22). No participants were inconvenienced by the need for calibration (quote 22). Most participants felt that despite the need for calibration, they needed less self-monitoring of glucose (quote 23).

3.3 | Trust in DIY-CGM

All participants reported that they trusted in the DIY-CGM device to some degree despite experiencing some technical challenges (quote 24). Almost half the participants reported that they always trusted the device completely and almost half said that they trusted it on most occasions with times of reduced trust being when the sensor glucose levels dropped rapidly during exercise or during the first 24–48 h where the sensor-to-phone connectivity tends to be more unstable (quotes 25 and 26). All participants indicated that they intended to continue using either DIY-CGM or RT-CGM after the trial, the one participant not wishing to use the DIY-CGM was transitioning to commercial hybrid closed loop.

4 | DISCUSSION

The present study qualitatively evaluated the experiences of rtCGM naïve adults with T1D aged 16 to 65 years using a smartwatch-integrated DIY-CGM. Overall, DIY-CGM users had the perception of an improved self-management experience compared to isCGM. Specifically, participants perceived an increase in their ability to access glucose information in a variety of settings and used the device functionality in innovative ways to make monitored changes in diet, exercise and insulin dosing. Compared to isCGM use, most participants found that using DIY-CGM reduced their disease burden by removing the need to remember to scan their isCGM sensor, and by alerting them when their glucose levels were out of range.

Data from a range of sources including randomised controlled trial data,[11] review and meta-analysis[9,17] indicate that use of rtCGM compared to isCGM provides advantages in both glycaemic control and patient-reported outcomes. The recently published FLASH-UK study has also demonstrated the benefits of adding alarms to an isCGM system.[8] The present study supported this view by demonstrating user perceptions of improved HbA1c, TIR and the feeling of being more in control of their diabetes with less glycaemic variability. Participants responded positively overall to reduced glycaemic variability and felt that this improved their overall trust in DIY-CGM.

The use of a watch as an adjunct to DIY-CGM was a novel aspect of the study. Users overall perceived this to improve awareness of sensor glucose levels. Smartwatches as a form of wearable technology are being utilised in a variety of health fields including detecting atrial fibrillation and falls prevention and thus can be considered a growth area of wearable healthcare technology.[18,19] There have been attempts to utilise watches to monitor glucose levels since 1999. Early devices such as the Glucowatch G2 were integrated glucose monitors in themselves, but they could not reliably detect hypoglycaemia, had limited accuracy and did not appear to improve glycaemic control.[20,21] More recent watch applications such as the smartwatch Pebble and One Drop integrated both activity trackers and food diaries as additional diabetes management tools.[22,23] The Pebble study evaluated integrating CGM data from a Dexcom G4 device but only a small proof-of-concept study was completed.[22] In our study, some participants found the watch difficult to wear in some work settings and occasionally faced difficulties due to alarm fatigue. Watch technology may make sensor glucose information more accessible, more discrete and provides the potential for greater integration of rtCGM data to optimise diabetes care.

Alarm fatigue has been reported as the most common reason to discontinue rtCGM and has presented barriers in other devices that utilise the technology including both CGM and hybrid closed Loop insulin pumps.[24,25] In prior qualitative and quantitative work, alarms have tended to detract from the overall user experience.[25] Both the recently published NICE guidelines and ACDC guidelines emphasise the use of shared decision making and a personalised care plan whilst introducing CGM and alarms.[26,27]

Given the novel aspect of DIY-CGM, for participants in this qualitative study, there was a high degree of trust in the device. This is like other studies utilising rtCGM and DIY-CGM.[12–14] This in turn led to DIY-CGM-inducing dietary changes, such as monitoring the effectiveness of split bolus dosing with non-sensor augmented pump therapy. This is an excellent example of user-derived innovation changing how existing technology is integrated. This innovation can only occur on a background of device trust, which is an essential aspect of integrating other wearable diabetes technology devices.[28] Trust exists on a continuum and can have many influencing factors, including the perceived confidence in the device exhibited by participants based on the training received and with access to on-call technical support while in the intervention arm of the wider study. However, it is notable that 11/12 participants stated that they intended to keep using the device after the completion of the study, suggesting that they did not feel reliant on study-specific technical support to trust the device in the long term.

Challenges to DIY-CGM use included reduced battery life and impaired connectivity. This impaired the user experience and were like those found in other DIY-CGM studies.[12,14] In terms of connectivity, utilising the DIY-CGM required three separate digital interfaces (Figure 1). If any one of these interfaces fail, no glucose data are visible on the watch. These connectivity challenges may be device or version specific, and future DIY devices will need more seamless and integrated interfaces. These too were commented upon in earlier studies.[12–14] These challenges are frequent in the DIY and watch-related glucose monitoring literature,[22] but our study overcame previous barriers with the non-diabetes functions of the watch operational and no need for manual data entry.[22] These challenges may in turn be reduced by more clinician experience, the publication of externally accepted and validated user guides by the manufacturer and the ability to ask questions to a help portal. The issues highlighted by the use of the Internet for troubleshooting highlight the need for ongoing dialogue between End users, clinicians and developers to reduce errors and deliver a more streamlined DIY-CGM experience. A further method of improving connectivity in the DIY-CGM setup, was the concomitant use of NFC and wireless (Wi-Fi) together to reduce signal loss, that in a prior study appeared to result in less signal loss than using NFC alone.[13]

Previous studies in children made extensive use of remote monitoring, with multiple followers/care partners per participant.[13] In our study, some participants felt that this intruded upon their independence. This finding is also inconsistent with a recent real-world survey that evaluated following in partners of adults and parents in children, which found increased hypoglycaemic confidence and well-being in both groups.[29] Further research in this area, including studies that evaluate the characteristics of non-users of remote monitoring may provide further insight into how this aspect of technology is perceived.

4.1 | Strengths and limitations

There are several strengths of the present study. First, the findings add adult data for the first time and build upon data from a prior qualitative study based on a crossover RCT in children as well as a survey that explored parental experiences with DIY-CGM.[13,14] Both of these works stated an improvement in quality of life following DIY-CGM/CGM use as well as reduced disease burden. Second, all participants were existing isCGM users and were therefore already comfortable with CGM, hence a clear step-wise comparison could be made between these technologies, whereas others have previously focused on experiences with CGM compared to SMBG. The present study had several limitations. Our findings, especially those related to device trust must be interpreted in context of our participants taking part in a clinical trial and may not be generalisable to the wider population of DIY-CGM users. These users often access the devices independently with only informal guidance from user forums for installation and troubleshooting. All participants were of New Zealand European or European descent which may limit transferability to non-European populations.[30] Participants only used DIY-CGM for 2 months. Studies of longer duration are required to evaluate long-term DIY-CGM use and whether technical difficulties seen in the short term, such as device connectivity or alarm fatigue, persist or disappear. This qualitative data while overall positive needs to be supported by published quantitative data. This is to follow.

5 | CONCLUSIONS

The findings from this qualitative study suggest that in adults' rt-CGM in the form of DIY-CGM, including having CGM values displayed on watch face, appears to offer advantages in quality of life and reduced disease burden compared to isCGM. As long as isCGM remains cheaper than most commercial rt-CGM, DIY-CGM has the potential to increase access to rtCGM use, especially if more clinicians and nurse specialists became familiar with its use.

A previous study has shown that rtCGM can reduce inequities in glucose outcomes based on socio-economic status or ethnicity,[31] and therefore a lower cost DIY-CGM has a role as an interim measure while advocacy to improve access for all to rtCGM continues.

ACKNOWLEDGEMENTS

This study was funded by the Department of Women's and Children's Health, Dunedin School of Medicine, University of Otago, New Zealand. Octavia Palmer (OP)'s summer studentship was funded by a New Zealand Society for the Study of Diabetes Summer Studentship Scholarship 2021/2022. SS's PhD is supported by a Health Research Council of New Zealand '2020 Health Delivery Research Career Development Award' and Clinical Research Training Fellowship from the Health Research Council NZ. Some editing assistance was provided by Alex Wilde. Open access publishing facilitated by University of Otago, as part of the Wiley - University of Otago agreement via the Council of Australian University Librarians.

FUNDING INFORMATION

None.

CONFLICT OF INTEREST STATEMENT

None.

DATA AVAILABILITY STATEMENT

The Data in this study is derived from qualitative interviews, data will only be made available following review and approval by relevant regulatory bodies and the consent of the participants on a case-by-case basis.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Sehgal S, Boucsein A, Styles S, et al. Do-it-yourself continuous glucose monitoring in people aged 16 to 69 years with type 1 diabetes: A qualitative study. *Diabet Med*. 2023;00:e15168. doi:10.1111/dme.15168