


# Development of a Novel Tool to Support Engagement With Continuous Glucose Monitoring Systems and Optimize Outcomes

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## Abstract

**Background:** Increasing numbers of people with diabetes, especially those with type 1 diabetes (T1D), are using continuous glucose monitoring (CGM) systems to support their diabetes self-management, yet even so only approximately 30% of individuals with T1D meet the American Diabetes Association HbA1c target of 58 mmol/mol (7.5%) for children and 53 mmol/mol (7.0%) for adults. We aimed to produce a useful tool for people with diabetes to improve personalized understanding of CGM.

**Method:** A brief leaflet titled “Guidelines to Improve Glucose Control Using CGM” was developed for people with diabetes. Semistructured interviews were held with 12 adults with T1D, focusing on their views regarding the relevance, readability, and usability of the newly revised leaflet. Participants were specifically asked to share what they would find most useful in terms of information and advice provided as well as how to make use of that in the context of their own diabetes self-management. Data were analyzed thematically and used to inform revisions of the leaflet content.

**Results:** Data highlighted information and advice needs as well as personalization in terms of own diabetes management.

**Conclusions:** CGM systems are associated with improved medical and psychosocial outcomes, especially when used effectively to meet the individual needs of the user. Ensuring greater understanding of the individual’s expectations when first starting CGM, matching experience and skills to meet those expectations, and tailoring use to the individual needs of each person with diabetes (PWD) are all required to achieve widespread and consistent benefit.

## Keywords

engagement, type 1 diabetes, psychosocial, continuous glucose monitoring

Increasing numbers of people with diabetes, especially those with type 1 diabetes (T1D), are using continuous glucose monitoring (CGM) systems to support their diabetes self-management, yet even so only approximately 30% of individuals with T1D meet the American Diabetes Association HbA1c target of 58 mmol/mol (7.5%) for children and 53 mmol/mol (7.0%) for adults.<sup>1</sup> Recent trials have demonstrated that CGM use contributes to improved glycemic control (including reduced glycemic variability, reduced frequency and severity of hypoglycemia and lower HbA1c) as well as enhanced quality of life.<sup>2–4</sup> Furthermore, CGM users typically report high satisfaction with the technology, with perceived benefits outweighing perceived hassles.<sup>5,6</sup> Still, many people find the sheer amount of data overwhelming and may find CGM use to be too stressful and/or burdensome.<sup>7</sup> Among youths with T1D, for example, Markowitz

and colleagues found that CGM use was associated with greater anxiety and depression scores than usual care.<sup>8</sup> To be fair though, given the rapid development of different CGM systems over recent years, making meaningful comparisons across clinical trials and published research is difficult. What is clear is that CGM uptake is rapidly increasing and that effectiveness, though variable, appears to be broadly

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improving, especially as CGM technology has grown more reliable and accurate<sup>1,9</sup> It is noteworthy that the increasingly simple set-up of newer CGM devices means that users do not require complex training in order to use and benefit from them; therefore, CGM uptake may increase even more substantially in the years to come. The DIAMOND trial, for example, demonstrated that simple training can be effective irrespective of education level, numeracy level or age of participants.<sup>3,4</sup>

At the present time, there are a number of different CGM systems that are available, and they differ in the degree of effort required, intrusiveness into daily life and in the degree and quality of feedback provided. In addition, some CGM systems, for example, allow CGM data to be shared with friends, families, and/or caregivers. What all of these systems have in common is the need for user engagement. More continuous wearing of CGM is—not surprisingly—associated with greater glycemic benefits.<sup>7</sup> In addition, how frequently the individual interacts with the CGM and makes appropriate use of the data available is critical. To achieve the best from any CGM system, it is first necessary to understand what that ‘best’ looks like in the context of individualized self-management, social environment and lived experience. For some, intrusive alarms may prevent effective, long-term engagement with CGM; for others, loss of connectivity is the key frustration. Ensuring that CGM systems are initially set up for the individual and reviewed with these factors in mind, as well as exploring with the new CGM user their specific needs and how those needs will be filled are crucial to effective onboarding and use of the systems. Gehr et al<sup>10</sup> developed a structured training program (SPECTRUM) in Germany to improve acceptance and use of CGM systems. It consists of six training modules, each approximately ninety minutes long. Our aim was to develop a brief clinical tool to assist onboarding in routine care.

## Methods

A brief leaflet titled “Guidelines to Improve Glucose Control Using CGM” was developed for use by participants and healthcare professionals in the DIAMOND trial.<sup>3</sup> The leaflet consisted of ten tips for maximizing the benefit of CGM systems. Following review after the trial, the leaflet was revised in line with feedback.

Semistructured interviews were then held with 12 adults with T1D, focusing on their views regarding the relevance, readability and usability of the newly revised leaflet. Interview scripts were piloted with potential participants prior to use and informed by current literature on the strengths and downsides of CGM systems. Participants were specifically asked to share what they would find most useful in terms of information and advice provided as well as how to make use of that in the context of their own diabetes self-management. Data were analyzed thematically and used to inform revisions of the leaflet content.

## Results

The final version of the newly revised leaflet can be found in Figure 1.

Following review, pilot, and rereview, the final leaflet was revised to focus on critical tips:

- a. Tips. The number of tips or “general guidelines” was reduced to nine: (1) wear the CGM as much as possible; (2) share your data in a way that works for you; (3) make alerts and alarms your friends, not your foes; (4) review your CGM results regularly; (5) know your personal glucose targets; (6) have a solid plan for preventing or responding to hypoglycemia; (7) explore the big, bad world of food (test out what really harms and helps your glucose control); (8) use the trend arrows to help you understand what is really going on; and (9) when diabetes is driving you crazy, remind yourself why you are bothering.
- b. Spaces are provided for recording personal glucose targets (premeal and two hours postmeal) as well as highlighting the standard suggestions for preventing or responding to low blood glucose.
- c. Space is provided for users to identify their personal hopes and desires from using the CGM.
- d. Trend arrows provide a visual representation of the arrows, their meaning, and how to use them alongside other relevant information.

Specific feedback from users has been that the inclusion of personalized targets and information has very much helped them reflect on current challenges and focus on use of the CGM in the context of their everyday life rather than general potential benefits of the system. The ability to include personal reasons for use and specific expectations of CGM facilitated review of those goals and whether experience matched expectation.

## Conclusions

CGM systems are associated with improved biomedical and psychosocial outcomes, especially when used effectively to meet the individual needs of the user. Ensuring greater understanding of the individual’s expectations when first starting CGM, matching experience and skills to meet those expectations, and tailoring use to the individual needs of each person with diabetes (PWD) are all required to achieve widespread and consistent benefit.

## Practice Implications

The Tips to Improve Glucose Control using CGM leaflet is a brief and practical tool for people with diabetes and healthcare professionals that could optimize benefit when first initiating CGM use. Critically, it can perhaps be used as a conversation starter, a useful communication tool to aid understanding of

**Nine Tips...**

**#1: Wear your CGM as much as possible**

The more you wear it and pay attention to it, the more you will be able to understand and control your glucose responses. Use your CGM to find out more about how foods and/or insulin dosing affect your glucose levels.

**#2: Share your data in a way that works for you**

If and when you decide to Share your CGM data, have a conversation ahead of time about boundaries and language that you prefer (e.g., supportive not bossy, helpful not intrusive).

**#3: Make alerts and alarms your friends, not your foes**

First, please don't ignore your alerts and alarms! And after responding to an alarm, take a few minutes to think about what may have caused it (e.g., you ate more or fewer carbs than usual, you were more or less active than usual, when did you last take any insulin?).

If you are getting too many alerts or alarms, you can adjust your settings so that they don't drive you crazy!

**#4: Review your CGM results regularly**

Regular review of your Dexcom Clarity reports can help you see if there are any patterns of highs or lows, helping you decide where—for example—you might want to adjust your insulin basal rates or doses in response.

**#5: Know your personal glucose targets**

If you're not achieving your targets as frequently as you like, please understand it may take a while for things to improve. Be patient!

My pre-meal target is less than \_\_\_\_\_

My peak glucose target is less than \_\_\_\_\_  
(after a meal)

My glucose is too low and requires action if it is less than \_\_\_\_\_

**#6: Have a solid plan for preventing or responding to hypoglycemia**

- Try not to panic and overreact. Take 15–20g glucose and re-check in 15 mins
- Repeat treatment if glucose level is not rising after 20 minutes
- Depending on your own individual needs, a follow-up snack providing 15–20g carbohydrate may be necessary
- If your CGM has predictive alerts, they can provide more time for you to take action to prevent lows

**#7: Explore the big, bad world of food: Test out what really harm<sup>S</sup> and helps your glucose control**

A CGM is the perfect tool for discovering whether foods really raise your glucose or not. On occasion, try out your favourite snack, a new type of meal you've never tried before, or one of those nutritional "no-no's" and find out for yourself whether they are worth it

**#8: Use the trend arrows to help you understand what is really going on**

Whether it concerns something you have recently eaten, an insulin bolus you have just taken or some recent exercise, your CGM's trend arrows can help you understand the direction and speed of your glucose changes:

- Constant: your glucose value is relatively stable
- ↗ Rising: your glucose value is rising and could increase as much as 1.7mmol/l (30 mg/dl) in 15 minutes
- ↑ Rising quickly: your glucose is rising and could increase as much as 2.5 mmol/l (45 mg/dl) in 15 minutes
- ↑↑ Rising very quickly: your glucose value is rising quickly and could increase more than 2.5 mmol/l (45 mg/dl) in 15 minutes
- ↘ Falling: your glucose is falling and could decrease as much as 1.7 mmol/l(30 mg/dl) in 15 minutes
- ↓ Falling quickly: your glucose is falling and could fall as much as 2.5 mmol/l (45 mg/dl) in 15 minutes
- ↓↓ Falling very quickly: your glucose is falling and could fall more than 2.5 mmol/l (45 mg/dl) in 15 minutes

**#9: When diabetes is driving you crazy, remind yourself why you are bothering:**

I am committed to keep using my CGM because I know it can help me to:

1. ....
2. ....
3. ....

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## Nine Tips to Improve Glucose Control Using CGM

**Figure 1.** Nine Tips to Improve Glucose Control Using CGM.

expectations of PWDs and HCPs and to target any critical skills that may need to be developed prior to onboarding CGM. It is evidence-based and freely available.

**Abbreviations**

CGM, continuous glucose monitoring; HCP, health care provider; PWD, person with diabetes; T1D, type 1 diabetes.

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