

CHAPTER 15:

WHO SHOULD USE CONTINUOUS GLUCOSE MONITORING (CGM)?



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Good diabetes care ranges from performing four blood sugar checks and two insulin injections per day, to checking blood sugar 15 times per day and using multiple injections or insulin pumps. Every person/family is unique in the complexity of their diabetes regimen. Some families thrive on having large amounts of information at their fingertips and can comfortably use meter downloads, food records, blood sugar records and complex basal settings. Other families feel overwhelmed by having to think about diabetes constantly, and cope better with a more basic diabetes regimen. For families who feel ready to take on additional information, continuous glucose monitoring (CGM) may fit into their diabetes care. In this chapter, we will discuss CGM and who might choose to use this technology.

WHAT IS CONTINUOUS GLUCOSE MONITORING?

Blood sugar checks only provide a person with diabetes information for small snapshots in time. One parent compared doing four blood sugar checks per day to hearing four notes of a symphony. Wouldn't it be better to be able to know where glucose levels were all of the time (i.e., to hear the whole symphony)? Likewise, wouldn't it be helpful to have warning alarms before glucose levels go too high or too low? CGMs offer these capabilities and provide much more detailed information about diabetes.

CGMs do not measure the blood sugar level. They measure the glucose (sugar) level in the fluid underneath the skin (the interstitial fluid). In laboratory animals this measurement most closely matches the glucose levels in the brain. The CGM uses a small sensor that is inserted

subcutaneously, similar to a pump catheter/cannula. The glucose information is then transmitted by radio frequency to a wireless monitor that the user wears on a belt or in a pocket. The sensor continually reads the glucose values in the interstitial fluid for up to seven days and is then replaced with a new sensor. Interstitial fluid glucose levels lag behind blood sugar levels by about 10 minutes. This is because it can take some time for the glucose to pass out of the blood stream and into the fluid surrounding the cells. Although interstitial glucose readings are slightly different from blood sugar, they are usually within 20% of the blood sugar level, unless blood sugar levels are rapidly rising or falling.

CGM has been in existence for several years. Two "first generation" CGM devices were used in clinical settings:

- The MiniMed CGMS® was used for three day periods of time to collect glucose information. Some of the indications for use included children who were starting insulin pump therapy, those who had frequent or severe hypoglycemia, or those who were concerned about their diabetes control. The CGMS system was retrospective, meaning it would not allow the user to see the information until a clinician downloaded the device.
- The Cygnus Glucowatch® was the first CGM to read the glucose levels as they occurred (in real time). It pulled fluid from under the skin and was not liked by most users.

The newest CGM devices all operate in real time (RT), allowing the user to see the sensor information every one to five minutes as the

readings are taken. The new CGM devices have alarms for high and low glucose levels, and some have alarms for predicted high and low glucose levels. Real-time CGM is available for people/families to purchase and can be used with or without an insulin pump.

It is important to note that CGM does not replace blood sugar monitoring. In fact, some families are disappointed to hear that CGMs can initially increase the number of blood sugar checks in order to calibrate the system or to confirm low and high sensor glucose readings. None of the systems are currently approved for replacement therapy, meaning they are not intended to replace blood sugar checks. **The primary function of the CGM is to provide additional information to the user about glucose levels and trends in real time.** Rather than relying on four blood sugar checks per day, the user can now examine up to 288 readings per day.

Looking at the trends in glucose levels can be very helpful. For example, if a person with diabetes did a blood sugar check that read 240 mg/dl (13.3 mmol/L), that person might decide to take a correction dose of insulin. If that person had a CGM, he or she might discover that 30 minutes ago the glucose value was closer to 285 mg/dl (15.8 mmol/L), and that it has been consistently trending downward ever since. This might change how the person/family managed the situation. What if the sensor had shown that the glucose level was steeply rising to the current 240 mg/dl (13.3 mmol/L)? A larger correction dose might be used. The point of this illustration is to demonstrate how CGM trends provide **additional** information to the blood sugar check. It reveals patterns and trends that the user can use in diabetes management decisions.

CGM systems must be prescribed by a diabetes doctor. Most of the systems are not covered by insurance companies at this time, so the person/family must pay for it. Price estimates will be presented later in this chapter. After receiving the system, the patient/family will need to be trained to use it, which usually takes two to three hours.

WHEN TO USE CGM TECHNOLOGY

Some indications for people/families to use CGM are:

- when experiencing wide fluctuations in blood sugar levels
- when experiencing frequent or severe hypoglycemia, or hypoglycemia during sleep
- when experiencing hypoglycemia without symptoms (hypoglycemia unawareness)
- in periods of stress or growth that affect insulin sensitivity and blood sugars
- during sports season
- with an unexpected increase in HbA1c
- when girls begin menstruating
- during basal testing or other insulin changes

WHO SHOULD USE CGM?

As with insulin pump use, CGM technology is not for everyone. In fact, all of the 12 factors listed in Chapter 1 relating to who is a good candidate for an insulin pump also apply to CGM. There are, however, several additional factors that are helpful in predicting success with CGM. They include the following:

1. The person and family must both be interested in CGM. CGM is most successful when it is equally desired by the person and the family. The exception is the very young infant, when the parents must make the decision. We have seen what happens when parents are excited about CGM but the youth is not. The youth may be careless with the device and lose or break it more often than expected, or CGM readings may be scattered and unhelpful and the family unit may be interrupted by resentment and pressure to use the device. When CGM is initiated as a team effort, both the person and family find the experience more useful and manageable.

2. Willingness to wear a sensor. Some youth do not want to be continually hooked up to a device. Although there is no tubing connecting the sensor to the receiver, a sensor is constantly

attached to the skin. People wearing pumps are often more willing to wear a second device, possibly because they are used to the pump infusion set. Sometimes it is helpful to tape a sensor to the person's skin for a few days to see if they can tolerate wearing it.

3. Stable and adequate diabetes care.

Although it is possible to start an insulin pump and a CGM at the same time, it is probably better for a person/family not to juggle too many changes at once. When a person is first put on a CGM, there is a substantial amount of training for the user and family, including how to use the device, how to set alarms, when to calibrate the sensor, how to use the information and how/when to change the sensor. The amount of information may be overwhelming at first, and it may be better tolerated when other aspects of diabetes care are stable.

It is also important that the person/family is already practicing good diabetes care. This includes at least four blood sugar checks per day, consistent insulin use and visits to a diabetes care provider every three months.

4. Stable diabetes care support system. For younger children, use of a CGM is dependent on a stable support system. Children rely on parents, school nurses, coaches and other caregivers to assist them with daily diabetes care. It is an additional responsibility for the adults to help the child manage CGM. The following questions should be discussed before putting a child on CGM:

- Who will help the child change the sensor?
- Who will help the child respond to an alarm?
- Who will use the information to make insulin changes?
- Who will help the child troubleshoot problems?

It is helpful to have these questions answered before CGM is initiated.

5. Willingness to change. CGM offers a wealth of diabetes information for the person/family. After just a few weeks of wear, it becomes apparent what is working and what is not working in the diabetes regimen. Insulin therapy changes may be indicated based on trend information from the CGM. This may involve giving more insulin doses, or changing diabetes care around exercise, food or high blood sugars. A person/family must be open to these changes to optimize the CGM experience.

6. Enough body fat to wear a sensor. Body “real estate” is an important factor to consider when starting CGM sensors, especially with young children. Sensors vary in length from about 6 to 15 mm (1/4 to 3/5 inch) and are inserted at different angles. Most people can wear a sensor on their buttocks regardless of size, and many can wear it on the abdomen and arm. If a small child is wearing pump infusion sets exclusively on their buttocks, there may not be enough space to also incorporate a sensor. It is recommended there be at least two inches between a sensor site and a pump infusion site.

7. Cost of CGM. Health insurance and the cost of using a CGM system may be a deciding factor. Most health insurance programs will pay for blood sugar checking, but may not yet cover CGM. The Juvenile Diabetes Research Foundation (JDRF) is doing an admirable job in helping to make this happen, but it will take time. Currently, a complete CGM system costs between \$1,000 and \$2,000 USD. Sensors are around \$35 USD each, and transmitters cost \$300 to \$800 USD.

SUMMARY

Overall, the decision to use CGM should not be made hastily. Although the companies who make CGMs may state that everyone can use these systems, some people/families are more ready for this technology than others. Talk about this decision carefully with your diabetes team. With careful planning and hard work, the experience can be tremendously rewarding.

DEFINITIONS

Interstitial fluid: The fluid in the spaces between cells in fatty tissue, muscle tissue and other tissues in the body. Insulin pump cannulas and CGM sensors both sit in interstitial fluid.

Real time glucose readings: The immediate displaying of the most current interstitial glucose reading available (within one to five minutes).

