

# Continuous Glucose Monitoring: Updated

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## Introduction

Diabetes is a chronic and complicated disease in which glycemic management must be accompanied by positive behavior changes to improve clinical outcomes and quality of life. Diabetes technology continues to expand and evolve to improve the quality of lives for persons with diabetes (PWD). The rapid influx of new devices and improvements to continuous glucose monitors (CGMs) in recent years can empower patients to gain more insight for self-management, take an active role in problem solving, and lessen the burden of multiple daily fingersticks. The American Diabetes Association (ADA) has published updated principles for integrating technology and best practices for a patient-centric approach when using CGMs and devices. However, the type and selection of CGMs should be individualized based on a person's specific needs, skill level, availability, and insurance coverage. It is imperative that PWD and caregivers receive initial and ongoing education and training on the CGM device. The training must be effective either in person or virtually to ensure the patient understands how to interpret the data and share the results with the care team. Patients with additional education regarding their CGM device have improved outcomes.<sup>1</sup>

## Updates in Clinical Guidelines

The ADA recommends that real-time continuous glucose monitoring or intermittently scanned continuous glucose monitoring be offered for youth and adults who are receiving multiple daily insulin injections or an insulin pump.<sup>1</sup> A recent randomized control trial investigated the efficacy of intermittently scanned continuous glucose monitoring compared with daily fingerstick testing in a population of type 1 diabetes patients with glycated hemoglobin levels between 7.5% and 11.0%. After 24 weeks, results demonstrated significantly lower glycated hemoglobin levels among participants using intermittently scanned continuous glucose monitoring compared with those using daily fingersticks. Observational studies have demonstrated reductions in acute complications such as diabetic ketoacidosis and severe hypoglycemia in patients with type 1 diabetes who are using intermittently scanned continuous glucose monitoring. Retrospective studies of adults with type 2 diabetes who received multiple daily

insulin injections and used intermittently scanned continuous glucose monitoring demonstrated reduced hospitalizations and overall increase in satisfaction compared with adults who used traditional blood glucose monitoring. Observational and retrospective studies have demonstrated clinical benefits in adults with type 2 diabetes who received basal insulin therapy and used intermittently scanned continuous glucose monitoring.<sup>1</sup> Even patients who only received basal insulin therapy had reduced A1C levels, reduced hospitalizations, and overall increased satisfaction in their self-management. The ADA emphasizes that professional or intermittent continuous glucose monitoring should include education regarding interpretation of the results to drive behavior change and shared decision-making.<sup>1</sup>

The Endocrine Society Clinical Practice Guidelines have also incorporated CGM into recent recommendations for noncritical hospitalized patients with diabetes. In adults with insulin-treated diabetes at high risk of hypoglycemia, real-time continuous glucose monitoring is now recommended for the inpatient setting to monitor for adjustments in insulin dosing.<sup>3</sup> Patients with hypoglycemia and hypoglycemia unawareness can be good candidates for CGMs. CGMs can be an important tool for PWD who are wholly engaged in their own self-care. CGMs should also be considered for patients with comorbid conditions, with advanced age, and with poorly managed diabetes. However, CGMs may not be accurate in the hospital setting in patients with extensive skin infections or hypovolemia or who are receiving high doses of acetaminophen or vitamin C.<sup>4</sup> CGMs would not be appropriate for patients who are dehydrated, hypotensive, in shock, or in a hyperglycemic hyperosmolar state with or without ketosis. CGMs are also not intended for diagnosis or screening of diabetes.<sup>4</sup>

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### Benefits of CGMs

The clinical utility of CGMs has been demonstrated in patients with type 1 and type 2 diabetes and in patients who are treated with intensive insulin management. Technology offers the dual benefit of convenience and the opportunity to improve health outcomes. Leveraging the technology while understanding perceptions and behaviors associated with its use is crucial. Understanding its appropriate use and awareness of the barriers that may exist in practice can potentially circumvent fragmented health care.<sup>5</sup> Technology-enabled diabetes self-management education effectiveness includes communication between the person with diabetes and the health care team, patient-generated health data use and analysis, tailored education application, and individualization of feedback. The use of technology allows improved access and care between visits and prevents or reduces therapeutic inertia. Technology-enabled care and education supports population health goals and improves overall diabetes and cardiometabolic performance measures.<sup>5</sup> Mobile Health (mHealth), which has been defined as “the medical and public health practice supported by mobile devices” by the World Health Organization, is CGMs combined with smart phone apps, which can play an important role in the self-management of diabetes.<sup>6</sup>

CGMs can be prescribed for personal or professional use to provide educational opportunities, aid in decision making, and provide insight into patient behaviors. Professional CGMs can be used from 3 days to 2 weeks to obtain glycemic trends. CGMs provide a continuum of blood glucose readings, with improved accuracy, factory calibration, and potential nonadjunctive use indications<sup>7</sup>. The advantage of CGMs is that they can provide both real time and predictive glucose data.<sup>5</sup> Ongoing studies have highlighted the cost effectiveness and significant HbA1C reductions with use of CGMs. CGMs can detect and alert users of immediate and impending hypoglycemia, which is a major barrier in diabetes self-management. Blood glucose monitoring can be painful and burdensome, leading to less frequency of testing.<sup>8</sup>

CGMs can transmit data directly to the user's handheld reader or smartphone app. Additionally, they enable informed decision-making regarding lifestyle behaviors and medication adjustments and allow the individual with diabetes to immediately act to mitigate current or impending acute glycemic events. The trend arrows in a CGM help individuals make better decisions and improve their lifestyle behaviors. Telehealth services allow providers to remotely follow up with their patients and provide

timely treatment recommendations.<sup>7</sup> CGMs that are used in practice are shown in Table 1.

### Potential Barriers with CGM Use

It is important to acknowledge that there is a disproportionate burden of diabetes and its associated complications in historically marginalized groups such as racial and ethnic minorities and those with lower socioeconomic status. There is a need to achieve social equity and address social determinants of health domains that include socioeconomic status, neighborhood and physical environment, food environment, health care, and social context.<sup>9</sup>

Structural barriers to use of CGMs include financial concerns related to insurance coverage.<sup>8</sup> There is inconsistency in the medical coverage criteria for CGMs, which is constantly changing in some states; in other states, medical coverage for CGMs is unavailable. Unfortunately, there is extensive documentation required for CGM coverage, and durable medical equipment suppliers are often tasked with making a final coverage determination for CGMs, with lack of clarity from the Centers for Medicare & Medicaid Services.<sup>7</sup> It is important to acknowledge patient-related barriers to the use of CGMs that may include hesitancy to wear a sensor, alarm fatigue, and misconceptions or inadequate information regarding the device. Although there are a plethora of education modules and tutorials to support patients using CGMs, common barriers arise in clinical practice. For example, patients can develop skin dermatitis or experience sensors falling off prematurely. Provider-level barriers can exist when implementing CGMs for PWD, including a lack of time to learn about, promote, or complete the detailed paperwork needed to obtain CGMs for PWD.<sup>8</sup> The most common cited barrier to the use of CGMs among clinicians and patients is insurance reimbursement and cost. Prerequisite coverage for CGMs depends on insurance plan and medications and may pose a greater burden on the physician to navigate reimbursement for the patient.<sup>10</sup>

### Role of the Care Manager

The care manager plays an integral role in supporting patients who use CGMs. Care managers can help identify appropriate candidates for CGMs and collaborate with physicians and payers to help overcome the barrier of insurance reimbursement. Large randomized controlled trials have shown that CGM use is beneficial even in patients who are not receiving intensive insulin

Ultimately, the clinical benefits of CGMs depend on support and training from the multidisciplinary team, including the case manager, who should address any barriers. Care managers play a critical role in helping persons with diabetes interpret their CGM data to implement lifestyle changes.

**TABLE 1** CONTINUOUS GLUCOSE MONITORS USED IN PRACTICE

CGM system	Dexcom G6	Eversense®	Freestyle Libre 14 day	Freestyle Libre 2	Freestyle Libre 3	Guardian™ Sensor 3
Company	Dexcom	Senseonics and Ascensia Diabetes Care	Abbott	Abbott	Abbott	Medtronic
Sensor	Yes	Yes. Professionally inserted only, under the skin	Yes	Yes	Yes	Yes
Sensor “warm up period”	2 hours	24 hours	1 hour	1 hour	1 hour	2 hours
Sensor wear	10 days	90 days	14 days	14 days	14 days	7 days
Transmitter	Yes. 90-day battery life	Yes. Removable, rechargeable, and water resistant	Yes. Built into sensor, making the system one piece	Yes. Built into sensor, making the system one piece	Yes. Built into sensor, making the system one piece	Yes. 1 year with charger (battery operated)
Receiver	Yes, can use compatible phone app	Use with compatible phone app or smart watch	Yes, or can use compatible phone app	Yes, or can use compatible phone app	No, use with compatible phone app only	Insulin pump and phone app
Alerts	Yes	Yes	No	Yes	Yes	Yes
Calibration with fingersticks	Not needed <sup>a</sup>	Initialization phase: after warm-up, 4 fingerstick tests spaced 2–12 hours apart Daily: fingerstick every 12 hours	Not needed	Not needed	Not needed	2-4 calibrations/day
MARD <sup>b</sup>	9.8%	8.5%	9.7%	9.2%	7.9%	8.7%–10.6% (site dependent)
Integration with pump	Yes	No	No	No	No	Yes
How often system measures blood glucose levels	Every 5 minutes	Every 5 minutes	Every 1 minute	Every 1 minute	Every 1 minute	Every 5 minutes
Age (y) of approved indication	≥2	≥18	≥18	≥4	≥4	≥2

Source: Adapted from Abbott.com, Medtronic.com, Senseonics Incorporated, Dexcom.com

a. Fingersticks not required as long as you enter the code number when starting the sensor; otherwise fingersticks are required. <https://www.dexcom.com/safety-information>

b. MARD, mean absolute relative difference. This metric is commonly used when comparing continuous glucose monitoring systems. The smaller the MARD, the closer the CGM readings are to the reference glucose values. A larger MARD indicates a wider range between the CGM values and the reference glucose value

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therapy or testing 4 times daily with fingersticks.<sup>7</sup> In addition, case managers can ensure that PWD and their caregivers can interpret the glucose data to increase self-efficacy with self-management skills for diabetes. Care managers can teach patients about best practices for sensor insertion when using CGMs and offer various resources for technical support and troubleshooting. Patients should wash their skin with warm soap and water before sensor insertion and avoid areas with scars, molds, or lumps. Soap should be free of moisturizers and fragrances. Sensors should be placed at least 1 inch away from where insulin is injected. The area should be cleaned with an alcohol wipe and completely dried before insertion of the sensor. Care managers can offer various solutions to help keep the sensor in place. There are many waterproof adhesive tapes that patients can purchase that can prevent sensors falling off during exercise or when sweating. Care managers educate PWD about the proper use of CGMs and interpretation of data, and this education is invaluable to achieving desired clinical outcomes.

### Potential Considerations of CGMs in Different Populations

Further research can also highlight benefits of using CGMs for managing prediabetes or for weight management purposes, which is currently an off-label use.<sup>11</sup> Preliminary studies have demonstrated an improvement in time in range in individuals with prediabetes who are using CGMs via mobile health apps. CGMs offer clinicians the ability to tailor individualized therapeutic diet recommendations based on postprandial glycemia. The future of nutrition science will be based on precision nutrition, or counseling patients based on their unique metabolic responses to meal composition. CGMs have enabled researchers to gain a deeper understanding of various factors that affect postprandial glycemic responses, including the gut microbiome, timing of meals, and sleep.<sup>12</sup>

One study showed promising results that the use of CGMs in a prediabetic population helped drive dietary changes by helping the patient visualize the effect of carbohydrates on their blood sugar.<sup>13</sup> The use of CGMs was a tangible way for patients to understand the relationship between their meal compositions and blood glucose level, while increasing their awareness of perceived risk of diabetes. Ultimately, the use of CGMs coupled with dietary counseling can drive patients to elucidate the relationship between diet, activity, stress, and sleep levels to promote weight loss and prevent type 2 diabetes.<sup>13</sup>

Research continues to show positive results for pregnant women using CGMs. While the U.S. Food and Drug Admin-

istration (FDA) has not authorized the use of CGMs during pregnancy in the United States, the ADA endorses CGMs to achieve A1C targets during pregnancy. The CONCEPTT trial was a randomized controlled trial that demonstrated that pregnant women with type 1 diabetes who used real-time continuous glucose monitoring improved their HgbA1C and their time in range by 7% without increasing their hypoglycemia.<sup>14</sup> In addition to improving maternal blood sugar levels, using CGMs during pregnancy significantly reduced the incidence of large for gestational age infants, neonatal hypoglycemia, and neonatal intensive care unit admissions.<sup>14</sup> The ADA and the American Association of Clinical Endocrinology recommend treating pregnant women with type 1 and type 2 diabetes with intensive insulin therapy and using CGMs to improve glycemic control and neonatal outcomes.<sup>15</sup> The use of real-time continuous glucose monitoring has not been well studied in clinical trials, but a large prospective cohort study of real-time continuous glucose monitoring in patients with gestational diabetes showed significantly improved daily blood glucose levels and lower glycemic variability compared with self-monitoring of blood glucose.<sup>15</sup>

### Conclusion

Technology confers many benefits to PWD, and the technology for CGMs is rapidly evolving to ease the burden of monitoring. Ultimately, the clinical benefits of CGMs depend on support and training from the multidisciplinary team, including the case manager, who should address any barriers. Care managers play a critical role in helping PWD interpret their CGM data to implement lifestyle changes. Technology is only as valuable as the patient's perceived understanding of glycemic data and the problem-solving strategies to make timely treatment decisions. There are significant research opportunities for determining the effectiveness of CGMs in various populations, including patients with prediabetes, patients who need weight management, and pregnant patients. Broadening access and insurance reimbursement for CGMs will ensure that technology is equitable among PWD. ■

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### Questions

- Continuous glucose monitoring can benefit people with diabetes by:**
  - Encouraging patients to gain more insight for self-management
  - Empowering patients to take an active role in problem solving
  - Lessening the burden of multiple daily fingersticks
  - All of the above
- The selection of continuous glucose monitors (CGMs) should be:**
  - Individualized for each patient
  - Based on availability
  - Based on insurance coverage
  - All of the above
- Training patients to ensure understanding of how to interpret data from CGMs is vital.**
  - True
  - False
- The American Diabetes Association recommends that real-time continuous glucose monitoring be offered to which of the following individuals?**
  - Any person with diabetes
  - Only people with type 1 diabetes
  - Only people with type 2 diabetes
  - Youth and adults who are receiving multiple daily insulin injections
- Compared with daily fingersticks, the use of CGMs can lower glycated hemoglobin levels.**
  - True
  - False
- Studies using CGMs have demonstrated which of the following for people with diabetes?**
  - Reductions in acute complications
  - Reduced hospitalizations
  - Increase in patient satisfaction
  - All of the above
- Patients with hypoglycemia and hypoglycemia unawareness are good candidates for CGMs.**
  - True
  - False
- CGMs are not appropriate for which of the following patients?**
  - Dehydrated patients
  - Hypotensive patients
  - Patients in shock
  - All of the above
- Technology-enabled diabetes self-management education effectiveness includes which of the following?**
  - Communication between patient and care team
  - Patient-generated health data use and analysis
  - Tailored education
  - All of the above
- The use of continuous glucose monitoring technology allows improved access and care between visits.**
  - True
  - False
- Which of the following social determinants of health are applicable to patients with diabetes who use continuous glucose monitoring?**
  - Socioeconomic status
  - Food environment
  - Neighborhood
  - All of the above
- Which of the following are patient-centered barriers to the use of CGMs?**
  - Hesitancy to wear a sensor
  - Alarm fatigue
  - Misconception or inadequate information about the device
  - All of the above
- The role of the case manager in working with CGMs includes which of the following?**
  - Identifying appropriate candidates for CGMs
  - Overcoming insurance barriers
  - Educating patients and caregivers
  - All of the above

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## Continuous Glucose Monitoring: Updated

### Objectives

1. State how diabetes technology has improved outcomes for people with diabetes.
2. State three benefits of continuous glucose monitoring.
3. State three potential barriers to use of continuous glucose monitoring.

### Answers

Please indicate your answer by filling in in the letter:

1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_ 4. \_\_\_\_\_ 5. \_\_\_\_\_ 6. \_\_\_\_\_ 7. \_\_\_\_\_ 8. \_\_\_\_\_ 9. \_\_\_\_\_ 10. \_\_\_\_\_ 11. \_\_\_\_\_ 12. \_\_\_\_\_ 13. \_\_\_\_\_

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