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Understanding Continuous Glucose Monitoring

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Introduction

Continuous glucose monitoring (CGM) is instrumental in optimizing glycemic outcomes for all people living with diabetes (PWD) (Elsayed et al., 2025a). CGMs are wearable, minimally invasive devices that provide greater glycemic insight than traditional capillary self-monitoring of blood glucose (SMBG) (Elsayed et al., 2025a) and can replace SMBG for insulin dosing. Frequent glucose measurements enable real-time alerts to help detect hypoglycemia and hyperglycemia. Viewing real-time data enables meaningful behavior changes, while analyzin data trends, providing insight into glycemic pattern.

How Does CGM Work?

The CGM measures glucose values from interstitial fluid every one to five minutes and records up to 1440 daily glucose readings. The CGM system consists of three main components: a sensor, a transmitter, and a receiver. The sensor is a small filament or sensing device placed in the subcutaneous tissue of the arm, abdomen, or buttock. Disposable sensors can be worn for 7 to 15 days, while implantable sensors can last up to 365 days. Transmitters are small devices that attach to the sensor and receive glucose data. Transmitters process and wirelessly send the sensor's glucose data to a receiver. Some transmitters are disposable and are connected to the sensor, while others are reusable and require charging between sessions. CGM receivers include reader devices, smartphone applications, or insulin pumps. The receiver displays real-time glucose values, glucose trends, and any alerts or alarms the PWD sets (Edelman et al., 2018).

Once a new sensor is placed and a session begins, a warm-up period without data display occurs, which varies by CGM system. Some CGM systems require capillary glucose calibrations after warm-up or throughout the wear period to ensure accuracy, while others are factory calibrated. As CGMs measure glucose in interstitial fluid instead of blood, sensor glucose data may lag when glucose levels rapidly rise or fall (i.e., after eating or physical activity).

Types of CGM

To date, four types of CGM provide glucose data. Real-time CGM (rtCGM) is a personal-use, prescription system that continuously measures and displays glucose values. Disposable rtCGM sensors include the Dexcom G6, Dexcom G7, Medtronic Guardian 4, Medtronic Guardian Connect, and Freestyle Libre 3 Plus. The Eversense 365 is a rtCGM sensor implanted in the arm that lasts up to 365 days (Ascencia 2024). Intermittently scanned CGMs (isCGMs) are personal-use, prescription systems that continuously measure glucose values but require scanning to view and store the results, including the Freestyle Libre 2 Plus (Abbott 2021). Professional CGMs, such as the Dexcom G6 Pro, are typically owned by healthcare clinics and installed by healthcare professionals. Professional CGMs are worn for up to 14 days, blinded or unblinded, and then downloaded in the clinic to gather glycemic data or assess glycemic patterns (Dexcom 2022). Over-the-counter biosensors are personal-use devices available without a prescription and indicated for individuals with pre-diabetes or PWD who do not take medications. Although biosensors continuously measure glucose values, they only display glucose values at certain times and provide data insights instead of hypoglycemia and hyperglycemia alerts and alarms (Elsayed et al., 2025a).

Criteria

In 2023, the Centers for Medicare and Medicaid Services (CMS) made significant modifications to CGM criteria, allowing for expanded coverage. At that time, the criteria for proof of capillary SMGB and the requirement of multiple daily insulin injections were removed, while problematic hypoglycemia was added. These updates enable broader CGM coverage, but limitations persist. To qualify for personal CGM coverage, one must take insulin or have problematic hypoglycemia (Oser & Oser 2024). Problematic hypoglycemia is defined as two or more episodes of level 2 hypoglycemia (glucose <54 mg/dL) despite treatment plan adjustments or documentation of at least one episode of level 3 hypoglycemia (glucose <54 mg/dL) with altered mental status or requiring assistance from others. Additional eligibility requirements include documentation of the following: a diagnosis of diabetes mellitus, patient or caregiver education on the CGM system, a prescription for the CGM system by FDA indications for usage, and a prescription for the CGM system to improve glycemia for individuals on insulin or with a documented history of problematic hypoglycemia (CMS 2023).

Professional CGM is often a beneficial alternative for individuals who would like to learn from CGM but may not qualify or be able to afford personal CGM. Professional CGM is typically covered

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for individuals with diagnosed diabetes who meet at least one of the following criteria: recent diabetes diagnosis, not using personal CGM, problematic hypoglycemia without access to personal CGM, individuals with T2D treated with noninsulin therapy who would like to learn from CGM as an educational tool, and individuals who would like to try CGM before committing to personal usage (Grunberger et al., 2021).

Patient Selection

CGMs are beneficial in improving glycemic outcomes for all individuals with diabetes across their lifespans and should be recommended as soon as possible for PWD starting insulin therapy (Elsayed et al., 2025a). Although CGM may be beneficial for all individuals living with diabetes, it should be specifically recommended for individuals who have elevated HbA1c, are treated with insulin, and have nocturnal hypoglycemia or hypoglycemia unawareness (Danne et al., 2017). However, it may not be realistic to get everyone to utilize CGM. Those who do not have adequate insurance coverage, incur out-of-pocket costs, experience body image issues, have allergies to adhesives, or are not interested in wearing a CGM may struggle with sustained CGM usage. Cost can be a significant barrier to CGM usage, especially for those with high deductibles or out-of-pocket costs (Agarwal et al., 2022). However, it is essential to acknowledge providers' implicit bias based on insurance and to offer CGM to all PWD.

Additionally, individuals who experience distress from a large amount of CGM data may be better candidates for blinded Professional CGM or isCGM than rtCGM. Individuals who do not have a high risk for hypoglycemia and have barriers to using rtCGM may also benefit from Professional CGM or isCGM (Elsayed et al., 2025a). Notably, no CGM system has been FDA-approved for use in dialysis or inpatient hospitalizations.

Benefits of CGM

Historically, individuals on intensive insulin therapy were advised to self-monitor capillary glucose levels at least four times a day, such as fasting, before meals, before bed, and whenever symptomatic of hyperglycemia or hypoglycemia (Benjamin 2002; CMS 1993). Individuals with T2D on other medication regimens were advised based on individual factors, but were typically advised to monitor their glucose levels at least once daily. Although SMBG throughout the day provides some glycemic insights, it does not provide information on how glucose trends overnight and between meals. CGM data includes information on meaningful glycemic patterns, such as postprandial rises and nocturnal hypoglycemia, to inform medication adjustments and behavior changes (Edelman et al., 2018; Martens et al., 2025). Additionally, CGM data provides a safety net to take action in aiding the prevention and treatment of hypoglycemia and hyperglycemia through real-time data, trend arrows, and personalized alarms (Longo & Sperling 2019). Lastly, CGM is integral to automated insulin delivery systems (AID). Automated insulin delivery systems integrate data from CGM, an algorithm, and a subcutaneous insulin pump to adjust insulin delivery in response to real-time glucose, insulin action, and other insulin delivery factors (Phillip et al., 2022; Sherr et al., 2022). AID systems enhance glycemic management while minimizing the daily burden of diabetes self-management, particularly in terms of insulin administration.

CGM usage, including Professional CGM (Nemlekar et al., 2023) and isCGM (Wright et al., 2021), is associated with lower HbA1c (Gilbert et al., 2021) levels. Personal CGM is associated with higher quality of life (Polonsky et al., 2017) and lower diabetes distress (Gilbert et al., 2021). Although many individuals living with type 1 diabetes (T1D) in the United States do not meet optimal glycemic targets of <7.0% HbA1c, PWD who utilize CGM have more optimal glycemic outcomes (Foster et al., 2019). Initiating CGM as close to diagnosis as possible is associated with long-term improvements in HbA1c for both adults (Champakanath et al., 2022) and children with T1D (Patton et al., 2019). Even in those with type 2 diabetes (T2D) on noninsulin therapy, isCGM (Aronson et al., 2023) and rtCGM are associated with improved glycemic outcomes (Grace & Salyer 2022) (Ferreira et al., 2024). In individuals with pre-gestational T1D, CGM usage is associated with numerous benefits, including lower HbA1c and increased time in range (70-140 mg/dL) without an increase in hypoglycemia.

CGM also has unique benefits per age group. In infants, toddlers, and young children, CGM aids in reducing the risk of hypoglycemia unawareness, decreasing glycemic variability, and improving prandial glucose control, which are often significant challenges. Sharing CGM data with caregivers is also a safety benefit for young children. Notably, in very young children with T1D, CGM usage reduces the time spent in hypoglycemia (<70 mg/dL) and improves parents' quality of life. (Laffel et al., 2021; Van Name et al., 2023). In teenagers and young adults, CGM is a vital tool in enabling them to take on diabetes self-management tasks independently. Like adult age groups, CGM improves glycemia awareness in adolescents and young adults (Laffel et al., 2020). In older adults with T1D, CGM has great safety benefits, as one can share their CGM data and engage care partners (Allen et al., 2022). Individuals who have lived with diabetes for long periods are at higher risk of hypoglycemia unawareness and benefit from CGM glucose alarms. In older adults,

Although CGM may be beneficial for all individuals living with diabetes, it should be specifically recommended for individuals who have elevated HbA1c, are treated with insulin, and have nocturnal hypoglycemia or hypoglycemia unawareness.

CGM usage reduces hypoglycemia and increases time spent in the target range of 70-180 mg/dL without increasing hyperglycemia (Miller et al., 2022). In older adults with T2D using basal-only insulin, CGM still increases time in range and reduces hyperglycemia (Bao et al., 2022).

Risks of CGM

Despite its many benefits, there are barriers to sustained CGM usage, including dermatological reactions and psychological impacts. The most common skin reactions are non-specific cutaneous conditions (erythema, pruritus, pain, rash, skin changes, infection, and exacerbation of existing skin conditions), followed by allergic contact dermatitis and lipodystrophies. Skin reactions often occur in PWD who have not worn a CGM before (Messer et al., 2018). Good skin care practices, such as gentle exfoliation and removing hair and oil, can help prepare the skin for sensor placement and minimize skin irritation. A PWD report recommends applying a nasal steroid spray topically to protect PWD with skin reactions from adverse reactions. Additional skin protective recommendations include liquid barriers, solid barrier bandages, and rotating CGM sensor site to preserve skin integrity (Messer et al., 2018).

Although CGM generally improves quality of life and lowers diabetes distress, some PWD experience psychological burdens from wearing CGM. Alarm fatigue may occur if CGM alerts are set to targets that are not realistic for the individual, such as a person who spends significant time above 180 mg/dL setting their high glucose alert to 180 mg/dL, when an actionable target, such as 250 mg/dL, may be more appropriate. Effective ways to minimize alarm fatigue include avoiding situations that may generate alarms and setting actionable, individualized alerts (Shivers et al., 2013). Access to a constant stream of glucose data may also induce feelings of anxiety or information overload (Heinemann & Klonoff, 2020), which can be mitigated by providing education about the meaning of the CGM data. Specific individuals may benefit from isCGM instead of rtCGM. Additional psychological burdens include disliking wearing the device on the body or body image-related issues (Messer et al., 2020; Tanenbaum et al., 2017). Common in the adolescent and young adult populations, wearing CGM may cause emotional distress as sharing data may cause family conflict or feelings that parents are overly engaged in monitoring diabetes self-management. Setting boundaries to avoid judgment and making a shared, instead of one-sided, decision to start using CGM or share data may reduce family-related CGM conflict (Litchman et al., 2018).

Goals of CGM

A 14-day ambulatory glucose report (AGP) is the standardized report to view CGM data. When reviewing CGM data, the following key metrics are available from a standardized 14-day report: number of days CGM is worn (target: 14 out of 14 days), percentage of time CGM is active or CGM wear time (target: >70%), mean glucose, glucose management indicator (GMI), glycemic variability (%CV) (target: <36%), and time in glycemic target range, or time in range (T. Battelino et al., 2019).

Time in range, or the time spent in the glycemic target range set at 70-180 mg/dL for many individuals, is a valuable metric of glycemic status. For many non-pregnant adults, a goal of achieving >70% time in range (70–180 mg/dL) is appropriate and correlates with a 7% reduction in HbA1c (Battelino et al., 2019). Still, for PWD with hypoglycemia unawareness or high risk of hypoglycemia, a goal of >50% may be appropriate (Battelino et al., 2019; Elsayed et al., 2025). Additional time in range metrics include time above range level 1 being the percent time spent 181–250 mg/dL, time above range level 2 being the percent time spent >250 mg/dL, time below range level 1 being the time spent 54-69 mg/dL and time below range level 2 being the time spent <54 mg/dL (Danne et al., 2017).

When reviewing the CGM AGP with PWD, the DATAA method can be applied to set self-management goals. First, download the CGM data and review the key metrics from the AGP report. Next, assess safety by identifying time spent below range, time in hypoglycemia, hypoglycemia events, and the patient's perspective on potential causes and solutions. Then, focus on the positives or the time in range, and discuss what works well. Then, focus on areas for improvement and review time spent above the range, percent time in hyperglycemia, and hyperglycemia events, identifying possible causes and self-management adjustments that can be made. Ensure the PWD collaborates actively in the action plan (Isaacs et al., 2020).

CGM Coding and Reimbursement

Insurance plans continue to expand reimbursement for CGM and billable services. Many national payors cover Current Procedural Terminology (CPT) codes 95249, 95250, and 95251, commonly used to initiate and interpret personal and Professional CGM data. To date, many national payors cover the CPT codes. Still, the criteria for personal versus professional usage may differ, and there may be limits on the number of times billed per year for 95250 and 95251 (CMS 2025). See Table 1 for more details per code.

Patient Education

Although multiple CGM systems are FDA-indicated for self-start, CGM education plays a crucial role in optimizing glycemic outcomes. Individuals must understand their CGM data to make meaningful changes in self-management behavior (Heinemann & Klonoff 2020). Providing CGM training and education also alleviates the associated emotional burden, promotes long-term utilization, and reduces the need for independent troubleshooting of a new technology device (Tanenbaum et al., 2021). CGM education should begin with setting expectations about what the CGM can do and tailoring CGM usage (i.e., alerts, alarms, sharing data) to individual needs (Barnard-Kelly & Polonsky 2020). Although CGM patient education should be individualized, key patient education should generally include the following:

- **Basic CGM Components and Parts:** Understanding the components and parts of CGM devices is essential for understanding how it is inserted, worn, and removed. Sensor site and locations, inserting the sensor (if applicable), attaching the transmitter (if applicable), connecting to the receiver, removing and disposing of the device, and calibrating (if applicable) should be discussed.
- **Understanding CGM Basics:** Next, it is essential to know how to use the CGM to obtain glucose readings and address fundamental safety concerns. Education points include the distinction between interstitial and blood glucose readings, understanding CGM data display, medication interactions, preventing overcorrection of hyperglycemia, basic troubleshooting, optimal skin and adhesive practices, and a contingency plan for CGM failure.
- **Advanced CGM Features:** Advanced CGM features are often used daily, but it is best to first focus on understanding the basics. Sometimes, advanced features are taught or reinforced at a follow-up appointment. Advanced CGM feature topics include understanding CGM trends, setting and managing alerts and alarms, utilizing trend arrows for informed treatment decisions, and sharing data with caregivers and healthcare clinicians (Barnard-Kelly & Polonsky 2020).
- **Advanced CGM Data:** Meaningful behavior changes occur when the CGM data is helpful to the PWD. Key patient education points to maximize beneficial impact on glycemic outcomes include understanding glycemic targets, understanding meaningful times to check CGM readings for behavior change (i.e., postprandial, fasting), and understanding the effects of food on glucose (i.e., MyPlate, food groups) ("Good To Know: Continuous Glucose Monitoring and Nutrition" 2024).

List of CGM Devices and Features

The CGM options can be overwhelming, and different features have unique benefits for individuals with diabetes. Table 2 presents the commercially available CGM systems as of 2025. Features to remember when a PWD chooses a CGM include the receiver options. Individuals with lower levels of comfort or technology literacy may prefer a reader device over a CGM system with only a mobile application option. Others with disabilities, such as low vision or blindness, may prefer a mobile application as a receiver due to phone accessibility features that work within the application. One must also consider compatible CGMs if using an AID system for insulin delivery; also if one is currently pregnant or planning to become pregnant, or if one takes any medications that may cause inaccurate glucose readings, and for children, if the CGM system is FDA-approved for their age 1 (Elsayed, et al., 2025a; Murray-Bachmann, et al., 2024). Table 3 provides more information about features to consider when choosing a CGM system.

TABLE 1 COMMONLY BILLED CPT CODES RELATED TO CGM

Code	Description	Billing Information
95249	CGM startup & patient training (personal CGM provided by the patient): Ambulatory CGM via a subcutaneous sensor for a minimum of 72 hours; sensor placement, hook-up, calibration of monitor, patient training, and printout of recording.	May be performed by qualified staff members but reported under the supervision of a physician, physician assistant, or nurse practitioner. It can only be billed once during the period the patient owns the receiver for the CGM.
95250	CGM Pro placement and training provided by healthcare clinic: Ambulatory CGM via a subcutaneous sensor for a minimum of 72 hours; sensor placement, hook-up, calibration of monitor, patient training, removal of the sensor, and printout of recording.	May be performed by qualified staff members but reported under the supervision of a physician, physician assistant, or nurse practitioner. It cannot be reported more than once a month.
95251	CGM interpretation & report analysis: Ambulatory CGM of interstitial tissue fluid via a personal wear subcutaneous sensor for a minimum of 72 hours; analysis, interpretation, and report. It can be attached to a telehealth visit.	It may only be reported by a physician, physician assistant, or nurse practitioner. It cannot be reported more than once a month.

TABLE 2 AVAILABLE (2025) PRESCRIPTION CGM DEVICES AND FEATURES

CGM system	**Dexcom Pro** *(Dexcom 2022)*	**Dexcom G7** *(Dexcom nd)*	**Eversense® E365** *(Ascensia 2024)*	**FreeStyle Libre 2 Plus** *(Abbott 2021)*	**FreeStyle Libre 3 Plus** *(Abbott 2022)*	**Guardian™ Sensor 4** *(Minimed 2024)*
Company	Dexcom	Dexcom	Senseonics Ascensia	Abbott	Abbott	Medtronic
Type of CGM	Professional CGM	rtCGM	rtCGM	isCGM	rtCGM	rtCGM
Warm-up period	30 minutes	30 minutes	24 hours	1 hour	1 hour	2 hours
Sensor wear time	10 days	10 days plus an additional 12-hour grace period	Up to 365 days	15 days	15 days	7 days
Transmitter	Yes. Built into the sensor	Yes. Removable, rechargeable	Yes. Built into the sensor	Yes. Built into the sensor	Yes. 1 year, rechargeable	Transmitter
Non-adjunctive indication (can make treatment decisions without a BGM)	Yes	Yes, if following proper calibration guidelines	Yes	Yes	Yes	No, do not use CGM to make treatment decisions if insulin pump is in manual mode. You can always utilize confirmatory BGM as needed
Calibrations required?	No, but can calibrate if needed	No, but can calibrate if needed	Yes. Initialization Phase: 4 fingerstick calibrations, spaced 2 to 12 hours apart 1 Daily Calibration Phase: fingerstick calibration every 24 hours for 13 days 1 Weekly Calibration Phase: fingerstick calibration once a week.	No	No	No, but can calibrate if needed
Adult MARD	8.2%	8.2%	8.8%	8.2%	8.2%	8.7%–10.6%
Measurement intervals	Every 5 minutes	Every 5 minutes	Every 5 minutes	Every 1 minute	Every 1 minute	Every 5 minutes

TABLE 3 CGM FEATURE CHOICES

CGM system	Dexcom Pro	Dexcom G7	Eversense® E365	FreeStyle Libre 2 Plus	FreeStyle Libre 3 Plus	Guardian™ Sensor 4
Receiver Options	Mobile application to view data unblinded	Reader device, insulin pump (Omnipod5, TandemX2, Tandem Mobi, Beta Bionics iLet), mobile application	Mobile application	Reader device, insulin pump (Omnipod5, TandemX2), mobile application	Reader device, insulin pump (Beta Bionics iLet), mobile application	Insulin pump, mobile application to reflect insulin pump receiver readings
Integration with insulin pump	No	Yes	No	Yes	Yes	Yes
Age of FDA-approved indication *(years)*	≥2	≥2	≥18	≥2	≥2	≥2
Approved for use in pregnancy *(Elsayed, et al., 2025b)*	No	Yes	No	Yes	Yes	No
Medication Interactions *(Elsayed, et al., 2025a)*	Hydroxyurea, high-dose acetaminophen	Hydroxyurea, high-dose acetaminophen	IV or peritoneal dialysis mannitol and sorbitol	High-dose vitamin C, hydroxyurea	High-dose vitamin c	Acetaminophen

Conclusion

CGM systems have vast benefits for individuals living with all types of diabetes across their lifespan. As CGM adoption increases, healthcare professionals outside of the diabetes specialty need to understand the basics of CGM. We hope this manuscript empowers case managers to identify PWD who would benefit from CGM and help them access and utilize CGM. ■

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Understanding Continuous Glucose Monitoring

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Questions

1. **Continuous glucose monitors (CGM) measure glucose values from interstitial fluid every one to five minutes and record the readings.**
   a. True
   b. False
2. **CGM are wearable, minimally invasive devices that provide greater glycemic insights than traditional self-monitoring of blood glucose.**
   a. True
   b. False
3. **Which of the following are types of CGMs?**
   a. Real-time CGM
   b. Intermittently, scanned CGM
   c. Professional CGM
   d. All of the above
4. **Criteria for CGM includes which of the following:**
   a. Taking insulin
   b. Problematic hypoglycemia
   c. Diagnosis of diabetes
   d. All of the above
5. **CGM should be specifically recommended for individuals who have elevated HbA1c and which of the following?**
   a. Treatment with insulin
   b. Nocturnal hypoglycemia
   c. Hypoglycemic unawareness
   d. All of the above
6. **Patient selection barriers may include which of the following?**
   a. Insurance coverage
   b. Body image issues
   c. Allergies to adhesive
   d. All of the above
7. **Cost can be a barrier to CGM usage.**
   a. True
   b. False
8. **CGM data includes information on which of the following?**
   a. Glycemic patterns
   b. Post-prandial rises
   c. Nocturnal hypoglycemia
   d. All of the above
9. **Initiating CGM as close to diagnosis as possible is associated with long-term improvement of HbA1c for both adults and children.**
   a. True
   b. False
10. **In infants, toddlers, and young children, CGM aids in which of the following?**
    a. Glycemic variability reduction
    b. Prandial glucose impact
    c. Hypoglycemia unawareness
    d. All of the above
11. **Psychological burdens of wearing CGM devices include which of the following?**
    a. Alarm fatigue
    b. Data overload
    c. Disliking wearing the device
    d. All of the above
12. **Which of the following key metrics are available for a standardized CGM report?**
    a. Time spent in glucose targeted range
    b. Mean glucose value
    c. Glycemic variability
    d. All of the above
13. **Categories of patient education for patients with CGM include which of the following?**
    a. Basic CGM pieces and parts
    b. Understanding CGM basics
    c. Advanced CGM features
    d. Advanced CGM data
    e. All of the above

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Understanding Continuous Glucose Monitoring

Objectives

1. Define continuous glucose monitoring.
2. State three patient benefits of using a continuous glucose monitor.
3. State four categories of patient education for using continuous glucose monitoring.

Answers

Please indicate your answer by filling in the letter:

1._____ 2._____ 3._____ 4._____ 5._____ 6._____ 7._____ 8._____ 9._____ 10._____ 11._____ 12._____

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