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Continuous Glucose Monitoring Systems: Applications and Integrated Benefits - review study

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ABSTRACT

Introduction: Continuous Glucose Monitoring (CGM) systems have evolved significantly, transforming the management of diabetes and expanding into various other fields. Originally developed to aid in diabetes management, CGM systems now offer real-time glucose tracking, providing insights into glycemic control, preventing hypoglycemia, and optimizing therapeutic decisions. These systems are used in type 1 and type 2 diabetes management, pregnancy, sports, and critical care. Despite their benefits, challenges such as cost and integration into routine care remain. Future research will be crucial to fully understand the long-term impact and cost-effectiveness of CGM systems.

Aim of the study: This study aims to present the diverse applications and integrated benefits of Continuous Glucose Monitoring (CGM) systems. It focuses on their role in improving diabetes management, enhancing pregnancy outcomes, supporting athletic performance, and optimizing care in critical conditions.

Materials and methods: A literature review was conducted using PubMed as the primary database. The search terms included: "continuous glucose monitoring", “CGM”, “diabetes mellitus", “diabetes mellitus type 1”, “diabetes mellitus type 2”.

Conclusion: Continuous glucose monitoring (CGM) systems have significantly advanced diabetes care, offering precise, real-time glycemic data that support individualized treatment. This review highlights CGM's broadening applications across diverse populations, including non-diabetic individuals, pregnant women, athletes, and critically ill patients. While strong evidence supports CGM's clinical and behavioral benefits, further research is required to optimize cost-effectiveness, long-term outcomes, and broader implementation strategies. CGM represents a transformative tool in both chronic disease management and personalized health monitoring.

KEYWORDS: continuous glucose monitoring, diabetes mellitus, hypoglycemia, gestational diabetes, physical activity, critical care

1. Introduction

Maintaining blood glucose levels within a physiological range is critical, as significant deviations can lead to serious acute or long-term health complications [1]. In healthy individuals, glucose homeostasis is tightly regulated by a network of distinct physiological processes that together sustain metabolic homeostasis [2]. When these mechanisms are disrupted, as in the case of metabolic disorders such as diabetes mellitus, individuals may experience chronic hyperglycemia or episodes of hypoglycemia.

Glucose monitoring enables people with diabetes to evaluate the effectiveness of their treatment and determine whether glycemic targets are being met without complications. Integrating glucose data into daily diabetes management offers significant benefits for meal and activity planning, preventing hypoglycemia, and adjusting pharmacological therapy, particularly concerning prandial and correctional insulin dosing [3]. In a healthy population, glycemic control may support optimal nutritional strategies through a personalized approach based on monitoring glucose levels, particularly using continuous glucose monitoring (CGM) systems. This strategy enables the adjustment of dietary intake to individual metabolic needs, which may lead to improved health outcomes [4].

Glycemic monitoring systems have evolved over centuries, fundamentally transforming diabetes management. Initially, glucose levels were assessed using urine samples; however, over time, the focus shifted to blood and interstitial fluid measurements [5]. The origins of self-monitoring blood glucose (SMBG) systems date back to the 1970s with the introduction of glucometers, marking a significant milestone in diabetes management [6]. Currently, the most advanced solution in this field is the Continuous Glucose Monitoring systems, which became commercially available in 1999 and have since transformed the approach to glycemic control [7].

Continuous glucose monitoring systems are increasingly adopted across diverse domains of medicine and biomedical research. Initially developed to facilitate real-time glucose tracking and optimize diabetes management, these technologies are now being applied in broader contexts, including the prediction of diabetes onset in non-diabetic populations [8]. Moreover, CGM is gaining recognition as a valuable tool in monitoring glycemic fluctuations during pregnancy and in athletic performance assessment, offering insights into metabolic responses to physical exertion [9][10].

In recent years, CGM has also been utilized in critically ill patients, particularly during the COVID-19 pandemic. The implementation of these systems enabled effective glucose monitoring while simultaneously reducing direct contact between healthcare personnel and patients [11].

This review aims to provide a comprehensive overview of the applications and integrated benefits of CGM systems, with particular emphasis on their use in both individuals with diabetes and those without the condition.

2. Technological foundations of CGM systems

Continuous glucose monitoring systems have undergone significant technological advancements over the years and are now regarded as standard tools for intensive glycemic management in patients with diabetes [12].

These systems consist of a disposable sensor that measures glucose levels in the interstitial fluid at intervals of approximately 1–5 minutes, and a transmitter that transmits and/or stores sensor readings to a dedicated receiver or mobile devices such as smartphones, smartwatches, or cloud platforms. [13]. Electrodes used in CGM systems employ enzymes to catalyze redox (reduction-oxidation) reactions, generating a current or voltage proportional to glucose concentration, which can be measured by the electrodes [14]. Sensor readings based on glucose oxidase may exhibit delays, typically ranging from 5 to 10 minutes, due to the time lag between interstitial and blood glucose concentrations [12].

Modern CGM systems not only measure glucose levels but also enable the analysis of trends and the detection of glycemic patterns. Users receive metrics such as time in range (TIR), time below range (TBR), and time above range (TAR), which are gaining recognition as critical indicators of glycemic control. Notably, TIR has been shown to correlate independently with diabetes-related complications, complementing the traditional HbA1c metric [15]. Furthermore, the latest devices, such as the Dexcom G7 and FreeStyle Libre 3, offer high point accuracy and support real-time therapeutic decision-making [16].

3. Clinical applications in diabetes management

Diabetes mellitus represents a group of metabolic disorders involving disturbances in carbohydrate metabolism, where glucose is underutilized and overproduced, resulting in elevated blood glucose levels (hyperglycemia) [17]. Currently, approximately 422 million individuals worldwide are affected by diabetes, and the number of people living with the condition has been increasing steadily in recent years. [18].

In diabetes management, regular monitoring of blood glucose levels is an essential and indispensable component of therapy [19]. For years, the cornerstone of glycemic control has been self-monitoring of blood glucose using capillary blood samples [20]. However, this method is associated with discomfort and inconvenience due to the need for frequent finger-pricking, which may reduce patient adherence to strict glucose monitoring [19].

The introduction of Continuous Glucose Monitoring systems has enabled continuous tracking of glucose levels, allowing for more precise and proactive glycemic management. This, in turn, contributes to the reduction of adverse events such as hypoglycemia [21]

3.1. Application of CGM Systems in Type 1 Diabetes

Continuous glucose monitoring systems have changed how type 1 diabetes (T1D) is managed. They not only show real-time glucose levels but also help track changes and give early warnings for low or high glucose levels.

Studies have shown that using continuous glucose monitoring leads to a reduction in glycated hemoglobin (HbA1c), decreased incidence and severity of hypoglycemic episodes, and increased time in range (TIR) [22][23]. These benefits are especially noticeable in individuals who use CGM consistently, as shown in long-term results from a large trial Juvenile Diabetes Research Foundation’s CGM randomized trial [24].

In addition to measuring glucose levels, combining continuous glucose monitoring with continuous subcutaneous insulin infusion (CSII) has led to the creation of insulin pumps controlled by algorithms. These systems work in a closed-loop way, stopping insulin when low glucose is expected and giving extra insulin when blood sugar is too high [22]. This advancement has paved the way for the management of type 1 diabetes to rely on automated, technology-based solutions increasingly.

In pediatric populations, an additional benefit of CGM use is the increased comfort and reassurance experienced by parents. Parents of young children with type 1 diabetes report reduced anxiety and an enhanced sense of safety, particularly in situations where children are unable to recognize or communicate symptoms of hypo- or hyperglycemia. Moreover, entrusting the care of their children to others becomes more manageable due to the availability of remote glucose monitoring features [25].

In the analysis of T1D Exchange data comparing the effectiveness of CGM in insulin delivery methods, CGM users—both those using insulin pumps and those administering insulin via injections—demonstrated lower HbA1c levels compared to individuals not using CGM systems [26].

A cohort study investigating adults with type 1 diabetes demonstrated that the use of continuous glucose monitoring was associated with a reduced risk of developing diabetic retinopathy and proliferative diabetic retinopathy. These findings indicate that CGM may serve as an effective tool for lowering the risk of these microvascular complications [27].

Despite strong evidence supporting the efficacy, safety, and benefits of continuous glucose monitoring, cost remains a significant concern. A systematic review by Jiao et al. provides evidence that CGM may be a cost-effective strategy for individuals with type 1 diabetes, as it contributes to the reduction of chronic complications through improved glycemic control and decreases the frequency of hypoglycemic episodes [28].

In conclusion, continuous glucose monitoring systems are widely recognized as essential tools in the individualized treatment of type 1 diabetes, backed by extensive scientific research. Their utility goes beyond tracking glucose levels, providing meaningful benefits across different age groups and contributing to the prevention of long-term diabetes complications, which supports their growing role in contemporary diabetes care.

3.2. Application of CGM Systems in Type 2 Diabetes

As early as 1998, the UKPDS 33 study demonstrated a significant reduction in microvascular complications through intensive glycemic control in individuals with type 2 diabetes [29]. This landmark study highlighted the importance of consistent glucose monitoring and maintaining target glucose levels. While continuous glucose monitoring systems are now recognized as the standard of care for individuals with type 1 diabetes, their adoption among those with type 2 diabetes (T2DM) has progressed more slowly and is primarily focused on patients undergoing intensive insulin therapy [30].

Traditional glucose monitoring methods, such as self-monitoring of blood glucose (SMBG), provide only intermittent readings, which may result in hyperglycemic or hypoglycemic episodes going undetected. In contrast, CGM systems offer real-time tracking of glycemic fluctuations, enabling the detection of trends and excursions that SMBG may miss. An increasing body of evidence from randomized controlled trials emphasizes the clinical benefits of CGM use in the management of type 2 diabetes [31][32][33][34].

HbA1c remains the most commonly studied parameter in clinical research on diabetes. In both the DIAMOND trial and the MOBILE study, a significant reduction in HbA1c levels was observed among patients with poorly controlled type 2 diabetes who were treated either with basal insulin alone or multiple daily insulin injections [31][32]. Systematic reviews and meta-analyses further support the effectiveness of CGM and intermittently scanned CGM (isCGM) in lowering HbA1c, while also suggesting that isCGM may be more acceptable to patients due to its ease of use and user-friendly design [19].

Beyond laboratory parameters, studies demonstrated that CGM not only facilitates improved glycemic control but also reduces the frequency and severity of hypoglycemia episodes, one of the main limitations of insulin therapy [35]. In addition to enhancing clinical outcomes, CGM contributes to significant behavioral changes [36][37]. Research by Yoo et al. (2008) and Manfredo et al. (2023) indicated that even short-term use of CGM can lead to increased physical activity, improved dietary habits, and heightened diabetes-related awareness.

Moreover, findings from a 2012 study revealed that glycemic improvements were sustained even after discontinuation of CGM use, suggesting a lasting behavioral effect and potential for long-term benefit beyond active device use [33].

The above evidence indicates that continuous glucose monitoring has become a valuable adjunct to the management of type 2 diabetes. Its benefits extend beyond laboratory parameters to include improvements in quality of life. However, questions remain regarding cost-effectiveness and integration strategies, particularly for patients not treated with insulin. Further research is needed to evaluate the long-term impact of CGM on diabetes-related complications, as well as on health system economics.

4. Application of CGM Systems in Pregnancy

The incidence and clinical impact of diabetes in pregnancy are increasing, with the incidence of both gestational diabetes mellitus (GDM) and pregestational diabetes nearly doubling over recent decades. Despite enhanced medical care, perinatal mortality rates have not declined, and the risk remains significantly higher compared to women without diabetes [38].

Continuous glucose monitoring systems are becoming increasingly prevalent among pregnant women with type 1 diabetes [39]. They have emerged as promising tools for optimizing glycemic control in this population. The landmark CONCEPTT study - a multicenter, randomized controlled trial involving 325 participants (including 215 pregnant women) - demonstrated that the use of CGM significantly improves glycemic parameters. The study reported reductions in HbA1c levels, increased time within the target glycemic range, and reduced time spent above the target range in women using CGM compared to those in the control group. Furthermore, women utilizing CGM exhibited a decreased incidence of large-for-gestational-age (LGA) newborns, fewer neonatal intensive care unit (NICU) admissions, shorter infant hospitalizations, and lower rates of neonatal hypoglycemia [40].

A population-based study conducted by Persson et al. observed that fetal macrosomia in type 1 diabetes results from a shift and broadening of the entire birthweight distribution. These findings indicate that fetal macrosomia in type 1 diabetes reflects broader metabolic disturbances rather than being solely attributed to isolated episodes of severe hyperglycemia [41].

While most data on the benefits of CGM during pregnancy are derived from studies involving women with type 1 diabetes, there is growing interest in its application among women with type 2 diabetes. In a cohort study, Murphy et al. evaluated 15,290 pregnant women, including 8,685 with type 2 diabetes. Their findings revealed a significant clinical challenge, as women with type 2 diabetes exhibited a higher median gestational age at delivery and higher neonatal mortality rates compared to those with type 1 diabetes [42]. These and other complications emphasize the need for greater focus on this group. Preliminary evidence suggests that CGM use in pregnant women with type 2 diabetes may similarly reduce maternal and neonatal complications; however, further research is warranted [43].

In the case of GDM, a growing body of research also supports the use of CGM to improve glycemic control and reduce risks for both mothers and newborns. A study conducted by Law et al. among women with GDM demonstrated that, despite overall good glycemic control, unrecognized nocturnal hyperglycemia episodes were significantly associated with an increased risk of LGA newborns [44]. Another study by Kluemper et al. confirmed that CGM use in GDM resulted in lower HbA1c levels at the end of pregnancy, less maternal weight gain, and lower neonatal birth weights compared to self-monitoring of blood glucose (SMBG) [45].

Nonetheless, further studies are necessary to better understand the impact of CGM on maternal and neonatal outcomes. Additional research by Li et al. suggested that CGM could serve as a supportive or even alternative tool to the oral glucose tolerance test (OGTT). Metrics derived from CGM, such as the TA140 index, may provide an early screening method for detecting elevated glucose levels during pregnancy, potentially replacing OGTT [46].

Regardless of the type of diabetes, fetal exposure to hyperglycemia has been linked to long-term adverse metabolic programming in offspring, including an increased risk of obesity and glucose intolerance later in life [47]. Therefore, efforts to improve glycemic control during pregnancy, such as broader implementation of CGM systems, may offer benefits not only during the neonatal period but also in the long-term health outcomes of future generations.

5. Application of CGM Systems in Sports

Physical activity plays a crucial role in the management of both type 1 and type 2 diabetes; however, its implementation can be hindered by psychological barriers and the risk of acute complications, including hypoglycemia. Even small lifestyle modifications, such as reducing sedentary time, can significantly improve glycemic regulation in individuals with type 2 diabetes [48]. Nevertheless, fear of hypoglycemia, particularly in patients with type 1 diabetes, remains a significant obstacle to engaging in physical activity[49]. In this context, continuous glucose monitoring systems have gained increasing importance, as they enable real-time assessment of glucose levels and prediction of their fluctuations during and after physical exercise.

Several studies have demonstrated that the use of continuous glucose monitoring can significantly reduce the risk of hypoglycemia in individuals with diabetes engaging in physical activity [50][51][52][53][54]. In an observational study by Riddell and Milliken, the implementation of CGM in conjunction with a carbohydrate intake algorithm effectively prevented exercise-induced hypoglycemia in real-world settings [53]. Similarly, the randomized controlled PACE trial showed that the use of a CGM system equipped with a predictive low-glucose alert significantly reduced the amount of time spent below the hypoglycemic threshold (<70 mg/dL) compared to the control group [51].

Additional evidence is provided by a randomized clinical trial conducted by Laffel et al., which included young patients with type 1 diabetes. The study demonstrated that regular use of CGM not only improves glycemic control but also significantly reduces the frequency of hypoglycemic episodes in a population particularly susceptible to such events [54]. These findings highlight the practical utility of CGM not only as a monitoring tool but also as a preventive measure against acute metabolic disturbances during physical activity.

An increasing number of studies highlight the potential benefits of using continuous glucose monitoring in athletes without diabetes and in healthy, physically active individuals. In this context, the primary goal is not the prevention of adverse events associated with a disease such as diabetes, but rather the monitoring of physiological responses to physical exercise and the assessment of metabolic changes.

Kulawiec et al. conducted a study on a small group of participants; however, the findings may represent an important step toward understanding the utility of CGM in a healthy population. Using CGM devices, they showed that physical exercise can cause an inflammatory response characterized by hyperglycemia and hyperinsulinemia. Moreover, found that blood sugar levels vary more than expected after eating carbohydrates, suggesting a disruption of normal metabolic processes. The authors emphasize that commercially available CGM systems hold potential for monitoring athletes' recovery following high-intensity training [55].

In their study, Ishihara et al. presented the estimation of individual carbohydrate requirements using CGM. They analyzed six participants in a 100 km race, divided into two groups: one group followed a standard carbohydrate intake, while the other group’s intake was tailored based on CGM measurements. The results showed that using continuous glucose monitoring helped athletes adjust their carbohydrate intake more accurately to match their body’s needs. This led to more stable blood sugar levels and faster running speeds. The authors concluded that CGM can be a useful and effective tool for personalizing nutrition strategies during long endurance exercise, helping to improve both safety and performance [56].

In a study conducted by Flockhart and Larsen (2024), the authors emphasize the importance of considering the physiological context when interpreting CGM data. They highlight that athletes often display highly individual glucose profiles and may spend a considerable amount of time in both hypo- and hyperglycemic states. The study also suggests that CGM can be used not only to optimize athletic performance but also as a tool for early detection of physical overload, particularly in endurance sports [10].

Further research is needed before CGM can become a standard tool in training for athletes without diabetes. However, the examples discussed above show that these systems may offer added value in monitoring metabolic adaptations and supporting the personalization of nutritional plans for high-performance athletes.

6. The role of CGM in critical care

Continuous glucose monitoring systems are becoming increasingly important in hospital settings. A turning point was the COVID-19 pandemic, when CGM allowed for effective insulin therapy while helping to reduce the risk of virus transmission to healthcare personnel.

In a study conducted by Sadhu et al., 11 critically ill patients with COVID-19 receiving intravenous and/or subcutaneous insulin therapy were monitored using both continuous glucose monitoring and point-of-care blood glucose (POC-BG) measurements, resulting in a total of 437 paired readings. The findings showed that CGM use was feasible, reliable, and accurate for tracking real-time glucose trends. Additionally, it helped reduce healthcare workers' exposure to patients and lowered the use of personal protective equipment during the COVID-19 pandemic [11].

During the COVID-19 pandemic, continuous glucose monitoring systems were implemented in the intensive care unit (ICU) at Montefiore Medical Center to evaluate their effectiveness and accuracy in real-world clinical settings. The study included 11 critically ill patients. The results showed that CGM use in the ICU was feasible, well tolerated, and reliable as a complement to traditional glucose measurements. Moreover, the use of CGM significantly reduced the number of point-of-care (POC) tests needed in patients receiving continuous intravenous insulin therapy, highlighting its potential to support glucose monitoring in critically ill patients [57].

A similar study was conducted at a large academic medical center in the United States, where the use of a hybrid model combining point-of-care glucose measurements with continuous glucose monitoring was evaluated in critically ill COVID-19 patients. This protocol proved to be safe, leading to a significant reduction in the number of POC measurements and providing acceptable glucose control with minimal risk of hypoglycemia. Although the accuracy of CGM was not sufficient, satisfactory glucose control was still achieved [58].

Conclusion

Continuous glucose monitoring (CGM) systems have rapidly developed in recent years, and with this, the number of applications in which they can be beneficial has expanded. Their use extends beyond diabetes management, including applications in sports, pregnancy, and critical care.

The technological advancements allowing real-time glucose level monitoring significantly improve diabetes management, personalization, and effective treatment for patients with both type 1 and type 2 diabetes. Beyond treatment, CGM provides additional benefits that impact not only the physical but also the mental health of patients. With continuous glucose monitoring, diabetic patients have better control over their health, reducing the risk of complications like retinopathy, nephropathy, and neuropathy.

Beyond diabetes, CGM has also found applications in pregnant women, both in cases of gestational diabetes and pre-pregnancy diabetes. Studies indicate that CGM can improve glycemic control in pregnant women, reducing the risk of complications for both the mother and the child, such as large for gestational age (LGA) infants and neonatal hypoglycemia.
Studies on the use of CGM in sports show promising results. With the ability to monitor glucose levels in real time, CGM allows for better dietary strategy adjustments and minimizes the risk of hypoglycemia during intense exercise. In the future, CGM may become a valuable tool not only for prevention but also for personalized nutrition, supporting the optimization of athletic performance.

In hospital settings, particularly in intensive care units, CGM can reduce the risk of infections and limit medical staff contact with patients. Research has shown that CGM can serve as an effective alternative to traditional glucose measurement methods, enabling better glucose level management in critical health conditions.

Although CGM systems offer numerous benefits, challenges still exist, such as their availability, cost, and the need for integration with other treatment methods. In the future, further development of CGM technology and its application in new patient populations and clinical situations may lead to even greater health benefits. Further research is needed to understand CGM's effects and impact on current and emerging patient populations.

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REFERENCES:

[1] El Malahi A, Van Elsen M, Charleer S, et al. Relationship Between Time in Range, Glycemic Variability, HbA1c, and Complications in Adults With Type 1 Diabetes Mellitus. J Clin Endocrinol Metab. 2022;107(2):e570-e581. doi:10.1210/clinem/dgab688

[2] Campbell JE, Newgard CB. Mechanisms controlling pancreatic islet cell function in insulin secretion. Nat Rev Mol Cell Biol. 2021;22(2):142-158. doi:10.1038/s41580-020-00317-7

[3] American Diabetes Association Professional Practice Committee . 7. Diabetes Technology: Standards of Care in Diabetes-2025 [published correction appears in Diabetes Care. 2025 Apr 1;48(4):666. doi: 10.2337/dc25-er04b.]. Diabetes Care. 2025;48(Supplement_1):S146-S166. doi:10.2337/dc25-S007

[4] Merino J, Linenberg I, Bermingham KM, et al. Validity of continuous glucose monitoring for categorizing glycemic responses to diet: implications for use in personalized nutrition. Am J Clin Nutr. 2022;115(6):1569-1576. doi:10.1093/ajcn/nqac026

[5] Raza, S., Raza, S., Kazmi, M., Saad, M. and Hussain, I. (2021) 100 Years of Glucose Monitoring in Diabetes Management. Journal of Diabetes Mellitus, 11, 221-233. doi: 10.4236/jdm.2021.115019

[6] Clarke SF, Foster JR. A history of blood glucose meters and their role in self-monitoring of diabetes mellitus. Br J Biomed Sci. 2012;69(2):83-93.

[7] Didyuk O, Econom N, Guardia A, Livingston K, Klueh U. Continuous Glucose Monitoring Devices: Past, Present, and Future Focus on the History and Evolution of Technological Innovation. J Diabetes Sci Technol. 2021;15(3):676-683. doi:10.1177/1932296819899394

[8] Rodríguez García J, Camiña Darriba F, Ortolá Devesa JB, Rodríguez-Segade Villamarín S, Valle Rodríguez A. Parameters of glycemic variability in continuous glucose monitoring as predictors of diabetes: a prospective evaluation in a non-diabetic general population. Adv Lab Med. 2025;6(1):46-51. Published 2025 Mar 7. doi:10.1515/almed-2025-0011

[9] Horgan R, Hage Diab Y, Fishel Bartal M, Sibai BM, Saade G. Continuous Glucose Monitoring in Pregnancy. Obstet Gynecol. 2024;143(2):195-203. doi:10.1097/AOG.0000000000005374

[10] Flockhart M, Larsen FJ. Continuous Glucose Monitoring in Endurance Athletes: Interpretation and Relevance of Measurements for Improving Performance and Health. Sports Med. 2024;54(2):247-255. doi:10.1007/s40279-023-01910-4

[11] Sadhu AR, Serrano IA, Xu J, et al. Continuous Glucose Monitoring in Critically Ill Patients With COVID-19: Results of an Emergent Pilot Study. J Diabetes Sci Technol. 2020;14(6):1065-1073. doi:10.1177/1932296820964264

[12] Cappon G, Vettoretti M, Sparacino G, Facchinetti A. Continuous Glucose Monitoring Sensors for Diabetes Management: A Review of Technologies and Applications. Diabetes Metab J. 2019;43(4):383-397. doi:10.4093/dmj.2019.0121

[13] Dovc K, Battelino T. Evolution of Diabetes Technology. Endocrinol Metab Clin North Am. 2020;49(1):1-18. doi:10.1016/j.ecl.2019.10.009

[14] Chen C, Zhao XL, Li ZH, Zhu ZG, Qian SH, Flewitt AJ. Current and Emerging Technology for Continuous Glucose Monitoring. Sensors (Basel). 2017;17(1):182. Published 2017 Jan 19. doi:10.3390/s17010182

[15] Dunn TC, Ajjan RA, Bergenstal RM, Xu Y. Is It Time to Move Beyond TIR to TITR? Real-World Data from Over 20,000 Users of Continuous Glucose Monitoring in Patients with Type 1 and Type 2 Diabetes. Diabetes Technol Ther. 2024;26(3):203-210. doi:10.1089/dia.2023.0565

[16] Hanson K, Kipnes M, Tran H. Comparison of Point Accuracy Between Two Widely Used Continuous Glucose Monitoring Systems. J Diabetes Sci Technol. 2024;18(3):598-607. doi:10.1177/19322968231225676

[17] Sacks DB, Arnold M, Bakris GL, et al. Guidelines and Recommendations for Laboratory Analysis in the Diagnosis and Management of Diabetes Mellitus. Diabetes Care. 2023;46(10):e151-e199. doi:10.2337/dci23-0036

[18] World Health Organization. Diabetes. Accessed April 13, 2025. https://www.who.int/health-topics/diabetes#tab=tab_1

[19] Seidu S, Kunutsor SK, Ajjan RA, Choudhary P. Efficacy and Safety of Continuous Glucose Monitoring and Intermittently Scanned Continuous Glucose Monitoring in Patients With Type 2 Diabetes: A Systematic Review and Meta-analysis of Interventional Evidence. Diabetes Care. 2024;47(1):169-179. doi:10.2337/dc23-1520

[20] Schnell O, Alawi H, Battelino T, et al. Self-monitoring of blood glucose in type 2 diabetes: recent studies. J Diabetes Sci Technol. 2013;7(2):478-488. Published 2013 Mar 1. doi:10.1177/193229681300700225

[21] van Beers CA, DeVries JH, Kleijer SJ, et al. Continuous glucose monitoring for patients with type 1 diabetes and impaired awareness of hypoglycaemia (IN CONTROL): a randomised, open-label, crossover trial. Lancet Diabetes Endocrinol. 2016;4(11):893-902. doi:10.1016/S2213-8587(16)30193-0

[22] Marks BE, Wolfsdorf JI. Monitoring of Pediatric Type 1 Diabetes. Front Endocrinol (Lausanne). 2020;11:128. Published 2020 Mar 17. doi:10.3389/fendo.2020.00128

[23] Zhou Y, Sardana D, Kuroko S, et al. Comparing the glycaemic outcomes between real-time continuous glucose monitoring (rt-CGM) and intermittently scanned continuous glucose monitoring (isCGM) among adults and children with type 1 diabetes: A systematic review and meta-analysis of randomized controlled trials. Diabet Med. 2024;41(3):e15280. doi:10.1111/dme.15280

[24] Chase HP, Beck RW, Xing D, et al. Continuous glucose monitoring in youth with type 1 diabetes: 12-month follow-up of the Juvenile Diabetes Research Foundation continuous glucose monitoring randomized trial. Diabetes Technol Ther. 2010;12(7):507-515. doi:10.1089/dia.2010.0021

[25] Hilliard ME, Levy W, Anderson BJ, et al. Benefits and Barriers of Continuous Glucose Monitoring in Young Children with Type 1 Diabetes. Diabetes Technol Ther. 2019;21(9):493-498. doi:10.1089/dia.2019.0142

[26] Foster NC, Miller KM, Tamborlane WV, Bergenstal RM, Beck RW; T1D Exchange Clinic Network. Continuous Glucose Monitoring in Patients With Type 1 Diabetes Using Insulin Injections. Diabetes Care. 2016;39(6):e81-e82. doi:10.2337/dc16-0207

[27] Liu TYA, Shpigel J, Khan F, et al. Use of Diabetes Technologies and Retinopathy in Adults With Type 1 Diabetes. JAMA Netw Open. 2024;7(3):e240728. Published 2024 Mar 4. doi:10.1001/jamanetworkopen.2024.0728

[28] Jiao Y, Lin R, Hua X, et al. A systematic review: Cost-effectiveness of continuous glucose monitoring compared to self-monitoring of blood glucose in type 1 diabetes. Endocrinol Diabetes Metab. 2022;5(6):e369. doi:10.1002/edm2.369

[29] Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group [published correction appears in Lancet 1999 Aug 14;354(9178):602]. Lancet. 1998;352(9131):837-853.

[30] Ajjan RA, Battelino T, Cos X, et al. Continuous glucose monitoring for the routine care of type 2 diabetes mellitus. Nat Rev Endocrinol. 2024;20(7):426-440. doi:10.1038/s41574-024-00973-1

[31] Martens T, Beck RW, Bailey R, et al. Effect of Continuous Glucose Monitoring on Glycemic Control in Patients With Type 2 Diabetes Treated With Basal Insulin: A Randomized Clinical Trial. JAMA. 2021;325(22):2262-2272. doi:10.1001/jama.2021.7444

[32] Beck RW, Riddlesworth TD, Ruedy K, et al. Continuous Glucose Monitoring Versus Usual Care in Patients With Type 2 Diabetes Receiving Multiple Daily Insulin Injections: A Randomized Trial. Ann Intern Med. 2017;167(6):365-374. doi:10.7326/M16-2855

[33] Vigersky, R. A., Fonda, S. J., Chellappa, M., Walker, M. S., & Ehrhardt, N. M. (2012). Short- and long-term effects of real-time continuous glucose monitoring in patients with type 2 diabetes. Diabetes care, 35(1), 32–38. https://doi.org/10.2337/dc11-1438

[34] Lind N, Christensen MB, Hansen DL, Nørgaard K. Comparing continuous glucose monitoring and blood glucose monitoring in adults with inadequately controlled, insulin-treated type 2 diabetes (Steno2tech study): a 12-month, single-center, randomized controlled trial. Diabetes Care. 2024;47(5):881-889. doi:10.2337/dc23-2194

[35] Haak T, Hanaire H, Ajjan R, Hermanns N, Riveline JP, Rayman G. Flash Glucose-Sensing Technology as a Replacement for Blood Glucose Monitoring for the Management of Insulin-Treated Type 2 Diabetes: a Multicenter, Open-Label Randomized Controlled Trial. Diabetes Ther. 2017;8(1):55-73. doi:10.1007/s13300-016-0223-6

[36] Yoo HJ, An HG, Park SY, et al. Use of a real time continuous glucose monitoring system as a motivational device for poorly controlled type 2 diabetes. Diabetes Res Clin Pract. 2008;82(1):73-79. doi:10.1016/j.diabres.2008.06.015

[37] Manfredo J, Lin T, Gupta R, et al. Short-term use of CGM in youth onset type 2 diabetes is associated with behavioral modifications. Front Endocrinol (Lausanne). 2023;14:1182260. Published 2023 May 29. doi:10.3389/fendo.2023.1182260

[38] Feig DS, Hwee J, Shah BR, Booth GL, Bierman AS, Lipscombe LL. Trends in incidence of diabetes in pregnancy and serious perinatal outcomes: a large, population-based study in Ontario, Canada, 1996–2010. Diabetes Care. 2014;37(6):1590-1596. doi:10.2337/dc13-2717

[39] Levy CJ, Foster NC, DuBose SN, et al. Changes in Device Uptake and Glycemic Control Among Pregnant Women With Type 1 Diabetes: Data From the T1D Exchange. J Diabetes Sci Technol. 2021;15(6):1297-1302. doi:10.1177/1932296820972123

[40] Feig DS, Donovan LE, Corcoy R, et al. Continuous glucose monitoring in pregnant women with type 1 diabetes (CONCEPTT): a multicentre international randomised controlled trial [published correction appears in Lancet. 2017 Nov 25;390(10110):2346. doi: 10.1016/S0140-6736(17)32712-5.]. Lancet. 2017;390(10110):2347-2359. doi:10.1016/S0140-6736(17)32400-5

[41] Persson M, Pasupathy D, Hanson U, Norman M. Birth size distribution in 3,705 infants born to mothers with type 1 diabetes: a population-based study. Diabetes Care. 2011;34(5):1145-1149. doi:10.2337/dc10-2406

[42] Murphy HR, Howgate C, O'Keefe J, et al. Characteristics and outcomes of pregnant women with type 1 or type 2 diabetes: a 5-year national population-based cohort study. Lancet Diabetes Endocrinol. 2021;9(3):153-164. doi:10.1016/S2213-8587(20)30406-X

[43] Rizos EC, Markozannes G, Charitakis N, et al. Continuous Glucose Monitoring in Type 1 Diabetes, Type 2 Diabetes, and Diabetes During Pregnancy: A Systematic Review With Meta-Analysis of Randomized Controlled Trials. Diabetes Technol Ther. Published online 2025. doi:10.1089/dia.2024.0599

[44] Law GR, Alnaji A, Alrefaii L, et al. Suboptimal Nocturnal Glucose Control Is Associated With Large for Gestational Age in Treated Gestational Diabetes Mellitus. Diabetes Care. 2019;42(5):810-815. doi:10.2337/dc18-2212

[45] Kluemper JR, Smith A, Wobeter B. Diabetes: the role of continuous glucose monitoring. Drugs Context. 2022;11:2021-9-13. Published 2022 Jun 14. doi:10.7573/dic.2021-9-13

[46] Li Z, Beck R, Durnwald C, et al. Continuous Glucose Monitoring Prediction of Gestational Diabetes Mellitus and Perinatal Complications. Diabetes Technol Ther. 2024;26(11):787-796. doi:10.1089/dia.2024.0080

[47] Clausen TD, Mathiesen ER, Hansen T, et al. High prevalence of type 2 diabetes and pre-diabetes in adult offspring of women with gestational diabetes mellitus or type 1 diabetes: the role of intrauterine hyperglycemia. Diabetes Care. 2008;31(2):340-346. doi:10.2337/dc07-1596

[48] Paing AC, McMillan KA, Kirk AF, Collier A, Hewitt A, Chastin SFM. Impact of free-living pattern of sedentary behaviour on intra-day glucose regulation in type 2 diabetes. Eur J Appl Physiol. 2020;120(1):171-179. doi:10.1007/s00421-019-04261-z

[49] Cockcroft EJ, Narendran P, Andrews RC. Exercise-induced hypoglycaemia in type 1 diabetes. Exp Physiol. 2020;105(4):590-599. doi:10.1113/EP088219

[50] Abdulrahman A, Manhas J, Linane H, Gurney M, Fitzgerald C, O'Sullivan E. Use of continuous glucose monitoring for sport in type 1 diabetes. BMJ Open Sport Exerc Med. 2018;4(1):e000432. Published 2018 Dec 17. doi:10.1136/bmjsem-2018-000432

[51] Rilstone S, Oliver N, Godsland I, Tanushi B, Thomas M, Hill N. A Randomized Controlled Trial Assessing the Impact of Continuous Glucose Monitoring with a Predictive Hypoglycemia Alert Function on Hypoglycemia in Physical Activity for People with Type 1 Diabetes (PACE). Diabetes Technol Ther. 2024;26(2):95-102. doi:10.1089/dia.2023.0376

[52] Houlder SK, Yardley JE. Continuous Glucose Monitoring and Exercise in Type 1 Diabetes: Past, Present and Future. Biosensors (Basel). 2018;8(3):73. Published 2018 Aug 3. doi:10.3390/bios8030073

[53] Riddell MC, Milliken J. Preventing exercise-induced hypoglycemia in type 1 diabetes using real-time continuous glucose monitoring and a new carbohydrate intake algorithm: an observational field study. Diabetes Technol Ther. 2011;13(8):819-825. doi:10.1089/dia.2011.0052

[54] Laffel LM, Kanapka LG, Beck RW, et al. Effect of Continuous Glucose Monitoring on Glycemic Control in Adolescents and Young Adults With Type 1 Diabetes: A Randomized Clinical Trial. JAMA. 2020;323(23):2388-2396. doi:10.1001/jama.2020.6940

[55] Kulawiec DG, Zhou T, Knopp JL, Chase JG. Continuous glucose monitoring to measure metabolic impact and recovery in sub-elite endurance athletes. Biomed Signal Process Control. 2021;70:103059. doi:10.1016/j.bspc.2021.103059

[56] Ishihara K, Uchiyama N, Kizaki S, Mori E, Nonaka T, Oneda H. Application of Continuous Glucose Monitoring for Assessment of Individual Carbohydrate Requirement

during Ultramarathon Race. Nutrients. 2020;12(4):1121. Published 2020 Apr 17. doi:10.3390/nu12041121

[57] Agarwal S, Mathew J, Davis GM, et al. Continuous Glucose Monitoring in the Intensive Care Unit During the COVID-19 Pandemic. Diabetes Care. 2021;44(3):847-849. doi:10.2337/dc20-2219

[58] Faulds ER, Boutsicaris A, Sumner L, et al. Use of Continuous Glucose Monitor in Critically Ill COVID-19 Patients Requiring Insulin Infusion: An Observational Study. J Clin Endocrinol Metab. 2021;106(10):e4007-e4016. doi:10.1210/clinem/dgab409