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THE ROLE OF SMARTPHONE GLUCOSE MONITORING APPS IN IMPROVING SELF-MANAGEMENT AMONG PATIENTS WITH TYPE 2 DIABETES

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ABSTRACT

Type 2 diabetes remains one of the most common chronic diseases worldwide, and despite available treatment options, achieving optimal glycaemic control is still a challenge for many patients [1]. In recent years, the growing availability of smartphones and the development of continuous glucose monitoring (CGM) systems have created new opportunities to support daily self-management [6]. This narrative review aims to explore the role of smartphone-based glucose monitoring applications in the management of type 2 diabetes. The analysis is based on literature from PubMed and Google Scholar published between 2015 and 2026. The selected studies focused on the use of CGM systems integrated with mobile applications and their impact on clinical outcomes, patient adherence, and quality of life. The available evidence suggests that these technologies may improve glycaemic control, as reflected by reductions in HbA1c levels, increased time in range (TIR), and fewer episodes of hypo- and hyperglycaemia [14, 15]. In addition, they appear to support greater patient engagement and independence by providing real-time feedback and facilitating a better understanding of the relationship between lifestyle factors and glucose levels [6]. At the same time, several limitations need to be considered, including unequal access to technology and cost-related barriers [10]. Overall, smartphone-based CGM applications seem to be a valuable addition to standard diabetes care, although their effectiveness depends on proper implementation and long-term use.

KEYWORDS

Type 2 Diabetes Mellitus; Continuous Glucose Monitoring; Mobile Applications; Self-Care; Telemedicine; Glycemic Control; Patient Compliance; Digital Health Technologies

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Introduction

Diabetes is one of the leading causes of disability and premature mortality worldwide. It affects individuals across all age groups and populations globally. A rapidly increasing trend has been observed since 1990, and by 2021 the number of individuals with diabetes exceeded 500 million, with over 90% of cases attributed to type 2 diabetes [1]. The increase in lifestyle-related/metabolic diseases is largely driven by reduced physical activity and sedentary behavior, which are closely linked to urbanization and changes in dietary patterns. [2] Globally, nearly one-third of adults fail to achieve recommended levels of physical activity, which is associated with approximately 3.2 million deaths each year. [3] Despite available treatments, glycaemic control remains suboptimal in many patients and that leads to severe complications of the disease. This fact highlights the need for innovative tools to support everyday self-management. Average daily smartphone use may exceed 7 hours, particularly among young adults, and with over 3.8 billion smartphone users worldwide (per 2022 year)—representing nearly half of the global population—this underscores the potential of easily accessible tools for everyday glycemic control. [4, 5] In this context, smartphone-based glucose monitoring applications emerge as a promising tool, and this narrative review aims to explore their role in supporting self-management among patients with type 2 diabetes.

Methodology

This narrative review was based on literature from PubMed and Google Scholar. The search included keywords such as *type 2 diabetes*, *continuous glucose monitoring*, *CGM*, *smartphone applications*, and *self-management*, used in different combinations to obtain relevant results. Only articles published between 2015 and 2026 were included, reflecting the rapid development of mobile technologies in diabetes care. Studies were initially selected based on titles and abstracts, and then full texts were reviewed in more detail. Both original studies and review articles were considered to provide a broader perspective. Papers focused

exclusively on other types of diabetes were generally excluded, unless they offered insights applicable to type 2 diabetes. Additionally, reference lists of selected articles were screened to identify further relevant studies. Due to the narrative nature of this review, no formal systematic review protocol was applied, and the aim was to present a descriptive overview of the available literature.

Results

Important aspects of type 2 diabetes treatment include lifestyle changes, a proper diet, weight loss, increased physical activity, and pharmacotherapy, most often consisting of metformin or insulin in advanced stages of the disease. Therefore, even in moderately advanced type 2 diabetes, where medication is not recommended, ongoing monitoring of blood glucose levels and, consequently, disease progression is essential. In the disease phase, when the patient is obliged to take medications, it is essential to understand how physical activity, food, and different types of insulin influence blood glycaemia. [8] Having the possibility to measure glucose levels so frequently on a daily basis quickly teaches patients how and when to properly dose their medication. Highlighting the need for easy, accessible, and pain-free measurement of blood glucose, the first continuous glucose monitoring systems were invented.

The first CGM systems integrated with smartphones were introduced over 20 years after the first touchscreen smartphone, in 2015, bringing hope for better glycaemic control and fewer complications among patients. Since then, continuous glucose monitoring technology compatible with smartphones has been advancing rapidly, offering digital tools designed for both patients and diabetes specialist doctors. These applications allow patients to record blood glucose levels, either manually or through automatic synchronization with monitoring devices. The collected data can be presented in graphical form, which helps to identify trends and patterns over time. In addition, many apps include reminder functions related to glucose measurements, medication use, or daily habits. Some platforms also integrate information on diet and physical activity, offering a broader perspective on factors that influence glycaemic control. [6]

Continuous glucose monitoring offers a broad spectrum of benefits to both patients and physicians. For patients, it allows continuous tracking of glucose levels, which in practice translates into better glycaemic control and a lower risk of both hypoglycaemia and hyperglycaemia. It also helps patients better understand their condition, as they can directly observe how diet, physical activity, or treatment affect glucose levels. In many cases, this leads to greater independence in daily self-management and improves quality of life, particularly by reducing the need for frequent finger-stick measurements and providing alert systems.

From a clinical perspective, CGM provides physicians with continuous and objective glucose data, which helps bridge the gap between routine visits. This makes it possible to adjust therapy more precisely and to detect patterns that might otherwise go unnoticed, such as nocturnal hypoglycaemia or significant glucose variability. The use of modern indicators, including time in range (TIR), further supports a more comprehensive assessment of glycaemic control. In addition, these systems facilitate remote monitoring, which is becoming increasingly important in modern telemedicine.

Importantly, these technologies are particularly useful in dependent populations, such as children, older adults, and patients with multiple comorbidities or disabilities. Through real-time data sharing, caregivers can monitor glucose levels even when they are not physically present, which improves safety and allows patients to maintain their usual daily activities. [7] Furthermore, current technologies allow the creation of so-called artificial pancreas systems by integrating continuous glucose monitoring with insulin pumps (AID) and smartphone applications. Such solutions can significantly increase independence in patients who require constant supervision, while also providing caregivers with a greater sense of safety and reassurance. [9]

Another important issue is patient education. Even the most advanced CGM-compatible application may be of limited value if the patient does not understand how to interpret glucose trends or respond appropriately to alarms and changes in glycaemic patterns. In everyday practice, patients are often faced with large amounts of data, which can be difficult to translate into practical decisions without proper guidance. As a result, there is a risk that the information provided by these systems may be underused or, in some cases, misinterpreted. The clinical usefulness of these technologies therefore depends not only on their technical quality, but also on the patient's ability to use the collected data in daily life. This includes recognizing patterns, adjusting lifestyle habits, and, when necessary, modifying treatment in accordance with medical recommendations. Importantly, the learning process takes time and often requires ongoing support from healthcare professionals. For this reason, digital tools should be introduced together with appropriate therapeutic education. Providing patients with clear instructions, practical examples, and regular follow-up may increase their confidence in using these

systems. In turn, this can improve adherence and contribute to more effective and sustainable self-management over the long term.

The promising development of CGM-based applications is increasingly supported by artificial intelligence, which can analyze real-time data, identify patterns, and even predict future glucose levels. In everyday use, this means that large volumes of information collected by sensors can be translated into more practical insights, rather than simply displayed as raw data. Instead of relying solely on retrospective analysis, patients and clinicians may benefit from early warnings or suggested adjustments based on predicted trends. As these technologies continue to evolve, they may enable more personalized treatment of type 2 diabetes, taking into account individual variability in response to diet, physical activity, and medication. Over time, this could gradually shift diabetes care toward a more predictive and partially automated model, in which routine decisions are increasingly supported by algorithms. At the same time, the role of the patient and clinician remains essential, particularly in interpreting recommendations and ensuring that technological support is used appropriately in real-life situations. [13]

Discussion

The diversity of access to technology around the world is very extreme. As mentioned before only half of population (45%-50%) has access to smartphones or other devices connected to internet. [4] Although continuous glucose monitoring systems technology admittedly helps with self-managing among patients with diabetes type-2 not everyone can afford a device compatible with CGM. In larger cities, the trade in electronic devices and the secondary market is highly developed and even poor or unemployed people can afford a basic, used smartphone. Persons of lower socio-economic status in rural areas or in low- and middle-income countries may be more likely to have access to technology issues. [10] Although consumer electronic technologies, such as smartphones, become more widely available over time due to rapid production and turnover, their cost and accessibility remain uneven across different regions and populations. [11]

Despite its well-documented clinical benefits, the use of CGM is still not widespread. This is largely due to high costs, limited reimbursement, and unequal access, especially among underserved populations. In study performed in 2021 in Grady Memorial Hospital in Atlanta, Georgia, history of CGM use was reported by 56% (42/75) of the participants, although half (20/42, 48%) had discontinued use, above all due to the cost of the device and issues with its adhesive [10] It is well recognized that reimbursement policies and eligibility criteria for CGM devices vary across countries; however, limited accessibility to this form of therapy remains a consistent issue reported in many studies.

Older adults may experience a range of difficulties when using smartphones, including age-related cognitive and physical limitations, as well as lower levels of digital literacy. In addition, concerns about complexity or lack of confidence can discourage them from using such technologies, even when they could be beneficial. In practice, many older individuals report that mobile applications are not intuitive and require a level of familiarity with digital interfaces that they have not previously developed. Even simple tasks, such as navigating menus, interpreting notifications, or adjusting application settings, may become challenging without prior experience. Physical factors also play an important role. Reduced visual acuity, impaired fine motor skills, or conditions such as tremor can make it difficult to interact with small touchscreens or read detailed graphical data. These limitations may lead to frustration and, over time, to reduced willingness to engage with the technology. Moreover, concerns about making mistakes or misinterpreting information can further decrease confidence in using such tools independently. [12]

Conclusions

Like any digital tool, CGM-compatible applications offer clear benefits, but they are not without limitations. Most available studies suggest that their use is associated with improved quality of life and better metabolic outcomes, including lower HbA1c levels, increased time in range (TIR), fewer episodes of hypo- and hyperglycaemia, and better treatment adherence. In some cases, a reduction in body weight has also been observed [14, 15]. At the same time, several important issues remain unresolved. There is still no widely accepted system for the standardization and validation of these applications. Although CGM systems generate large amounts of data, their interpretation is not always straightforward, and the lack of uniform guidelines may limit their clinical usefulness. This points to the need for further research, as well as clearer regulatory frameworks. Another aspect worth noting is the long-term effectiveness of these technologies. As CGM-based applications are still relatively new, more data from extended follow-up studies are needed to better understand their real-world impact. In addition, the growing role of artificial intelligence may further support

individualized care, although its practical application requires careful evaluation. It is also important to consider how these tools fit into everyday clinical practice. While they may facilitate remote monitoring and improve communication between patients and healthcare providers, their effective use depends on proper patient education and the ability to interpret the data correctly. In patients with type 2 diabetes, CGM-compatible applications can support self-management and increase patient involvement in treatment. However, they should be treated as a complement to standard care rather than a replacement, and their benefits are closely linked to accessibility, patient engagement, and appropriate clinical use.

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