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Assess the Effectiveness of Continuous Glucose Monitoring Device in Early Detection and Prevention of Glycemic Variability among Diabetes Patients

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Abstract: *Diabetes mellitus is a chronic metabolic disorder that requires continuous monitoring to prevent acute and long-term complications. Traditional intermittent finger-prick testing often fails to capture real-time glucose fluctuations, leading to missed hypoglycemic and hyperglycemic episodes. Continuous Glucose Monitoring (CGM) devices provide dynamic glucose trends that support early detection and improved self-management. This study aimed to assess the effectiveness of CGM in detecting glycemic variability and enhancing glycemic stability among early-diagnosed diabetic patients at SIMS Hospital, Vadapalani, Chennai.* ***Methods:*** *A pre-experimental one-group pretest–posttest design was employed. Early-diagnosed diabetic patients meeting the inclusion criteria were selected through purposive sampling. Baseline glycemic parameters—fasting glucose, postprandial glucose, and HbA1c—were recorded prior to CGM implementation. Participants were monitored using a CGM device for a specified period. Post-intervention glycemic data were compared with baseline values. Descriptive and inferential statistics, including paired t-test, were applied to evaluate the effectiveness of CGM in reducing glycemic variability.* ***Results:*** *CGM revealed previously undetected glycemic fluctuations, including nocturnal hypoglycemia and postprandial spikes in over 60% of participants. Mean fasting glucose levels improved after CGM use, and time-in-range increased significantly. HbA1c values showed improvement in a majority of patients following CGM-guided lifestyle and medication adjustments. Participants reported enhanced diabetes awareness, better adherence to diet and medication, and improved confidence in self-management.****Conclusion:*** *Continuous Glucose Monitoring is effective in early detection of glycemic variability, improving glycemic control, and enhancing diabetes self-management among newly diagnosed diabetic patients. Integration of CGM into routine diabetic care can reduce complications, improve clinical outcomes, and enhance overall quality of life.*

Keywords*:* Continuous Glucose Monitoring, Glycemic Variability, Diabetes Mellitus, Early Detection, Self-Management, Time-in-Range

I. INTRODUCTION

Diabetes mellitus is one of the most rapidly growing chronic metabolic disorders worldwide, characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both [1,2]. Its prevalence has increased dramatically over the past two decades, with India ranking among the countries with the highest burden of diabetes [1]. Early diagnosis and timely management are essential because uncontrolled blood glucose levels can lead to acute complications such as diabetic ketoacidosis and severe hypoglycemia, as well as long-term complications including retinopathy, nephropathy, neuropathy, cardiovascular disease, and reduced quality of life [2]. For newly diagnosed patients, maintaining tight glycemic control during the initial years of disease progression plays a crucial role in

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preventing irreversible microvascular and macrovascular damage [2]. Traditionally, self-monitoring of blood glucose (SMBG) through intermittent finger-prick testing has been the standard method for assessing glycemic status; however, SMBG provides only single time-point readings and often fails to detect glycemic fluctuations such as nocturnal hypoglycemia or postprandial spikes [2]. Continuous Glucose Monitoring (CGM) represents a major advancement in diabetes technology, offering real-time measurement of interstitial glucose levels and capturing fluctuations that SMBG may miss [3,4]. Numerous studies have shown that CGM use improves time-in-range, reduces glycemic variability, decreases hypoglycemic events, and enhances HbA1c outcomes and patient confidence [4–8].

For early-diagnosed diabetic patients, CGM provides essential insight into lifestyle–glucose relationships and supports self-management by offering instant feedback that guides medication adherence, dietary choices, activity, and stress management [9,10]. Despite its proven benefits, CGM adoption remains limited in many Indian clinical settings due to cost, accessibility, and lack of awareness [10]. Therefore, evaluating the effectiveness of CGM among newly diagnosed patients is crucial to support broader clinical integration. The present study aims to assess CGM's effectiveness in identifying glycemic variability, improving time-in-range, and enhancing self-management behaviors among early-diagnosed diabetic patients at SIMS Hospital, Chennai.

Objectives

- To evaluate the effectiveness of CGM in identifying real-time glycemic fluctuations among early-diagnosed diabetic patients.
- To compare glycemic variability before and after CGM implementation.
- To assess the role of CGM in early detection and prevention of hypoglycemic and hyperglycemic episodes.
- To determine the impact of CGM on patient adherence to lifestyle modifications and medication compliance.
- To measure overall improvement in glycemic control, patient satisfaction, and quality of diabetes self-management following CGM use.

II. METHODS AND MATERIALS

A quantitative pre-experimental one-group pretest–posttest design was adopted for the study conducted at SIMS Hospitals, Vadapalani, Chennai, over six months (June–November 2025). Using purposive sampling, early-diagnosed Type 1 and Type 2 diabetic patients on insulin therapy, experiencing glycemic variability, or requiring strict glucose control, aged ≥4 years and able to operate the device, were included, while those with adhesive allergies, skin disease at the sensor site, active infection, dehydration, inability to use the device, or non-compliance with follow-up were excluded. Demographic variables such as age, sex, BMI, education, occupation, income, residence, health literacy, and psychosocial factors were collected along with clinical variables including CGM-derived glycemic metrics, HbA1c, diabetes duration, complications, treatment details, and lifestyle patterns. The data collection consisted of a pretest (fasting glucose, postprandial glucose, HbA1c), followed by the intervention phase wherein participants were fitted with a CGM device that continuously monitored glucose trends and provided real-time alerts facilitating individualized adjustments in diet, medication, and activity, and a posttest reassessment of glycemic parameters. Data were analyzed using SPSS 25.0 with descriptive statistics (mean, SD, percentage) and inferential statistics using paired t-tests with significance set at $p < 0.05$. Ethical approval was obtained from the Institutional Ethics Committee of SIMS Hospital, and informed consent, confidentiality, and voluntary participation were ensured.

III. RESULTS AND DISCUSSION

The study included 40 diabetic patients aged 12 to 86 years, with a mean age in the mid-fifties. Most participants were male, from urban areas, and belonged to an affordable socioeconomic group. Type 2 diabetes mellitus was predominant (85%), consistent with national epidemiological patterns [1]. Nearly 90% of participants experienced frequent hyperglycemic events, and all had elevated HbA1c values, indicating poor baseline glycemic control similar to previously reported findings [2]. CGM implementation enabled identification of significant glycemic fluctuations, including frequent nocturnal and postprandial spikes, which traditional SMBG often fails to detect [2–4]. Post-intervention results showed improved fasting glucose, decreased variability, and increased time-in-range, aligning with international evidence demonstrating the clinical benefits of CGM [4–8]. The structured teaching program contributed to a substantial improvement in knowledge scores, reflecting enhanced understanding of dietary management, physical activity, glucose monitoring, and medication adherence. These findings support existing research showing that diabetes self-management education significantly improves glycemic control and self-efficacy [11–13]. Overall, CGM combined with structured education proved highly effective in promoting glycemic stability and empowering newly diagnosed patients in self-care.

IV. CONCLUSION

The findings of this study demonstrate that the structured teaching program was highly effective in improving diabetes-related knowledge among patients with poor baseline glycemic control. Prior to the intervention, participants showed significant glycemic instability, high HbA1c levels, limited understanding of diabetes management, and multiple associated comorbidities. Following the educational program, there was a substantial improvement in knowledge scores, indicating enhanced awareness of blood glucose monitoring, medication adherence, dietary practices, and lifestyle modifications. These results highlight that patient-centered, structured education is a powerful tool for empowering individuals to take control of their health, strengthening self-management behaviors, and reducing the risk of diabetes-related complications. The study concludes that integrating structured teaching programs into routine clinical practice can significantly contribute to improved glycemic outcomes and overall quality of life for diabetic patients.

Conflict of Interest: Nil

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Table 1: Frequency and Percentage distribution of Socio-Demographic Characteristics of diabetic Patients (N=40)

Variable	Category	Frequency (n)	Percentage (%)
Age	<30 yrs	5	12.5
	30–60 yrs	22	55
	>60 yrs	13	32.5
Sex	Male	27	67.5
	Female	13	32.5
Place of Residence	Urban	32	80
	Rural	8	20
Affordability	Affordable	40	100

Table 2: Frequency and Percentage distribution of Clinical Characteristics of Patients (N=40)

Variable	Category	Frequency	%
Diabetes Type	T1DM	6	15

Variable	Category	Frequency	%
	T2DM	34	85
Frequent Hypoglycemia	Yes	13	32.5
	No	27	67.5
Frequent Hyperglycemia	Yes	36	90
	No	4	10
A1C Above Target	Present	40	100
Co-morbidities	Present	33	82.5
	None	7	17.5

Table 3: Frequency and Percentage distribution of Treatment and Dietary Pattern (N=40)

Variable	Category	N	%
Treatment	Insulin / infusion	26	65
	OHA	9	22.5
	OHA + Insulin	5	12.5
Diet Pattern	Good	22	55
	Adequate	12	30
	Poor	6	15

Table 4: Comparison of Pre-test and Post-test Knowledge Scores (N=40)

Test	Mean ± SD	Min–Max
Pre-test	5.9 ± 0.7	5–7
Post-test	9.5 ± 0.5	9–10
Mean Gain Score	**3.6 points**	—

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