

Improvement of Diabetes Mellitus Management in a Resident-run Clinic by using Continuous Glucose Monitoring (CGM)

Janet Tam, DO, Nathan Holt, DO, Rakahn Haddadin, MD, Ranier Rivera, DO, Yasra Badi, MD, Esar Dini, MD, Andre Manov, MD, FACP, MSHM



Introduction

- Diabetes Mellitus (DM) is a metabolic disorder that affects more than 34 million people of all ages in the USA, which is around 9-10% of the US population. The main subtypes are Type 1-DM and Type 2-DM [1].
- Self-monitoring of blood glucose does not provide an accurate picture of the glucose trends throughout a 24 hour day [2].
- Continuous glucose monitoring (CGM) is a more accurate and advanced method for monitoring 24-hour blood glucose.
- Randomized & observational studies of real-time CGM systems have demonstrated improved glucose control measured by time in range (TIR), decreased glucose variability measured by coefficient of variation (CV), decreased episodes of hyperglycemia and hypoglycemia compared to SMBG [3].
- CGM was started at our Internal Medicine residency primary care clinic for better glycemic control.

Objective

- Would implementation of CGM improve Type 1 and 2 DM management in the MountainView Clinic employed by Internal Medicine and Transitional Year Residents?

Methods

Inclusion Criteria:	Exclusion Criteria:	Type of Study:
Age 18-80 years old	Patients wearing their CGM < 70% of the time	Retrospective study
Diagnosis of Type 1 or Type 2 DM	Patients unresponsive to calls from the clinic	Study Period: 2020 – 2023
Patients with uncontrolled blood glucose levels while using SMBG ≥ 4 times daily	Patient non-compliant with dietary and exercise recommendations	Study Location: Resident-run MountainView Clinic
Patients on 3-4 Insulin injections medications	Patients unable to understand the instructions for titration of insulin based on CGM data	Number of patients: 51
Patients with HbA1c > 7% and who were only receiving their primary care in the Resident-run MountainView Clinic in Nevada	Patient with impaired decision-making capacity	Patient counseling: In-office visits every 2-3 months and follow-up phone calls every 2 weeks. Counseling on diet and exercise, as well as insulin-dose adjustments were performed.
Patient can use a CGM device	Patient missing > 2 scheduled clinic visits	
Patient can adjust their insulin based on CGM device		

Methods continued

- Data was extracted from the eClinicalWorks electronic medical record system and CGM devices (Freestyle Libre 3, DEXCOM G6/7).
- Paired t-test & Wilcoxon signed-rank test were used for the following data on HbA1c and BG pre- and post-CGM:
 - HbA1c
 - Time-in-Range (TIR) of Blood Glucose 70-180 mg/dL
 - Average blood glucose
 - Mild hypoglycemia 54-70 mg/dL
 - Pronounced hypoglycemia <54 mg/dL
- Initial measurements were taken and the final measurements were averages over time, calculated at end of study period.

Results

Table 1 Descriptive Statistics of Measured Variables			
Variable	Median	Mean	SD
PreA1c	9.2	9.914	2.217
PostA1c	7.4	7.625	1.34
PreTIR	31	0.336	0.207
PostTIR	67	0.669	0.202
PreAvgBG	230	242.255	65.485
PostAvgBG	167	169.431	34.581
PreMildHypo	5	0.047	0.006
PostMildHypo	0	0.008	0.014
PreProHypo	3.1	0.031	0.013
PostProHypo	0	0.002	0.006

Note: TIR = Time in Range (BG 70-180 mg/dL); AvgBG = Average Blood Glucose; MildHypo = Mild Hypoglycemia (54-70 mg/dL); ProHypo = Pronounced Hypoglycemia (< 54 mg/dL)

Table 2 Results of Paired T-Test and Wilcoxon Signed-Rank Test								
Variable Pair	Mean Diff		95% CI of Mean Diff		t	df	p	Cohen's D
	Mean Diff	SD	Diff					
PreA1c								
PostA1c	-2.288	-2.216	-1.665	-2.912	-7.373	50	0	-1.032
PreTIR								
PostTIR	33.333	39.723	44.505	22.216	5.993	50	0	0.839
PreAvgBG								
PostAvgBG	-72.824	-68.563	-53.540	-92.107	-7.585	50	0	-1.062
Variable Pair	Med Diff				z	df	p	
	Med Diff	SE						
PreMildHypo								
PostMildHypo	-3.1	-102.375	-	-	-6.193	50	0	-
PreProHypo								
PostProHypo	-5.0	-104.199	-	-	-6.224	50	0	-

Note: Diff = Difference; Med = Median; TIR = Time in Range (BG 70-180 mg/dL); AvgBG = Average Blood Glucose; MildHypo = Mild Hypoglycemia (54-70 mg/dL); ProHypo = Pronounced Hypoglycemia (< 54 mg/dL)

- 10% of participants discontinued their insulin due to better diabetic control and continued their oral diabetic medications.
- The quality of life improved in patients.
- Decreased frequency of unproductive office visits for DM follow-ups due to accessible and convenient data extraction from CGM devices.
- Successful implementation of CGM in a Resident-run clinic with proficiency of Residents to manage Type 1 and 2 DM patients on CGM.

Discussion

- In our three-year study, we found switching from SMBG to CGM led to a significant improvement in the health outcomes of the 51 patients with type 1 or type 2 DM. We observed significant improvements in HbA1c levels, blood glucose levels, hypoglycemic events, and time in range (Table 1 and 2).
- Our findings demonstrates that using CGM instead of SMBG methods can lead to better glycemic control, fewer side effects, and lifestyle improvements [4, 5]. To our knowledge, this is first time CGM is successfully implemented into a resident-run Internal Medicine primary care clinic (instead of an endocrine clinic), managed by Internal Medicine and Transitional Year residents. These results are likely due to the combination of medical resident vigilance and relatively smaller number of patients each resident is responsible for.
- CGM can also help with decreasing the frequency of unproductive office visits for DM management due to data accessibility and convenience. This leads to streamlined management, better provider experience, improved patient quality of care and satisfaction, and improved client health outcomes by maximizing health-related quality of life and reducing costs.
- Some limitations of our project includes: small sample size of 51 patients, relative short project timeline of 3 years, differences of patient compliance with diet and lifestyle interventions, presence of other potential confounding diagnoses that may affect HbA1c levels (i.e. anemia, CKD).

Conclusion

- We have demonstrated a model that other Internal Medicine residency programs can implement to improve the quality of care for difficult-to-treat patients on multiple injections of Insulin per day with type 1 and type 2 DM.
- Randomized prospective trials with larger sample sizes are needed to fully assess the potential of CGM implementation and guided treatment of diabetes mellitus in Internal Medicine residency primary care clinics.

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