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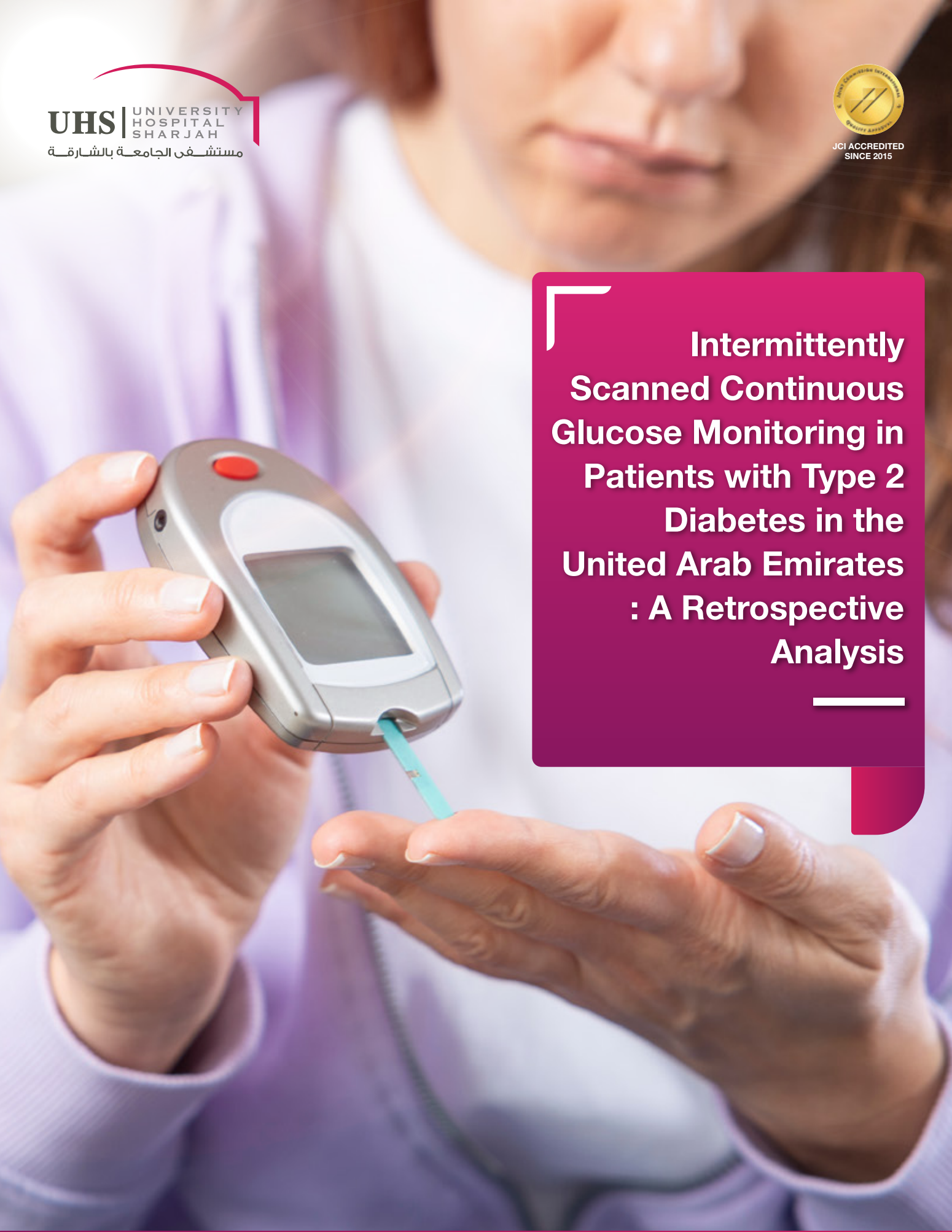

Intermittently Scanned Continuous Glucose Monitoring in Patients with Type 2 Diabetes in the United Arab Emirates : A Retrospective Analysis

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ABSTRACT

Objective: This retrospective observational study aimed to determine the effectiveness of six weeks to six months of intermittently scanned continuous glucose monitoring (isCGM) use on glycemic control in patients with type 2 diabetes (T2D) from the United Arab Emirates (UAE).

Materials and methods: The study involved isCGM users with T2D from two centers in the UAE: University Hospital Sharjah and Dubai Hospital. The medical records of isCGM users were randomly collected and reviewed for eligibility. Patients aged ≥ 18 years, diagnosed with T2D, with glycated hemoglobin (HbA1c) ≥ 7%, who had used FreeStyle Libre for ≥ 6 weeks, with available HbA1c measurements within the three months prior to initiating FreeStyle Libre, and within the six months following FreeStyle Libre initiation were included. Patients aged < 18 years, diagnosed with type 1 diabetes, pregnant females, and those on dialysis were excluded.

Results: A total of 107 medical records were included from the two centers: 49 from University Hospital Sharjah and 58 from Dubai Hospital. The mean (standard deviation [SD]) age of participants was 63 (15) years. Mean (SD) HbA1c prior to isCGM use was 9.14% (1.63%), which reduced to 8.15% (1.42%) after isCGM initiation ($p < 0.001$), a mean (SD) change of 0.99% (1.80%). A medium-level negative correlation ($r = –0.21$; $p < 0.05$) was seen between age and HbA1c reduction.

Conclusions: This study demonstrated a significant reduction in HbA1c levels with isCGM use among patients with T2D who were using a range of antidiabetic treatments.

Keywords: type 2 diabetes, continuous glucose monitoring, glycemic control, HbA1c, retrospective analysis

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Introduction

Type 2 diabetes (T2D) is a global public health concern that poses challenges for healthcare facilities [1]. The prevalence of T2D in the United Arab Emirates (UAE) is high, at approximately 21.6% of the adult population [2]. Patients with T2D in the UAE have been shown to have poor glycemic control, high rates of comorbidities (including hypertension, dyslipidemia, and obesity), as well as diabetes-associated complications (such as retinopathy, coronary artery disease, neuropathy, and nephropathy) [3]. Insufficient physical activity and poor eating habits are contributors to poor glycemic control and diabetes complications in this population [4, 5].

The field of diabetes technologies, particularly continuous glucose monitoring (CGM), is experiencing rapid advancement. Over the last decade, 17 new CGM devices have been brought to market, reflecting the continuous innovation in this area of diabetes management [6]. Whilst there is an abundance of evidence for the use of CGM in type 1 diabetes — demonstrating improved glycemic control, increased time in range, and fewer hypoglycemic episodes — evidence in T2D is limited [7, 8].

The FreeStyle Libre is an intermittently scanned continuous glucose monitoring (isCGM) system, which uses a sensor placed on the upper arm and measures glucose in the interstitial fluid every minute. The sensor can be scanned with a specialized reader or smartphone to reveal glucose levels and trends [9]. With the most recent update, the FreeStyle Libre 2 is now able to provide real-time glucose readings that are transmitted automatically to the user's smartphone [10]. The performance and accuracy of this technology have been shown to be comparable to those of conventional self-monitoring of blood glucose (SMBG) [11].

There is increasing evidence for the use of CGM in T2D, particularly for patients treated with insulin [12]. Although the REPLACE randomized controlled trial (RCT), which assessed the efficacy and safety of isCGM, did not show an improvement in glycated hemoglobin (HbA1c) [11], there is evidence from other trials and real-world studies of a reduction in HbA1c levels in isCGM users with T2D [7, 13]. Data from a multicenter open-label RCT have shown improved glycemic control in non-insulin-treated patients with T2D using isCGM, with a reduction in HbA1c of –0.46% at 24 weeks compared with baseline ($p < 0.001$), and also compared with patients using SMBG who experienced a reduction in HbA1c of –0.17% compared with baseline ($p = 0.124$) [14]. In addition to greater glycemic control, increased time in range (70–180 mg/dL), reduced time above range (> 180 mg/dL), reduced time below range (< 70 mg/dL), and greater treatment satisfaction with isCGM have been reported [15, 16].

Such evidence in local Middle Eastern populations with T2D is scarce. Studies in Saudi Arabia have shown reduced HbA1c in patients with T2D treated with insulin [17] and non-intensively managed patients with T2D [18] after initiation of isCGM. Data on isCGM use in patients with T2D in the UAE are largely focused on understanding patterns of glucose variability in those who are fasting during Ramadan, highlighting the need for evidence in the wider T2D therapeutic space in the UAE.

The aim of this study is to assess the impact of isCGM on glycemic control in adult patients with T2D managed by various antidiabetic regimens in the UAE. Furthermore, the study aimed to describe parameters of the standardized glycemic metric during the use of an isCGM system in adults with T2D in the UAE.

Materials and methods

Study design

This retrospective observational multicenter study was conducted at the diabetes and endocrinology outpatient departments of two healthcare centers in the UAE: University Hospital Sharjah (UHS) and Dubai Hospital (DH). All data were collected retrospectively from electronic medical records spanning the period of January 1, 2018, to December 31, 2022.

Study population/study participants

All Freestyle Libre users from the two healthcare centers were eligible for inclusion in the study. Freestyle Libre users were identified using the LibreView website, FreeStyle Libre user logbooks, and dispensed prescription data from the hospital pharmacy. Prior to FreeStyle Libre use, the diabetes education clinic in both hospitals provided structured education and training sessions for users, emphasizing the benefits and outcomes of the device. Patients aged ≥ 18 years, diagnosed with T2D, with HbA1c ≥ 7%, who had used FreeStyle Libre for a minimum of six weeks, with available HbA1c measurements within the three months prior to initiating FreeStyle Libre and within the six months following FreeStyle Libre initiation were included. Patients aged < 18 years, those diagnosed with type 1 diabetes, pregnant females, and those on dialysis were excluded.

Ethical approval

Ethical approval was granted for the study from the scientific research ethics committees of UHS (UHS-HERC-070-01092021) and Dubai Health Authority (DSREC-SR-09/2021-04).

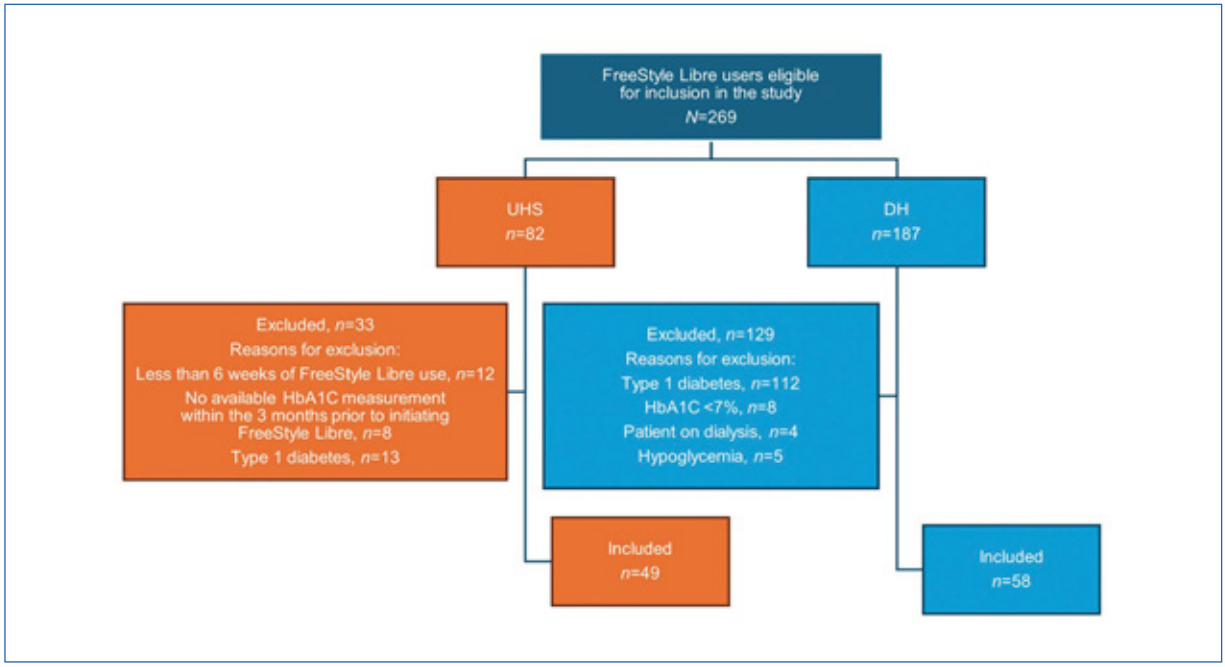

Figure 1. Study Flow Chart
DH — Dubai Hospital; HbA1c — glycated hemoglobin; UHS — University Hospital Sharjah

Data collection/variables

All data were extracted from electronic medical records. HbA1c levels were measured by each hospital's central laboratory. Baseline HbA1c was defined as an HbA1c measurement taken within the three months prior to the initiation of isCGM. Post-isCGM initiation HbA1c was the first HbA1c measurement between six weeks and six months after isCGM initiation. Demographic and clinical data, including age, sex, body mass index (BMI), diabetes duration, diabetes therapy, and diabetes complications, were extracted at baseline, prior to isCGM initiation. Standardized metrics from the FreeStyle Libre reports, including glucose variability, time in range, glucose management indictor, time above range, and time below range, were collected between six weeks and six months after starting isCGM. Data on the duration of isCGM use, BMI, and changes in treatment regimen were also collected between six weeks and six months after starting isCGM.

Statistical analysis

Descriptive analysis involved the calculation of frequencies and percentages for categorical variables, and the mean and standard deviation (SD) for continuous variables. A paired *t*-test was performed to investigate differences between HbA1c values pre and post isCGM use. Pearson's correlation was performed to understand the association between variables. P-value < 0.05 was considered statistically significant. All statistical analyses were performed using SPSS® Statistics (IBM, version 23).

Results

Flow of the study population

Of the 269 patients with T2D eligible for inclusion, 107 patients were included: 49 from UHS and 58 from DH (Fig. 1).

Baseline characteristics

Baseline characteristics are presented in Table 1. The mean patient age was 63 years, with 51.4% being female. Most patients (56.0%) had diabetes for 10 years or longer, and 50.0% of patients were on multiple daily doses of insulin. Neuropathy, retinopathy, and cardiovascular disease were common complications, found in 30.8%, 23.0%, and 20.0% of patients, respectively.

Change in HbA1c levels

There was a significant reduction in HbA1c following the implementation of the isCGM system, with a mean change of 0.99% (SD 1.80%; 95% CI 0.64, 1.33). Mean (SD) baseline HbA1c was 9.14% (1.63%), while mean HbA1c following isCGM initiation was 8.15% (1.42%; $p < 0.001$) (Fig. 2).

Factors correlated with HbA1c levels

The improvement in HbA1c was observed across different factors including age, sex, and BMI. There was

Table 1. Baseline Characteristics

Variables	N = 107
Sex	
Female	55 (51.4)
Age [years]	
<65	55 (51.4)
≥65	52 (48.5)
Mean ± SD	63 ± 15
BMI [kg/m^2] mean ± SD	32 ± 7
Diabetes duration [years]	
< 10	47 (43.9)
≥ 10	60 (56.0)
Therapy type	
Insulin	54 (50.0)
Basal insulin + OHA	24 (22.4)
OHA	21 (19.6)
GLP-1 RA+ OHA	5 (4.6)
Basal insulin + GLP-1 RA+ OHA	3 (2.8)
Diabetes complications	
None	33 (30.8)
Neuropathy	33 (30.8)
Retinopathy	25 (23.0)
CVD	22 (20.0)
Nephropathy	19 (17.7)
Foot ulcer	7 (6.5)

Data are *n* (%) unless stated otherwise; BMI — body mass index; CVD — cardiovascular disease; GLP-1 RA — glucagon-like peptide-1 receptor agonist; OHA — oral hypoglycemic agent; SD — standard deviation

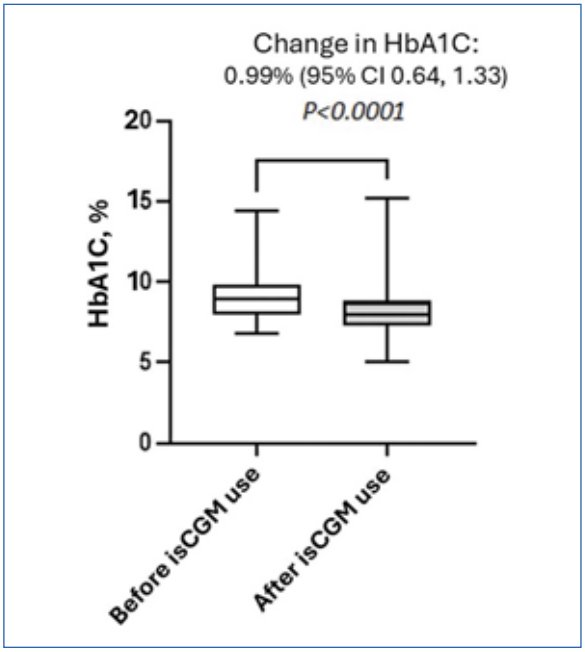

Figure 2. Boxplot of HbA1c Before and After Use of isCGM (N =107)
95% CI — 95% confidence interval; HbA1c — glycated hemoglobin; isCGM — intermittently scanned glucose monitoring

no significant impact of BMI (r = 0.140; p = 0.231) or duration of isCGM use (r = –0.183; p = 0.070) observed on the reduction of HbA1c. However, a moderate-level negative correlation (r = –0.21; p < 0.05) was observed between age and HbA1c reduction after the use of isCGM.

Standardized glycemic metrics

Of the 107 patient records, standardized glycemic metrics from the FreeStyle Libre reports were available for 40 patients. Mean and SD values for these standardized glycemic metrics are shown in Supplementary Table 1. Mean average glucose and glucose management indicator values were higher than the recommended targets set by the American Diabetes Association (ADA). Mean time in range was lower than the ADA recommended targets.

Discussion

This study demonstrated a significant reduction in HbA1c following initiation of isCGM in this group of patients with poorly controlled T2D in the UAE. Similar results were reported by Yaron et al., with a mean reduction in HbA1c of 0.82% (9 mmol/mol) after 10 weeks of isCGM use in 101 patients with T2D on multiple daily injections (MDIs) of insulin [15]. Furthermore, in three parallel European retrospective non-interventional chart review studies, a significant reduction in HbA1c was observed following the use of isCGM for 3–6 months in 363 patients with T2D using a basal-bolus insulin regimen (mean 9.6 mmol/mol [3%], SD 8.8) [19]. Additionally, in 1034 patients treated with basal insulin or non-insulin antidiabetic therapies, the mean HbA1c was reduced by 1.5% (SD 2.2%) at 2–10 months following isCGM prescription, according to results from a retrospective observational study by Wright et al. [20]. A further retrospective chart review study in Canada also reported a mean HbA1c reduction of 0.8% (SD 1.1%) after 3–6 months of isCGM use in 91 patients with T2D using basal insulin [21]. In terms of regional data, Al Hayek et al. reported a mean reduction in HbA1c of 0.44% after 12 weeks of isCGM in patients with T2D treated with MDIs of insulin in Saudi Arabia [17].

Results from this study showed that HbA1c reduction was negatively correlated with age. Similar results

were observed in the REPLACE RCT, which reported an improvement in HbA1c in patients using isCGM aged < 65 years but not for those aged ≥ 65 years [11]. However, this conflicts with results from a retrospective chart review study in Canada, which showed that reduction in HbA1c after initiating isCGM was not associated with age [21]. Potential reasons for this may be due to differences in the populations being studied, with the mean age of participants in the REPLACE RCT study being lower (59.0 years) compared to the Canadian retrospective chart review (64.3 years) [11, 21]. A negative correlation between HbA1c and age might be explained by greater interest in, and understanding of, technologies in younger individuals.

Given the benefits of isCGM, the UK National Institute for Health and Care Excellence [22] and the American Association of Clinical Endocrinologists [23] recommend the use of isCGM for patients with T2D on MDIs of insulin who have poorly controlled disease and a consistent inability or unwillingness to perform SMBG despite persistent efforts of healthcare providers, and for those with T2D on MDIs of insulin with poorly controlled disease associated with excess glycemic variability or frequent hypoglycemia [22, 23]. In such instances, the benefits of isCGM outweigh the risks of both long- and short-term diabetes complications. In this study, the benefits of isCGM for patients with T2D on MDIs of insulin and non-insulin therapies are evident.

Mean standardized glycemic metrics from the FreeStyle Libre reports showed that several metrics were aligned with the recommended targets set by the ADA for patients with T2D [24]. Participants had a mean time in low range of 2.3% (SD 3.8%) and time in very low range of 0.4% (SD 1.6%), which are within the ADA-recommended goals of < 4% and < 1%, respectively [24]. Moreover, mean glucose variability was 28.6% in this group of patients, which is also within the target set by the ADA of ≤ 36% [24]. However, average glucose in this group of patients was 163.4 mg/dL (SD 42.7 mg/dL), higher than the ADA recommendation of < 154 mg/dL [24]. Furthermore, the mean time in range of 59.4% (SD 24.7%) was lower than the ADA recommendation of ≥ 70% [24]. Finally, the mean glucose management indicator value was also slightly higher in this group of patients, at 7.2% (SD 1.1%), than the goal of ≤ 7% [24].

Limitations of the study include the small sample size and limited FreeStyle Libre report data during isCGM use. Patients included in the study were those who had used FreeStyle Libre for ≥ 6 weeks. Whilst it has previously been reported that HbA1c reductions can be seen within the first two months of use in adults patients with diabetes [25], additional longitudinal data would be beneficial to enable a better understanding of whether these reductions were sustained within this population. The study was conducted in two hospitals in two emirates of the UAE, which may also affect the generalizability of results. Larger-scale studies among patients with T2D across the seven emirates of the UAE would be beneficial, providing additional data on the benefits of isCGM in the wider T2D population in the UAE. Furthermore, additional factors that affect HbA1c levels and significantly influence diabetes management, such as seasonal changes, patient adherence to medication, medication adjustments, diet, and lifestyle, were not accounted for in this study. Future studies should aim to collect data pertaining to medication adherence and adjustments, diet, and lifestyle using patient and physician questionnaires, and undertake multifactorial analysis to account for such factors. Finally, changes in time in range, time above range, and time below range were not captured in this study — such data would give more insight into patterns of standardized glycemic metrics following isCGM initiation.

Conclusions

The findings of this study demonstrated a significant reduction in HbA1c levels after implementation of isCGM, showcasing its potential to improve diabetes management in patients with T2D with poorly controlled disease who face challenges with SMBG.

Article information

Data availability

The data from this study are available from the corresponding author, F.A., upon reasonable request.

Author contributions

All authors contributed to the concept, design, and execution of the study. P.M.B. contributed to the data analysis. All authors contributed to the drafting and/or critical revision of the manuscript and approved the final version of the manuscript. F.A. and T.A.M.H. are the guarantors of this work and take responsibility for the contents of this article.

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Conflicts of interest

The authors declare no conflict of interest.

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