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Real-world glycaemic outcomes in adult persons with type 1 diabetes using a real-time continuous glucose monitor compared to an intermittently scanned glucose monitor: A retrospective observational study from the Canadian LMC diabetes registry (REAL-CGM-T1D)

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Abstract

Real-time continuous glucose monitoring (rtCGM) and intermittently scanned CGM (isCGM) have both been shown to improve glycaemic outcomes in people with T1D. The aim of this study was to compare real-world glycaemic outcomes at 6–12 months in a propensity score matched cohort of CGM naïve adults with T1D who initiated a rtCGM or an isCGM. Among the matched rtCGM and isCGM cohorts ($n = 143$/cohort), rtCGM users had a significantly greater HbA_{1c} benefit compared to isCGM users (adjusted difference, −3 mmol/mol [95% CI, −5 to −1]; −0.3% [95% CI, −0.5 to −0.1]; $p = 0.01$). There was a significantly greater lowering of HbA_{1c} for rtCGM compared to isCGM when baseline HbA_{1c} was <69 mmol/mol (8.5%) (adjusted difference, −4 mmol/mol [95% CI, −7 mmol/mol to −2 mmol/mol]; −0.4% [95% CI, −0.6% to −0.2%]; $p < 0.001$), and in MDI users (adjusted difference, −3 mmol/mol [95% CI, −6 mmol/mol to −0 mmol/mol]; −0.3% [95% CI -0.5% to 0.0%], $p = 0.04$). The rtCGM cohort had significantly greater time in range (58.3 ± 16.1% vs. 54.5 ± 17.1%, $p = 0.03$), lower time below range (2.1 ± 2.7% vs. 6.1 ± 5.0%, $p < 0.001$) and lower glycaemic variability compared to the isCGM cohort. In this real-world analysis of adults with T1D, rtCGM users had a significantly greater reduction in HbA_{1c} at 6–12 months compared to isCGM, and significantly greater time in range, lower time below range and lower glycaemic variability, compared to a matched cohort of isCGM users.

KEYWORDS

continuous blood glucose monitoring, glycaemic control, HbA_{1c}, hypoglycaemia, type 1 diabetes

1 | INTRODUCTION

The capacity to self-manage diabetes is paramount for optimal health outcomes and includes regular assessment of blood glucose levels. Real-time continuous glucose monitoring (rtCGM) systems display an estimate of blood glucose in real time and provide alerts for hypoglycaemia and hyperglycaemia. rtCGM systems have been associated with improved HbA_{1c} and a reduction in the risk of hypoglycaemia in people with diabetes using multiple daily injections (MDIs) of insulin or continuous subcutaneous insulin infusion (CSII) therapy. In the GOLD randomized clinical trial (RCT), adults with type 1 diabetes (T1D) treated with MDI had improved HbA_{1c} when using a CGM device compared to using conventional self-measured blood glucose (SMBG).[1] Furthermore, a retrospective real-world analysis of adults with T1D reported that CGM use was associated with improved HbA_{1c} and reduced health care utilization compared to SMBG therapy.[2]

Flash glucose monitoring (FGM) systems available in Canada, now known as intermittently scanned CGM (isCGM) systems, provide interstitial glucose measurements when the reader (or compatible smartphone) is flashed over the sensor. Recent studies, such as the IMPACT RCT study and the FUTURE prospective observational real-world study, have reported reduced time in hypoglycaemia and maintained HbA_{1c} following isCGM use among adults with T1D.[3,4] In an 8-week head-to-head randomized controlled pilot study that directly compared rtCGM to isCGM in T1D,[5] rtCGM was associated with significantly less time spent in hypoglycaemia compared to isCGM. In the CORRIDA RCT, adults with T1D using rtCGM spent significantly more time in range (TIR) and less time in hypoglycaemia during exercise and during a 4-week home observation period, compared to participants using isCGM.[6] Moreover, the ALERTT1 RCT showed that adults with T1D who switched from isCGM to rtCGM had improved TIR.[7] Furthermore, a real-world cross-sectional analysis of the German/Austrian DPV Registry reported that rtCGM combined with CSII therapy had significantly greater TIR compared to isCGM and CSII therapy.[8] To our knowledge the real-world effectiveness of using rtCGM compared to isCGM on HbA_{1c} and CGM metrics has not been directly compared in a matched cohort of participants with T1D.

The aim of the REAL-CGM-T1D study was to explore real-world glycaemic outcomes in adults with T1D who initiated a rtCGM compared to a matched cohort of adults with T1D who initiated an isCGM using data from the Canadian LMC Diabetes Registry.

What is already known?

- Real-time continuous glucose monitoring (rtCGM) and intermittently scanned CGM (isCGM) have shown to improve glycaemia and reduce hypoglycaemia in people with type 1 diabetes (T1D). The real-world effectiveness of using rtCGM compared to isCGM on HbA_{1c} and CGM metrics has not been directly compared in a matched cohort of adults with T1D.

What this study has found?

- The real-world analysis demonstrated both rtCGM and isCGM significantly improved glycaemia from baseline, with a greater reduction in HbA_{1c} at 6–12-month follow-up in adults with T1D using rtCGM compared to isCGM.

What are the implications of the study?

- The study highlights the benefits and importance of rtCGM and predictive alerts for adults with T1D.

2 | METHODS

2.1 | Study design and data source

This study was a retrospective, observational analysis of the Canadian LMC Diabetes Registry. LMC comprises 13 clinics in three different provinces, with >55 endocrinologists who share one common medical record system in a publicly funded healthcare system. LMC endocrinologists care for >46,000 active patients with diabetes, of which >4700 have T1D. A detailed description of this registry has been previously published.[9]

Participants were considered eligible for inclusion if they met the following criteria: diagnosis of T1D > 12 months, age ≥ 18 years, initiated a Dexcom rtCGM device (rtCGM cohort) or a first-generation FreeStyle Libre isCGM device (isCGM cohort), or maintained SMBG therapy (SMBG cohort) between January 2018 and December 2020, ≥one HbA_{1c} measurement within 6 months of index date, and ≥one HbA_{1c} measurement 6–12 months post-index date. The choice of blood glucose monitoring device was based on a shared care model, which included a physician-determined, guideline-based approach in accordance with standard clinical care. Participants were CGM naïve adults with T1D, and excluded if they used any type of CGM device within 12 months of the index date or were pregnant

at baseline or during follow-up. Participants consented to having their medical records used for research purposes and an independent ethics committee approved the protocol.

Clinical study outcomes were evaluated at baseline (most recent value up to 6 months prior to or on the index date) and during a 6–12-month (±6 week) follow-up period. The follow-up period was from June 2018 to September 2021. Continuous glucose monitor data were retrieved from the Clarity®, LibreView® or Diasend® platforms at 6–12 months (±6 weeks).

2.2 | Study outcomes

The primary end point was HbA_{1c} at 6–12 months in the matched rtCGM and isCGM cohorts, and in matched rtCGM and SMBG cohorts. The following secondary end points were assessed between the rtCGM and isCGM cohorts, and between the rtCGM and SMBG cohorts: HbA_{1c} at 6–12 months in participants with baseline HbA_{1c} < 69 mmol/mol (8.5%) and ≥69 mmol/mol (8.5%), proportion of participants with follow-up HbA_{1c} < 53 mmol/mol (7.0%), change in weight, and change in weekly incidence of self-reported hypoglycaemia. Change in total daily dose (TDD) of insulin was evaluated between the rtCGM and isCGM cohorts.

In participants with available data, the following CGM metrics were compared between the matched rtCGM and isCGM cohorts at 6–12-month follow-up (last 14 days of available data where % sensor capture is ≥70%): per cent sensor capture, per cent TIR (3.9–10.0 mmol/L), per cent time above range (TAR, 3.9–10.0 mmol/L), per cent time below range (TBR, ≤3.8 mmol/L), per cent TBR level 2 (<3.0 mmol/L), mean glucose, standard deviation (SD) and coefficient of variation (CV).

As exploratory end points, HbA_{1c} at 6–12 months, TIR and TBR were also compared between matched rtCGM and isCGM cohorts in participants using MDI therapy and in participants using CSII therapy .

2.3 | Statistical analysis

The analysis population for primary, secondary and exploratory outcomes included participants on-treatment with evaluable data for baseline and follow-up. Baseline demographics and clinical characteristics were summarized. Continuous variables were reported using means or medians, and standard deviations or interquartile range. Discrete variables were reported using counts (n) and percentages.

Participants initiating a rtCGM device were matched 1:1 to participants initiating an isCGM device by means of propensity score matching. The propensity score (odds of participants' treatment being rtCGM) was estimated with a logistic regression model. Participants were matched using a greedy nearest neighbour process without replacement, within a calliper width equal to 0.2 of the SD of the logit of the propensity score, therefore a patient using isCGM whose propensity score was closest to that of a patient using rtCGM was selected for matching from a restricted set of participants within the calliper distance.[10]

The primary outcome, HbA_{1c} at 6–12 months between cohorts, was evaluated with a multivariate linear regression model adjusted for baseline HbA_{1c} as a covariate. Secondary outcomes, including body weight, TDD of insulin, per cent TIR, per cent TAR, per cent TBR, mean glucose, SD and CV at follow-up, were also evaluated with multivariate linear regression models adjusted for baseline HbA_{1c}. The proportion of participants who achieved HbA_{1c} < 53 mmol/mol (7.0%) was evaluated with a chi-square test.

Missing CGM data were not replaced. p-values < 0.05 were considered statistically significant, and all tests were two-sided. Statistical analyses were performed using SAS 9.4 and R software (R Foundation for Statistical Computing Platform; version 4.0.3).

3 | RESULTS

3.1 | rtCGM and isCGM

The medical records of 613 participants using a Dexcom® rtCGM and 999 participants using a FreeStyle Libre® isCGM were reviewed for eligibility. After eligibility criteria were applied, there were 187 rtCGM participants and 230 isCGM participants eligible for matching. A visual depiction of the patient flow is provided in Figure S1. Prior to matching, the rtCGM cohort was younger, had a greater proportion of women, shorter duration of T1D, lower HbA_{1c}, and greater CSII use compared to the isCGM cohort. After propensity score matching, there were 143 participants in each cohort who were well balanced on their baseline characteristics (Table 1). The mean propensity score in the matched cohorts was 0.48 ± 0.15 (range 0.063–0.816). The distribution of the propensity scores in the matched rtCGM and isCGM cohorts is shown in a box-and-whiskers plot in Figure S2.

The mean follow-up period for HbA_{1c} was 9.6 ± 2.2 months for the rtCGM cohort and 9.9 ± 2.1 months for the isCGM cohort. HbA_{1c} at baseline and follow-up between the matched rtCGM and isCGM cohorts is presented in Table 2. The rtCGM cohort had a significantly greater reduction in HbA_{1c} compared to the isCGM cohort (between cohort difference −3 mmol/mol [95% CI, −5 mmol/mol to −1 mmol/

TABLE 1 Baseline characteristics of the rtCGM and isCGM cohorts pre- and post-propensity score matching

	Unmatched			Matched		
	rtCGM	isCGM	d	rtCGM	isCGM	d
N	187	230		143	143	
Age (years)	41.5 ± 12.7	48.2 ± 17.6	0.433	43.2 ± 12.6	43.5 ± 16.7	0.018
Women, *n* (%)	112 (59.9)	95 (41.3)	0.378	71 (49.7)	72 (50.4)	0.014
Duration of T1D (years)	21.1 ± 13.1	22.9 ± 15.2	0.130	22.1 ± 13.7	21.6 ± 14.2	0.031
White ethnicity, *n* (%)	143 (76.5)	155 (67.4)	0.203	104 (72.7)	106 (74.1)	0.032
Education, *n* (%)						
Post-secondary school	110 (58.8)	118 (51.3)	0.152	80 (55.9)	80 (55.9)	0.000
Secondary school	37 (19.8)	60 (26.1)	0.150	29 (20.3)	34 (23.8)	0.084
HbA_{1c}, mmol/mol (%)	66 ± 11 (8.2 ± 1.0)	72 ± 16 (8.8 ± 1.4)	0.446	68 ± 12 (8.4 ± 1.1)	68 ± 11 (8.4 ± 1.0)	0.005
Insulin mode, *n* (%)						
MDI	111 (59.4)	156 (67.8)	0.175	90 (62.9)	88 (61.5)	0.029
CSII	76 (40.6)	74 (32.2)	0.175	53 (37.1)	55 (38.5)	0.029
Co-morbidities, *n* (%)						
Macrovascular complications	6 (3.2)	25 (10.9)	0.303	5 (3.5)	6 (4.2)	0.036
Microvascular complications	31 (16.6)	55 (23.9)	0.183	26 (18.2)	24 (16.8.)	0.037
CKD	26 (13.9)	68 (29.6)	0.387	23 (16.1)	25 (17.5)	0.037
Non-diabetes therapies, *n* (%)						
Statins	78 (41.7)	127 (55.2)	0.273	67 (46.9)	67 (46.9)	0.000
Other lipid therapies	6 (3.2)	23 (10.0)	0.276	5 (3.5)	3 (2.1)	0.085
ACEi/ARB	58 (31.0)	103 (44.8)	0.287	51 (35.7)	52 (36.4)	0.015
Other CVD therapies	21 (11.2)	51 (22.2)	0.297	18 (12.6)	16 (11.2)	0.043
Index year						
2018	64 (34.2)	70 (30.4)	0.081	47 (32.9)	52 (36.4)	0.074
2019	75 (40.1)	106 (46.1)	0.121	61 (42.7)	58 (40.6)	0.043
2020	48 (25.7)	54 (23.5)	0.051	35 (24.5)	33 (23.1)	0.033

Note: Data presented as mean and SD unless otherwise specified. d = standardized mean difference. d < 0.1 indicates a variable is balanced between cohorts.

Abbreviations: ACEi/ARB, angiotensin-converting enzyme inhibitor/angiotensin II receptor blockers; CKD, chronic kidney disease; CSII, continuous subcutaneous insulin infusion; CVD, cardiovascular disease; MDI, multiple daily injections.

mol]; −0.3% [95% CI, −0.5% to −0.1%]; $p = 0.01$) (Figure 1A). Among participants with baseline $HbA_{1c} < 69$ mmol/mol (8.5%), the rtCGM cohort had a significantly greater reduction in HbA_{1c} compared to the isCGM cohort (−4 mmol/mol [95% CI, −7 mmol/mol to −2 mmol/mol]; −0.4% [95% CI, −0.6% to −0.2%]; $p < 0.001$) (Table 2). There was no significant between treatment difference when baseline HbA_{1c} was ≥69 mmol/mol (8.5%) (−1 mmol/mol [95% CI, −5 mmol/mol to 4 mmol/mol]; −0.1% [95% CI, −0.5% to 0.3%]; $p = 0.68$). HbA_{1c} reduction at 6–12 months in the rtCGM cohort was significantly greater in participants using MDI therapy (−3 mmol/mol [95% CI, −6 mmol/mol to −0 mmol/mol]; −0.3% [95% CI −0.5% to 0.0%], $p = 0.05$), but not in participants using CSII therapy (−2 mmol/mol [95% CI, −6 mmol/mol to 1 mmol/mol]; −0.2% [95% CI, −0.5% to 0.1%]; $p = 0.14$) (Table 2).

The proportion of participants in the rtCGM cohort who achieved $HbA_{1c} < 53$ mmol/mol (7.0%) at follow-up (18.9%) was not significantly different from the isCGM cohort (16.1%) ($p = 0.53$). HbA_{1c} at 6–12 months was also assessed in the matched rtCGM and SMBG cohort as a secondary outcome, however, because the focus of this paper was to compare clinical outcomes among a matched rtCGM and isCGM cohort, the secondary analyses between rtCGM and SMBG were presented in the Supplement (Table S1 and Table S2).

Participants who did not have CGM data available on Clarity®, LibreView® or Diasend® platforms were excluded from the secondary analyses of CGM metrics. There were 113 rtCGM participants and 107 isCGM participants with available CGM data. The mean CGM follow-up period was 10.9 ± 1.6 months for the rtCGM cohort and

TABLE 2 Between treatment difference in HbA_{1c} at follow-up in the matched rtCGM and isCGM cohorts

rtCGM			isCGM				
All participants							
n	Baseline HbA_{1c}, mmol/mol (%)	Follow-up HbA_{1c}, mmol/mol (%)	*n*	Baseline HbA_{1c}, mmol/mol (%)	Follow-up HbA_{1c}, mmol/mol (%)	Adjusted mean difference at follow-up (95% CI)	Adjusted *p*-value
143	68 ± 12 (8.4 ± 1.1)	60 ± 11 (7.7 ± 1.0)	143	68 ± 11 (8.4 ± 1.0)	63 ± 12 (7.9 ± 1.1)	−3 (−5 to −1) (−0.3 [−0.5 to −0.1])	0.01
Baseline HbA_{1c} < 69 mmol/mol (8.5%)							
84	60 ± 5 (7.7 ± 0.4)	55 ± 8 (7.2 ± 0.7)	90	61 ± 5 (7.8 ± 0.4)	60 ± 8 (7.6 ± 0.7)	−4 (−7 to −2) (−0.4 [−0.6 to −0.2])	<0.001
Baseline HbA_{1c} ≥ 69 mmol/mol (8.5%)							
59	79 ± 10 (9.4 ± 0.9)	68 ± 11 (8.4 ± 1.0)	53	80 ± 10 (9.4 ± 0.9)	69 ± 15 (8.5 ± 1.4)	−1 (−5 to 4) (−0.1 [−0.5 to 0.3])	0.68
MDI therapy							
90	69 ± 11 (8.4 ± 1.0)	60 ± 12 (7.6 ± 1.1)	88	69 ± 12 (8.5 ± 1.1)	63 ± 13 (7.9 ± 1.2)	−3 (−6 to 0) (−0.3 [−0.5 to 0.0])	0.05
CSII therapy							
53	67 ± 13 (8.3 ± 1.1)	61 ± 9 (7.8 ± 0.9)	55	67 ± 10 (8.3 ± 0.9)	64 ± 10 (8.0 ± 0.9)	−2 (−6 to 1) (−0.2 [−0.5 to 0.1])	0.14

Note: Data presented as mean ± SD. The multivariate linear regression model was adjusted for baseline HbA_{1c} for follow-up HbA_{1c} for all participants, MDI therapy and CSII therapy.

Abbreviations: CSII, continuous subcutaneous insulin infusion; isCGM, intermittently scanned continuous glucose monitor; LS, least squares; MDI, multiple daily injections; rtCGM, real-time continuous glucose monitor.

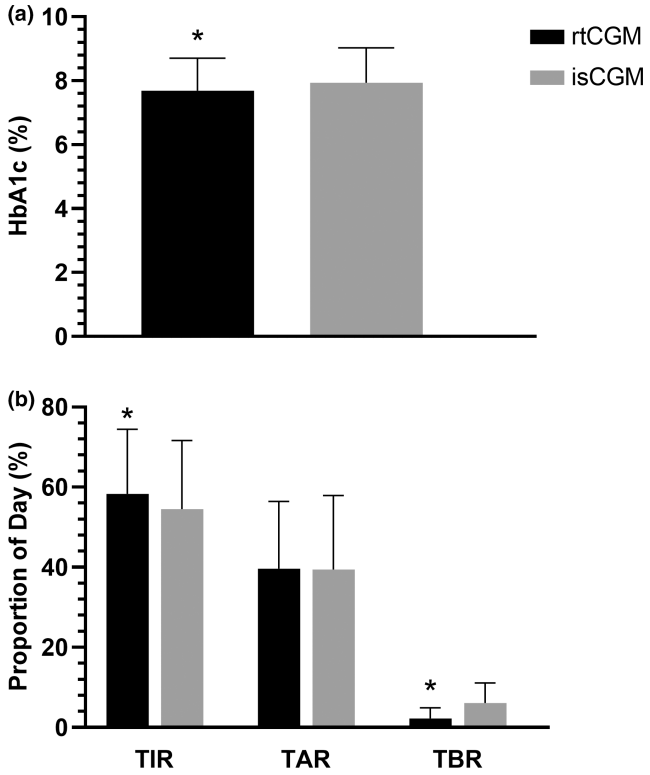

FIGURE 1 (a) HbA_{1c} between rtCGM and isCGM at 6–12 months. (b) CGM metrics between rtCGM and isCGM at 6–12 months. HbA_{1c}, glycated hemoglobin; isCGM, intermittently scanned continuous glucose monitor; rtCGM, real-time continuous glucose monitor; TAR, time above range (>10.0 mmol/L); TBR, time below range (<3.9 mmol/L); TIR, time-in-range (3.9–10 mmol/L). *significantly different between groups ($p < 0.05$).

10.9 ± 1.7 months for the isCGM cohort. The rtCGM and isCGM cohorts who had available CGM data were similar in age, sex, duration of T1D, baseline HbA_{1c} and proportion using CSII therapy (data not shown). The mean % sensor capture was 96.1 ± 4.3% for the rtCGM cohort, and 87.4 ± 9.5% for the isCGM cohort. TIR was significantly greater in the rtCGM cohort (4.4% [95% CI 0.4–8.3], $p = 0.03$) (Table 3 and Figure 1B). TBR, SD and CV were all significantly lower in the rtCGM cohort ($p < 0.001$). The proportion of participants meeting the CV target of ≤36%, was significantly greater in the rtCGM cohort ($p < 0.001$) (Table 3).

In the subset of participants with available weight data, there was no significant difference in weight between cohorts (−0.4 kg [95% CI −1.5 to 0.8 kg], $p = 0.56$). In the subset of participants with available insulin dose data, there was no significant difference in TDD of insulin within either cohort. Self-reported weekly incidence of hypoglycaemia was low at baseline and follow-up for both cohorts, and did not differ between cohorts ($p = 0.18$).

4 | DISCUSSION

The REAL-CGM-T1D study was a retrospective observational analysis that investigated real-world clinical outcomes at 6–12 months in adults with T1D who initiated a rtCGM device and compared these clinical outcomes to a matched cohort of participants who initiated an isCGM device. The

TABLE 3 CGM metrics in the rtCGM and isCGM cohorts with available data

	rtCGM ($n = 113$)	isCGM ($n = 107$)	adjusted mean difference (95% CI)	adjusted *p*-value
% TIR (3.9–10.0 mmol/L)	58.3 ± 16.1	54.5 ± 17.1	4.4 (0.4 to 8.3)	0.03
% TAR (>10.0 mmol/L)	39.6 ± 16.8	39.4 ± 18.5	−0.5 (−4.7 to 3.7)	0.82
% TBR (<3.9 mmol/L)	2.2 ± 2.7	6.1 ± 5.0	−3.9 (−4.9 to −2.8)	<0.001
% TBR level 2 (<3.0 mmol/L)	0.5 ± 1.0	2.3 ± 2.8	−1.8 (−2.4 to −1.3)	<0.001
Mean glucose (mmol/L)	9.6 ± 1.6	9.5 ± 1.9	0.0 (−0.4 to 0.4)	0.92
SD (mmol/L)	3.3 ± 0.8	4.3 ± 1.1	−1.0 (−1.3 to −0.8)	<0.001
CV (%)	34.3 ± 6.1	39.3 ± 7.6	−5.0 (−6.9 to −3.2)	<0.001
CV ≤ 36%, *n* (%)	73 (64.6)	44 (41.1)		<0.001

Note: Data presented are the last available 14 days of data 6–12 months following the index date, where data capture >70%. Data presented as mean ± SD. Multivariate linear regression models were adjusted for baseline HbA_{1c}.

Abbreviations: isCGM, intermittently scanned continuous glucose monitor; rtCGM, real-time continuous glucose monitor; TAR, time above range; TIR, time in range; TBR, time below range.

primary findings of this study are that adults who initiated a rtCGM device had a significantly greater improvement in HbA_{1c} at 6–12-month follow-up by −3 mmol/mol (−0.3%) compared to the cohort who initiated an isCGM device. Participants using a rtCGM device had significantly greater TIR by 4.4% (1.1 hours), lower glycaemic variability based on mean SD and CV, and lower TBR by −3.9% (0.9 h), compared to participants using an isCGM device.

Although both cohorts had clinically significant reductions in HbA_{1c} from baseline, the rtCGM cohort had a statistically significantly greater reduction in HbA_{1c} of −3 mmol/mol (0.3%) compared to the isCGM cohort. This between treatment difference in HbA_{1c} in rtCGM and isCGM users is similar to results reported in the 6-month ALERT1 clinical trial.[7] Furthermore, our data indicate that there may be a greater real-world glycaemic benefit of initiating a rtCGM versus an isCGM device when baseline HbA_{1c} is <69 mmol/mol (8.5%). Conversely, both cohorts experienced large and clinically significant reductions in HbA_{1c} when baseline HbA_{1c} was ≥69 mmol/mol (8.5%), with no significant between treatment difference. When comparing HbA_{1c} within MDI and CSII users, there was a greater glycaemic improvement in the rtCGM cohort compared to the isCGM cohort in MDI users only. Thus, this real-world analysis provides evidence that in adults with T1D, initiating a rtCGM device over an isCGM device may be particularly beneficial to those with HbA_{1c} < 69 mmol/mol (8.5%), and using MDI therapy.

In the subgroup of participants with available CGM data at 6–12 month follow-up, rtCGM users had significantly higher TIR, significantly lower glycaemic variability, and significantly lower TBR, compared to isCGM users. The lower glycaemic variability and TBR remained consistent regardless of baseline HbA_{1c}. In the CORRIDA randomized trial, rtCGM (Guardian Connect System) was superior to isCGM in TIR and TBR during physical activity, as well as during a 4-week home phase. Our results provide further evidence of greater TIR and lower TBR in participants using rtCGM compared to participants using isCGM. The TIR in the CORRIDA trial was much higher in the rtCGM (75.6%) and isCGM (67.4%) groups compared to the present study (58.3% and 54.5% respectively), likely a reflection of the real-world nature of our study in an endocrinology group setting, and of the much longer follow-up period of 6–12 months. The TIR in the present study was more in line with the 6-month TIR in the ALERT1 clinical trial (rtCGM 59.6%, isCGM 51.9%).[7] Our study also showed significantly lower glycaemic variability in the rtCGM group, whereas there was no difference in glycaemic variability between the treatment arms in the CORRIDA trial.[6]

Although improvements in glycaemic control were demonstrated in both rtCGM and isCGM groups, similar to findings report by Kyuhan Lee and colleagues in a real-world analysis among unmatched, adults with T1D using FGM and rtCGM,[11] the study findings demonstrated a benefit for TBR for rtCGM compared to isCGM, consistent with previously published results.[5] The reduced TBR with rtCGM compared to isCGM could be tied to the advantages of real-time and predictive alerts provided with rtCGM, as the isCGM cohort consisted of all first-generation FGM users in the study. TBR remained lower in the rtCGM cohort regardless of MDI or CSII use. Although only individuals who were CGM naïve prior to initiating a rtCGM or isCGM device were analysed, and the study did not investigate the real-world clinical effectiveness of switching from isCGM device to a rtCGM device, results from the randomized, controlled iHART study[5] suggest patient profiles with higher hypoglycaemic risk may benefit from switching from isCGM to rtCGM. More endocrinologist-led discussions with suitable participants , considering hypoglycaemic risk as well as the availability of technology and coverage, could be beneficial.

TIR was also higher in the rtCGM cohort compared to the isCGM cohort in the sub-group using CSII therapy. This is similar to a real-world cross-sectional analysis of the German/Austrian/Swiss Prospective Diabetes Follow-up (DPV) registry, which also found significantly greater TIR in participants using rtCGM + CSII compared to participants using isCGM + CSII.[8]

To our knowledge, this is the first study to compare HbA_{1c} and CGM metrics in a matched cohort of participants with T1D who initiated a rtCGM or an isCGM device during real-world clinical practice. The 6–12 month follow-up period is also a strength of this study, as it shows the longer term real-world glycaemic effects of initiating these devices. A limitation of this study is that due to the observational study design, causality cannot be implied, and results should be interpreted appropriately. LMC primarily sees adults with T1D, and we could not assess outcomes in children or youth. Furthermore, the use of a hybrid closed-loop systems among CSII and CGM users could not be evaluated, as the timing of software upgrades for these systems could not be separated and captured during the retrospective study analysis period. Due to the retrospective nature of the study, data on hospitalizations related to diabetic ketoacidosis or severe hypoglycaemia were unavailable. Access to provincial health card information or a prospective study would be required to further assess hospitalizations by treatment. Since missing data were not replaced, the analysis may be reflective of participants who are more motivated to improve their glycaemic management, however, there is no evidence to suggest this would be different between isCGM and rtCGM users or impact the study results. Finally, individuals in this study were followed at a specialist endocrinology practice, in a publicly funded healthcare system with advanced resources. Therefore, the results may not be generalizable to all individuals with T1D.

In conclusion, this retrospective study demonstrated that adults with T1D who initiated a rtCGM system in real-world clinical practice had a significant improvement in HbA_{1c} at 6–12-month follow-up compared to a matched cohort of adults who initiated an isCGM device. Initiating a rtCGM device over an isCGM device may be particularly beneficial when HbA_{1c} is <69 mmol/mol (8.5%), and when using MDI therapy. Although both the rtCGM and isCGM cohorts demonstrated clinically significant improvements in glycaemic control from baseline, the superior glycaemic control in the rtCGM cohort may be due to the higher TIR, lower TBR and lower glycaemic variability, compared to the isCGM cohort. The data from this study support the benefits and importance of real-time and predictive alerts for individuals with T1D. As the gap between rtCGM and isCGM technologies is narrowing, with the release of second- and third-generation FGM systems that offer alerts for hypoglycaemia, further investigations are warranted.

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CONFLICT OF INTEREST

R.E.B. and L.C. have no conflict of interest to declare. G.J.N. is an employee of Dexcom. A.A. reports grants and personal fees outside of the submitted work from Amgen, Bayer Inc., Sanofi, Novo Nordisk, Janssen, AstraZeneca, Eli Lilly, Boehringer Ingelheim, Merck, Senseonics, Insulet, Gilead, Glaxo-Smith-Kline, Lexicon, Pfizer, Xeris, Zealand and Zucara.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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