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BRIEF REPORT

Transatlantic Comparison of Pediatric Continuous Glucose Monitoring Use in the Diabetes-Patienten-Verlaufsdokumentation Initiative and Type 1 Diabetes Exchange Quality Improvement Collaborative

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Abstract

Achieving glycemic targets in youth and young adults with type 1 diabetes (T1D) is challenging. Diabetes devices, including continuous glucose monitors (CGM) may impact glycemic control. We analyzed the proportion of CGM use in youth and young adults with T1D at nine U.S. T1D Exchange Quality Improvement (T1DX-QI) Collaborative centers and 402 European diabetes prospective follow-up registry (Diabetes-Patienten-Verlaufsdokumentation [DPV]) sites from 2017 to 2020 and examined the association of CGM use to glycemic control as measured by hemoglobin A1c (HbA1c). CGM use increased each year from 2017 to 2020 across all age ranges (<6, 6–<12, 12–<18, 18–<25 years) in both registries and lower mean HbA1c was observed in CGM users compared with nonusers regardless of insulin delivery method for all years analyzed. CGM use appeared to increase more so in the European DPV than the U.S. T1DX-QI, which may be due to transatlantic differences in health care systems, insurance coverage, and prescriber habits.

Keywords: Continuous glucose monitoring , Glycemic control, Pediatric diabetes, Quality improvement.

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Introduction

ACHIEVING OPTIMAL GLYCEMIC control in type 1 diabetes (T1D) during childhood, adolescence, and young adulthood is difficult due to a myriad of challenges, including periods of rapid physical growth, neurocognitive development, sexual maturation, evolving dynamics in parent–child responsibilities, and new professional responsibilities and intimate partner relationships. Clinical trials provide evidence that continuous glucose monitoring (CGM) improves glucose control and quality of life for children, adolescents, and young adults; however, even as uptake of CGM in diabetes management is increasing, clinical outcomes vary.[1–6]

The T1D Exchange Quality Improvement (T1DX-QI) Collaborative is a learning health system engaging selected U.S. diabetes clinics in quality improvement initiatives and data sharing; whereas the diabetes prospective follow-up registry (Diabetes-Patienten-Verlaufsdokumentation [DPV]) is an initiative for quality improvement in Germany, Austria, Luxemburg, and Switzerland. Both registries provide anonymized, real-world clinical data for health care research. In a prior study analyzing the U.S. T1D Exchange Clinical Registry and the European DPV, participants in the European centers were twice as likely to achieve hemoglobin A1c (HbA1c) target of <7.5%.[3] However, the T1D Exchange Clinical Registry only included select research participants, while the T1DX-QI Collaborative includes all patients with T1D at the centers sharing clinical data.

The objectives of this study were to analyze the proportion of CGM use in youth and young adults with T1D in the U.S. T1DX-QI and European DPV from 2017 to 2020 and examine the association of CGM use to glycemic control as measured by HbA1c.

Methods

Children, adolescents, and young adults (age <25 years) with T1D duration >1 year with at least one clinic encounter during the years 2017–2020 from nine T1DX-QI clinics ($n = 14,803$ in 2017, $n = 16,856$ in 2018, $n = 17,377$ in 2019, $n = 18,078$ in 2020) and 402 DPV sites ($n = 31,103$ in 2017, $n = 31,750$ in 2018, $n = 32,302$ in 2019, $n = 32,334$ in 2020) were included in the analysis. CGM use was analyzed across age groups and HbA1c (%) was used to assess glycemic control for CGM users compared with nonusers. Patients were classified as CGM users for the year of interest if they indicated information on a device start date, or model/company of CGM within the past 1 year of their most recent diabetes clinic visit. Patients were also categorized by insulin delivery modality (insulin pump or multiple daily injections [MDI]) and each insulin therapy was further stratified by CGM use (users vs. nonusers).

Statistical analysis

Mean and standard deviation were reported for HbA1c, whereas frequency and percentage were used to describe the distribution of CGM users and nonusers across years. The association between A1c levels and CGM use was examined using linear regression models, constructing separate models for each year of interest, while adjusting for age and gender of people with T1D, and in a sensitivity analysis we additionally adjusted for pump use.

Results

From 2017 to 2020, overall CGM use among patients <25 years of age increased from a baseline of 25%–49% in the T1DX-QI Collaborative and from 40% to 76% in the DPV Initiative (Fig. 1). On analysis across the entire pediatric and young adult age span, CGM use increased each year from 2017 to 2020 across all age ranges (<6, 6–<12, 12–<18, 18–<25 years) in both the T1DX-QI and DPV (Table 1).

Lower mean HbA1c was observed in CGM users compared with nonusers in both registries for all years analyzed ($P < 0.001$ in all years for both registries). Analyses stratified by age group (<6, 6–<12, 12–<18, 18–<25 years old), pump use, and gender for both registries showed similar results in each year analyzed with lower HbA1c in CGM users versus nonusers ($P < 0.001$). In each year analyzed, lower mean HbA1c was observed in CGM users across insulin delivery modalities, including insulin pump and MDI (Table 1).

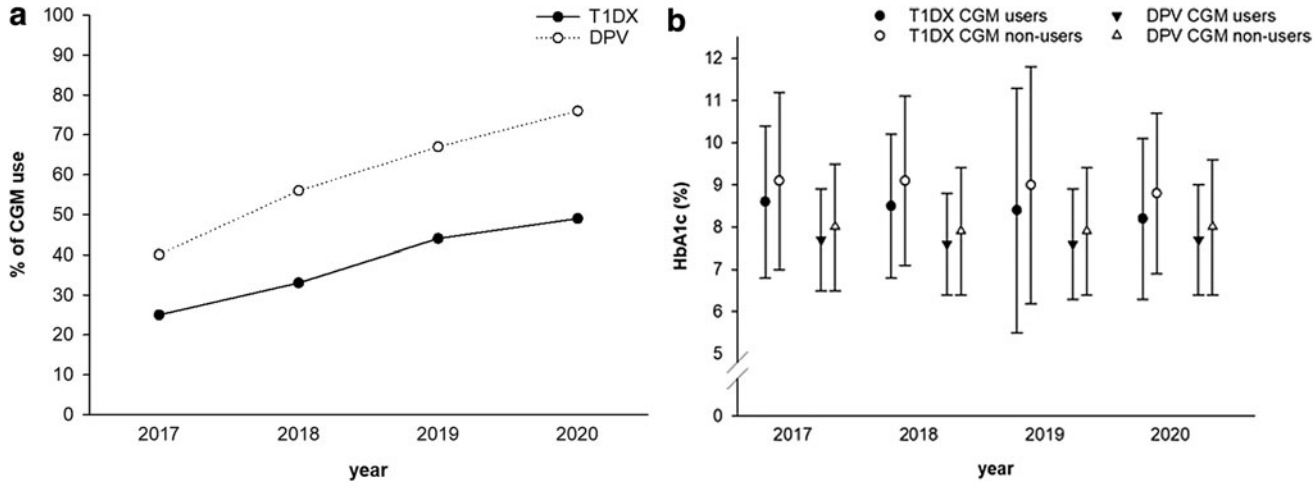

FIG. 1. **(a)** Proportion of CGM use from 2017 to 2020 among those <25 years of age. **(b)** HbA1c (%) in CGM users compared with nonusers. CGM, continuous glucose monitoring; HbA1c, hemoglobin A1c.

Table 1. Rates of Continuous Glucose Monitoring (CGM) Use and Glycemic Control Among CGM Users Versus Nonusers with Modes of Insulin Delivery

	T1DX-QI				*DPV*			
	2017 (n = *14,803*)	*2018* (n = *16,856*)	*2019* (n = *17,377*)	*2020* (n = *18,078*)	*2017* (n = *31,103*)	*2018* (n = *31,750*)	*2019* (n = *32,302*)	*2020* (n = *32,234*)
Overall CGM use	3737 (25)	5506 (33)	7589 (44)	8912 (49)	12,363 (40)	17,741 (56)	21,577 (67)	24,359 (76)
Age (years)								
<6	338 (34)	446 (39)	537 (49)	608 (55)	1195 (51)	1490 (62)	1796 (71)	1988 (76)
6–<12	1223 (29)	1710 (35)	2303 (49)	2557 (51)	4319 (47)	5917 (63)	6919 (73)	7598 (80)
12–<18	1550 (22)	2493 (30)	3581 (43)	4274 (48)	5970 (38)	8905 (55)	11,056 (67)	12,736 (77)
18–<25	626 (26)	839 (32)	1168 (43)	1473 (46)	877 (23)	1429 (38)	1806 (47)	2037 (58)
Pump with CGM								
n (%)	2481 (41)	3349 (50)	4168 (58)	4814 (60)	7568 (48)	10,947 (65)	13,146 (75)	14,658 (82)
HbA1c	8.5% ± 1.6%	8.4% ± 1.7%	8.2% ± 1.6%	8.1% ± 1.7%	7.7% ± 1.1%	7.6% ± 1.1%	7.6% ± 1.2%	7.7% ± 1.2%
Pump without CGM								
n (%)	866 (15)	3309 (50)	3057 (42)	3246 (40)	8166 (52)	5785 (35)	4437 (25)	3195 (18)
HbA1c	8.7% ± 1.7%	8.7% ± 1.7%	8.6% ± 1.7%	8.3% ± 1.6%	8.0% ± 1.3%	7.9% ± 1.4%	7.9% ± 1.4%	8.0% ± 1.4%
MDI with CGM								
n (%)	866 (15)	1279 (20)	2123 (31)	2858 (38)	4810 (33)	6802 (48)	8396 (60)	9723 (70)
HbA1c	8.8% ± 2.2%	8.7% ± 2.0%	8.7% ± 2.2%	8.7% ± 2.3%	7.7% ± 1.4%	7.6% ± 1.4%	7.6% ± 1.4%	7.6% ± 1.4%
MDI without CGM								
n (%)	4938 (85)	4966 (80)	4685 (69)	4525 (62)	9744 (67)	7417 (52)	5683 (40)	4160 (30)
HbA1c	9.3% ± 2.2%	9.3% ± 2.2%	9.4% ± 2.3%	9.1% ± 2.2%	8.0% ± 1.6%	7.9% ± 1.6%	7.9% ± 1.6%	7.9% ± 1.7%

*T1DX-QI and DPV: all $P < 0.001$ for comparing treatment modality with and without CGM.

CGM, continuous glucose monitoring; DPV, Diabetes-Patienten-Verlaufsdokumentation; HbA1c, hemoglobin A1c; MDI, multiple daily injections; T1DX-QI, T1D Exchange Quality Improvement.

Discussion

These findings are in line with previous studies providing additional real-world evidence of the steady increase in CGM use[3–5] and association to lower HbA1c compared with non-CGM users among youth and young adults with T1D.[3,5,6] In a prior study that evaluated the proportion of pediatric CGM use in the DPV and research participants in the T1D Exchange Registry from 2011 to 2016, overall CGM use was similar between the two groups (2016: 19% in DPV, 22% in T1DX Registry). However, in the present study analyzing CGM use from 2017 to 2020, the proportion of CGM use appears to have increased more so in DPV than in the U.S. T1DX-QI Collaborative, which comprises all patients at the diabetes centers sharing data (2020: 76% in DPV, 49% in T1DX-QI with a divergence observed since 2017 as displayed in Fig. 1). This transatlantic divergence in CGM use uptake may be in part due to differences in health care systems, insurance coverage, prescriber habits, and implicit bias.

Strengths of this analysis include capturing real-world data from two large international registries with key participant characteristics, including insulin delivery regimen (insulin pump vs. MDI) and description of findings across the pediatric lifespan into young adults. There are several limitations to this study, most notably the observational nature of the data, which does not allow determination of causality of CGM use with glycemic control. Socioeconomic data were lacking in this analysis and may have contributed to divergence in CGM use and clinical outcomes, including HbA1c. Another limitation is that unlike the DPV, which includes nationwide data (>80% coverage), the T1DX-QI represents a large sample of patients with T1D among select diabetes specialty clinics but is not representative of the population at large.

Additionally, this analysis did not include data on the use of hybrid closed-loop therapy, which may have contributed to the observed glycemic benefit of lower HbA1c in pump with CGM users, however, this group represented a small percentage of this group in both registries, including just 4% of T1DX-QI participants and 1.4% of DPV participants in 2020. Finally, the model of CGM was not consistently provided due to differences in reporting across sites, so rates of real-time CGM (rtCGM) and intermittent scan CGM (isCGM) across countries could not be analyzed. Thus, the observational findings in this study, including association of HbA1c to CGM use should be interpreted with caution.

As CGM use continues to increase worldwide, it will remain important to monitor the impact on clinical outcomes and quality of life in people with diabetes. The divergence in U.S. and European CGM use and whether this is a result of health care system differences, including regulatory approval, insurance coverage, and cost of device (rtCGM vs. isCGM), or driven by underlying deficits in health equity should be explored in future studies and addressed through advocacy efforts. Quality improvement interventions to enhance CGM uptake, advocacy efforts promoting improved insurance coverage, and tailored clinical education to optimize personal use of CGM especially when incorporated with closed-loop, automated insulin delivery systems have potential to improve clinical outcomes in pediatric diabetes.

Authors' Contributions

D.J.D. researched data and wrote/edited the article. S.L. and N.N. researched data, performed statistical analyses, and wrote/edited the article. C.S.S., O.E., S.v.S., N.H.Y.J., K.L., D.M.M., and R.W.H. researched data, contributed to data interpretation, and reviewed/edited the article. All authors reviewed and approved the final version of the article. D.J.D. is the guarantor of this work.

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Author Disclosure Statement

D.J.D. has served as an independent consultant for Dexcom and Insulet and his institution has received research support from Insulet separate from this work. O.E. is a member of the Medtronic Diabetes Health Equity Advisory Board and his institution has received research support from Eli Lilly, Medtronic Diabetes, and Dexcom separate from this work. D.M.M. has had research support from the NIH, JDRF, NSF, and the Helmsley Charitable Trust and his institution has had research support from Medtronic, Dexcom, Insulet, Bigfoot Biomedical, Tandem, and Roche, and he has consulted for Abbott, Aditxt, the Helmsley Charitable Trust, Sanofi, Novo Nordisk, Eli Lilly, Medtronic, Insulet, Dompe, and BIOSPEX.

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