FEATURE ARTICLE

Increasing Continuous Glucose Monitoring Use for Non-Hispanic Black and Hispanic People With Type 1 Diabetes: Results From the T1D Exchange Quality Improvement Collaborative Equity Study

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Despite the benefits of continuous glucose monitoring (CGM), there is lower use of this technology among Non-Hispanic Black and Hispanic people with type 1 diabetes compared with their non-Hispanic White counterparts. The T1D Exchange Quality Improvement Collaborative recruited five endocrinology centers to pilot an equity-focused quality improvement (QI) study to reduce racial inequities in CGM use. The centers used rapid QI cycles to test and expand interventions such as provider bias training, translation of CGM materials, provision of CGM education in multiple languages, screening for social determinants of health, and shared decision-making. After implementation of these interventions, median CGM use increased by 7% in non-Hispanic White, 12% in non-Hispanic Black, and 15% in Hispanic people with type 1 diabetes. The gap between non-Hispanic White and non-Hispanic Black patients decreased by 5%, and the gap between non-Hispanic White and Hispanic patients decreased by 8%.

The adoption of continuous glucose monitoring (CGM) improved care and glycemic outcomes for people with type 1 diabetes (1). Studies have demonstrated that CGM improves glycemic outcomes and long-term outcomes in both children and adults in this population (2–4). CGM has also improved quality of life, reduced diabetes distress, yielded high levels of patient satisfaction, and improved cost-effectiveness of diabetes management (5,6). CGM thus has become the standard of care for type 1 diabetes, demonstrating reductions in A1C, diabetic ketoacidosis, and severe hypoglycemia (7).

Significant inequities exist in CGM use by race/ethnicity and socioeconomic status despite its documented benefits (8). Non-Hispanic Black and Hispanic people with type 1 diabetes use CGM less frequently than their non-Hispanic White counterparts (9,10). The attitudes, assumptions, and behaviors of health care providers (HCPs) have been identified as one of the factors contributing to inequities in diabetes technology use (11,12). Biases are likely to affect both diagnosis and treatment decisions at all levels of care, including diabetes technology recommendations (13–15). Studies have demonstrated a disconnect between HCPs' perceived barriers to diabetes technology use and those actually experienced by people with type 1 diabetes (16). Additionally, perceived discrimination, cultural incongruence, and limited English language proficiency likely exacerbate this disconnect between HCPs and people with type 1 diabetes of various racial/ethnic backgrounds (17,18). This project aimed to use quality improvement (QI) methods to reduce racial inequities in CGM use.

Research Design and Methods

The study was conducted across three pediatric diabetes centers and two adult diabetes centers in the T1D

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Exchange Quality Improvement Collaborative (T1DX-QI). Established in 2016 with 10 pilot centers (19), the T1DX-QI has grown to include 55 clinical centers caring for >75,000 people with type 1 diabetes across 20 U.S. states. In creating the Collaborative, endocrinologists, people with type 1 diabetes/parents, informational technology experts, diabetes educators, QI experts, and clinical staff were mobilized to design broad interventions that can yield the highest impact for patients and lead to improved organizational QI culture. Participating organizations receive QI guidance from T1DX-QI Collaborative coaches (20).

The five centers that participated in this project serve 12,394 people with type 1 diabetes with a mean age of 25.9 ± 15.6 years. Aggregate baseline data were collected between November 2020 and June 2021 and stratified by race and ethnicity (Table 1). Participating center teams consist of physician champions, nurse practitioners, physician associates, social workers, and psychologists (Table 2). The five participating T1DX-QI centers were Cincinnati Children's Hospital Medical Center in Cincinnati, OH; Nationwide Children's Hospital in Columbus, OH; Le Bonheur Children's Hospital in Nashville, TN; Montefiore Medical Center in Bronx, NY; and SUNY Upstate Medical University in Syracuse, NY.

A previous article from the T1DX-QI described how QI tools and principles can be adapted into a practical 10-step framework to advance equity in diabetes management (21). This framework is an adaptation of the Institute for Healthcare Improvement's Model for Improvement (21). Participating centers used this framework to increase the equitable use of CGM among their patients. The framework for this project included performing an extensive review of clinic baseline data and processes, building a diverse team, setting equity-focused aims, identifying inequities in workflow, identifying factors contributing to inequities, brainstorming improvement ideas, and testing specific changes using a series of rapid QI cycles to increase the prescription and adoption of CGM among non-Hispanic Black and Hispanic people with type 1 diabetes.

Participating centers collaboratively developed an aim statement that is specific, measurable, achievable, realistic, timebound, with equity revision (SMART-ER) (21). A key driver diagram was also developed to identify primary drivers and practical change ideas to increase and sustain equitable CGM use (Figure 1). The following primary drivers were identified to directly contribute to achieving the SMART-ER aim: *1*) provider bias, *2*) social determinants of health (SDOH), *3*) education, *4*) technology, *5*) policies and insurance, *6*) communication and shared decision-making, and *7*) access, and *8*) equity framework. The participating centers tested the following interventions to address inequities in CGM use: *1*) unconscious bias training;

TABLE 1 Baseline Participant Characteristics in the Five Participating Sites

	Pediatric Site 1	Pediatric Site 2	Pediatric Site 3	Adult Site 1	Adult Site 2
Total patients	3,903	3,484	828	1,149	3,030
Insurance type					
Public	936	1,450	454	896	583
Private	2,732	1,929	356	256	1,269
Other/unknown	235	105	18	24	1,178
Race/ethnicity					
Non-Hispanic White	3,280	2,652	417	167	981
Non-Hispanic Black	358	526	312	338	226
Hispanic	76	51	32	503	32
Other/unknown	189	255	67	139	1,791
Age, years	16.9 ± 4.7	16 ± 4.9	12 ± 5	36.6 ± 17.9	44.4 ± 16.6
Female sex	1,905	1,622	357	597	1,421
CGM use	559	1,927	469	778	1,469
Insulin pump use	2,086	3,021	122	115	1,031

Data are *n* or mean ± SD.

TABLE 2 Number of Full-Time Equivalent Staff Positions by Discipline in the Five Participating Sites

	Pediatric Site 1	Pediatric Site 2	Pediatric Site 3	Adult Site 1	Adult Site 2
Medical doctors or doctors of osteopathic medicine	8	10.2	5	16	3
Nurse practitioners or physician associates	5	7.6	3	4	2.2
Social workers	4	4.4	1	0	0.4
Psychologists	2	0.1	4	1	0
Certified diabetes care and education specialists	10	0	1	0	2.4

2) translation of educational materials into Spanish, Nepali, and Arabic; *3*) SDOH screening and referral; *4*) use of CGM champions; *5*) standardized workflow for people with type 1 diabetes on public or private insurance; and, 6) streamlining of communication among HCPs, durable medical equipment (DME) suppliers, and people with type 1 diabetes. Table 3 shows the full list of all interventions tested. A fishbone diagram was completed by participating centers to understand the factors contributing to the inequities (Figure 2). Participating centers met monthly to share improvement results, observations, and findings.

The primary QI measure was the disparity gap between non-Hispanic White and minority (non-Hispanic Black and Hispanic) populations. This gap was measured by the difference in the median between the total number of all people with type 1 diabetes by race and ethnicity (denominator) and the total number using CGM by race and ethnicity (numerator). This difference was measured before and after the interventions. For the denominator, we counted people with type 1 diabetes of all ages who had a minimum duration of diabetes ≥12 months and at least one in-person or telehealth visit in the reporting month, categorized by race and ethnicity. For the numerator, we counted the total number of people from the denominator who were using CGM in the reporting month, categorized by race and ethnicity.

We collected data from November 2020 through December 2022. Data were plotted on a trend chart showing the pre-intervention median (November 2020 to July 2021) and post-intervention median (August 2021 to December 2022) (Figure 3). Median statistical analysis testing for significance between pre- and post-intervention medians was conducted using a Wilcoxon signed-rank test.

All participating centers received local institutional review board approval to share aggregate data and participate in this QI project. No protected health information was transmitted outside of each clinic for this project. This QI project was approved centrally and deemed nonhuman subject research by the Western Institutional Review Board. We applied guidelines from SQUIRE 2.0 (Revised Standards for Quality Improvement Reporting Excellence) in preparing this article (22).

Results

Pre-intervention median CGM use was 69% among non-Hispanic White, 51% among non-Hispanic Black, and 56% among Hispanic people with type 1 diabetes. Post-intervention median CGM use was 76, 63, and 71% for these same groups, respectively. The median increased by 7% in non-Hispanic White, 12% in non-Hispanic Black, and 15% in Hispanic patients. The gap between non-Hispanic White and non-Hispanic Black patients was reduced by 5%, and the gap between non-Hispanic White and Hispanic patients was reduced by 8%. As determined by Wilcoxon signed-rank test, median CGM use from pre- to post-intervention increased by 7% in non-Hispanic White patients ($P = 0.006$), by 12% in non-Hispanic Black patients ($P = 0.003$), and 15% in Hispanic patients ($P = 0.004$). The gap between non-Hispanic White and Hispanic patients was reduced by 8% ($P = 0.02$), and the gap between non-Hispanic White and non-Hispanic Black patients was reduced by 5% ($P = 0.16$) (Table 4).

All five centers participated in the unconscious bias training. This training was conducted virtually by health equity experts for HCPs, diabetes educators, nurses, administrators, QI specialists, and other clinic staff as a group session with breakout activities to reinforce the concepts taught.

The training included an engaging simulation in which the conditions of oppression were recreated to facilitate

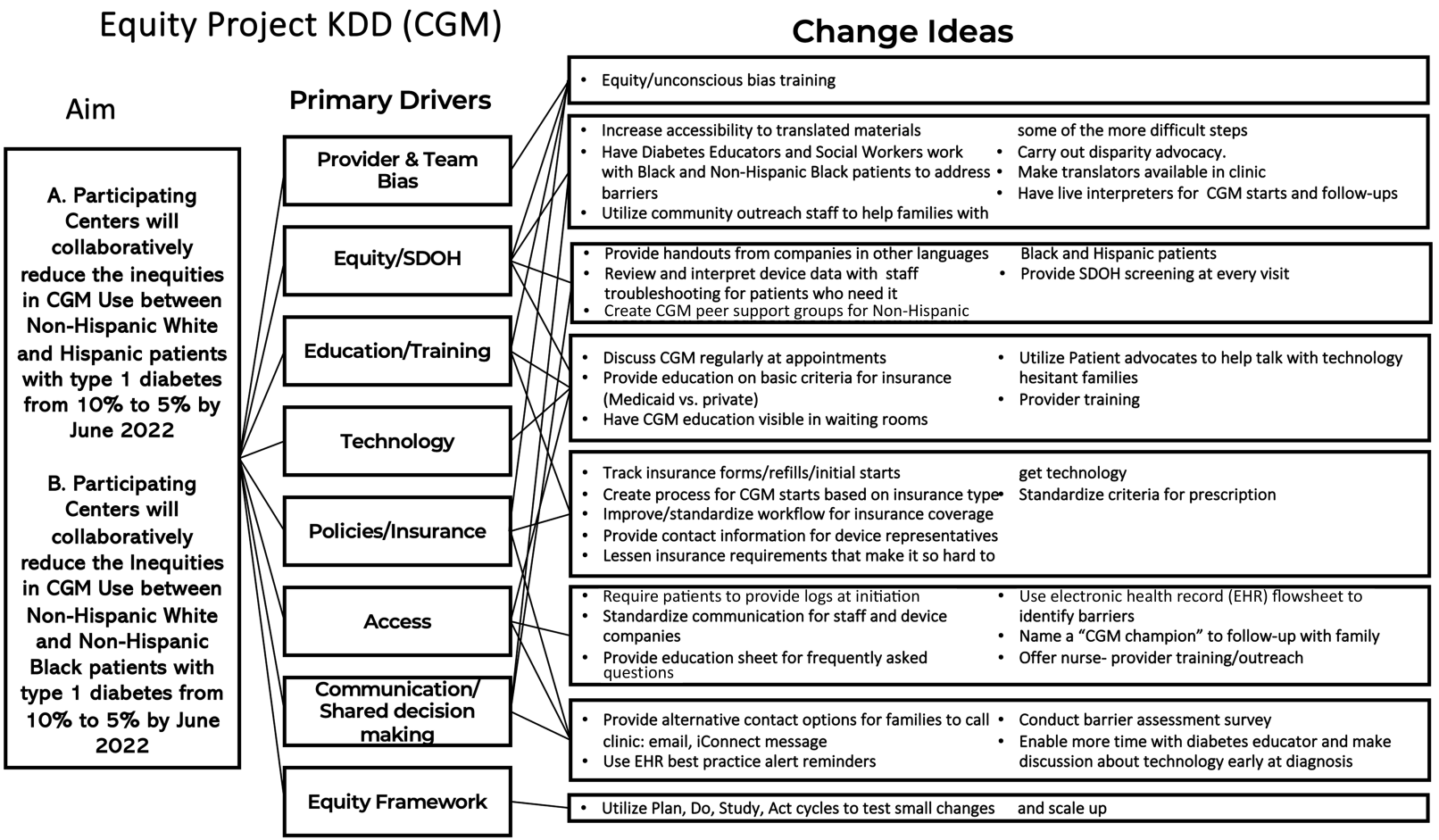

FIGURE 1 Diagram showing key drivers of inequities in CGM use and potential interventions. CDE, certified diabetes educator; EPIC, Epic electronic health record system; FAQ, frequently asked questions; KDD, key driver diagram. NHB, non-Hispanic Black; PDSA, Plan, Do Study, Act; reps, representatives; SW, social worker; T1D, type 1 diabetes.

TABLE 3 Interventions Tested in the Five Participating Sites

	Pediatric Site 1	Pediatric Site 2	Pediatric Site 3	Adult Site 1	Adult Site 2
Equity/unconscious bias training to learn about major historical events that contributed to health inequities, articulate successful strategies for addressing diabetes technology inequities, and describe the role of diabetes care teams in reducing diabetes inequities	X	X	X	X	X
The use of SDOH paper forms to make screening more accessible. Creation of SDOH tab on electronic health record (EHR) system to make screening and documentation more accessible for patients and providers. Use of EHR best practice alert to flag patients who need to be referred.	X	X			X
In-clinic interpreters and translation of educational materials into other languages	X	X		X	X
Standardized workflow to address pain points for historically excluded patients	X	X	X	X	X
Adapted workflow to integrate DME suppliers in the process to improve communication between clinic, DME suppliers, and patients				X	X
Provider education to discuss patient eligibility and prescription practices to improve access for patients		X	X	X	X
The use of a patient advocate/advisor to understand barriers and brainstorm improvement ideas	X	X	X	X	X
Patient education to ensure that communication about the CGM process is continuous and effective	X	X	X	X	X
The use of "My Diabetes Journey," a shared decision-making tool to facilitate conversations with patients in the clinic			X		
In-clinic CGM champions dedicated to assisting patients with insurance-related matters. These champions proactively engaged with patients and their families, offering troubleshooting support until the patients successfully received CGM devices	X		X		

a more complex and nuanced understanding of unconscious bias. Participants navigated this activity and absorbed some unexpected but insightful lessons that helped to internalize and intellectualize concepts important to confronting and advancing racial equity in their lives and organization.

Educational modules covered four topics: the historical perspective of racism, layers of racism, embracing discomfort, and collective care. Participants were provided access to the organization's learning portal to reinforce the training. The portal is a tool to stay connected, through which participants can continue to collaborate, discuss, and identify new ways to facilitate racial equity awareness in and change to health care communities.

Several other interventions were initiated. Four centers translated educational materials and classes into other languages to support non–English-speaking families. Three centers introduced SDOH screening and facilitated social work referrals. The centers used different SDOH screening tools. A sample SDOH screening tool is provided in the Supplementary Material. Two centers provided translation services for in-person and telehealth visits and implemented social work screenings in Spanish.

All centers standardized CGM workflow to address pain points and make the process more efficient. Two centers revised workflow to increase communication with DME suppliers and use device company

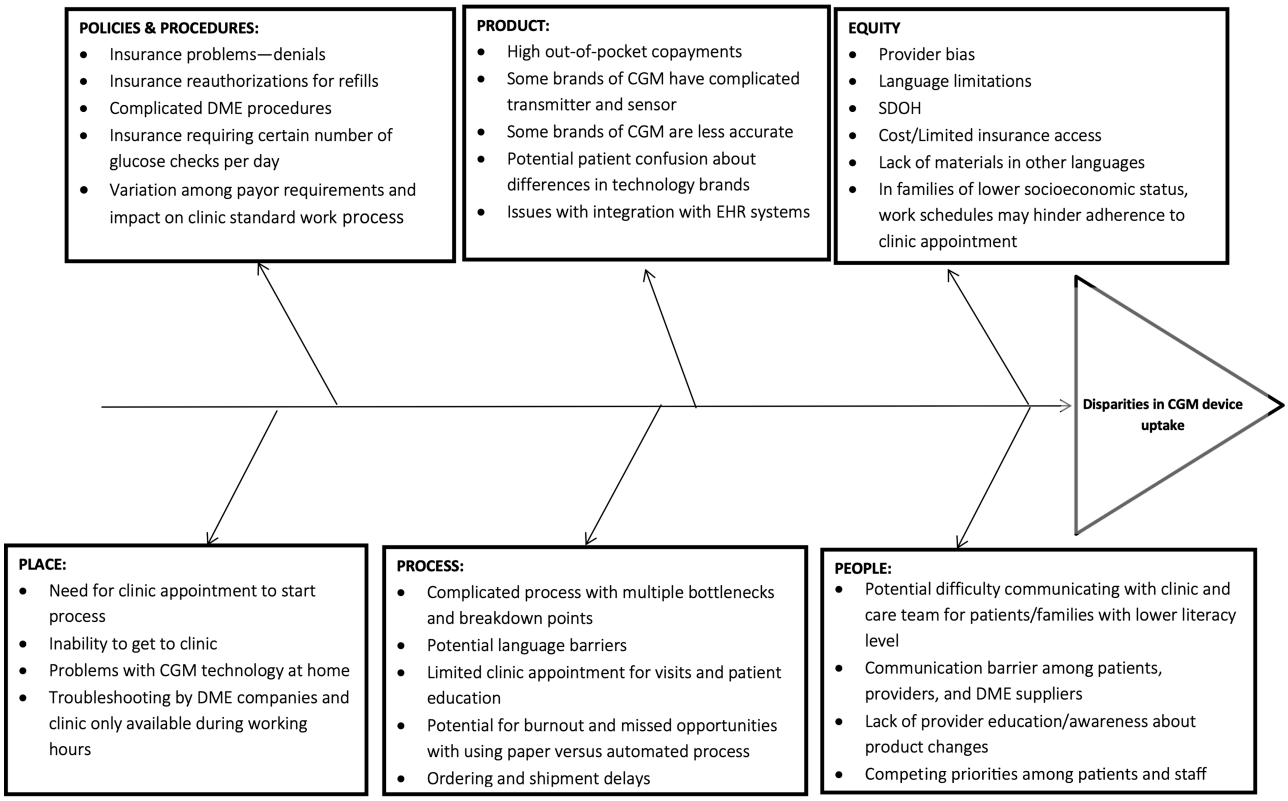

FIGURE 2 Fishbone diagram showing contributors to CGM inequities.

representatives to provide patient education and device troubleshooting.

Three centers implemented HCP education to discuss patient eligibility and prescription practices to improve patients' access to CGM. Two centers used a shared decision-making tool (called My Diabetes Journey) to facilitate conversations with patients in the clinic (23).

Two centers tested the use of CGM champions to help patients navigate insurance issues. The nurses at these centers doubled as CGM champions and were committed to promptly resolving any issues patients encountered in accessing CGM. However, the study did not quantify the extent of the CGM champions' efforts. Future research could focus on assessing their capacity-building potential and the level of effort they contribute.

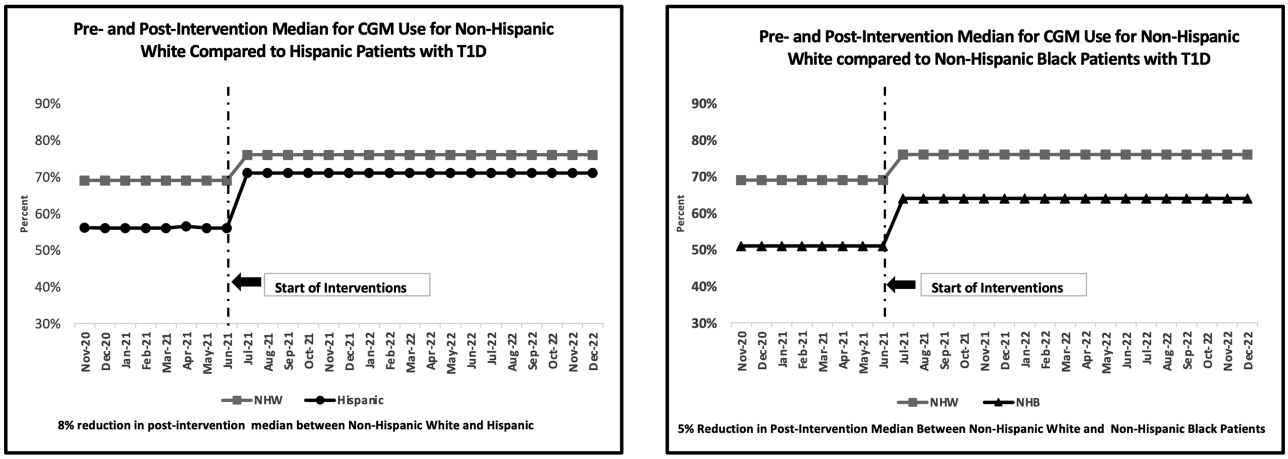

FIGURE 3 Trend charts showing an increase in median CGM use among non-Hispanic White (NHW), non-Hispanic Black (NHB), and Hispanic people with type 1 diabetes and reduced disparity gaps between non-Hispanic White and Hispanic (left) and non-Hispanic White and non-Hispanic Black (right) patients.

TABLE 4 Median Pre- and Post-Intervention CGM Use by Race and Ethnicity and Pre- to Post-Intervention Change in Gaps Between Non-Hispanic White and Minority Racial/Ethnic Groups

	Pre-Intervention, %	Post-Intervention, %	Change, %	*P*
Non-Hispanic Whites	69	76	7	0.006
Non-Hispanic Blacks	51	63	12	0.003
Hispanics	56	71	15	0.004
Non-Hispanic Whites versus Hispanics	13	5	−8	0.02
Non-Hispanic Whites versus non-Hispanic Blacks	18	13	−5	0.16

Discussion

To our knowledge, this is the first study involving a multicenter QI project with an equity lens to reduce disparities in CGM use. Our study describes a stepwise approach to addressing inequities in diabetes care.

During the study period, all participating centers experienced an increase in overall CGM use across all racial and ethnic groups. All five sites collectively designed interventions to address barriers to and increase use on CGM. These interventions promoted and expanded CGM use among Non-Hispanic Black and Hispanic people with type 1 diabetes.

Our findings align with results from other institutions' QI projects focusing on CGM equity. Montefiore Medical Center, a safety-net hospital system in Bronx, NY, developed interventions that focused on redesigning health care delivery and removing structural barriers to CGM prescribing (7). Interventions tested include a social needs assessment, provider bias training, and revision of the CGM workflow to integrate DME suppliers and pharmacy technicians and thereby lessen barriers for HCPs and patients. CGM prescriptions increased across all racial/ethnic demographics. There was an increase of 59% in CGM use among non-Hispanic Black and Hispanic patients over 3 years (7).

Alabama Children's Hospital decreased the disparity in CGM access between non-Hispanic White and non-Hispanic Black people with type 1 diabetes from 18 to 6% over 13 months. This program used the 1-page My Diabetes Journey tool to facilitate communication about CGM and solicit patients' and caregivers' input by asking them to identify what they were doing well with and the difficulties they faced in diabetes management. The program gave participating patients an opportunity to try CGM during routine diabetes clinic visits and advocated for simplification of coverage criteria for publicly insured patients (23).

Ten centers in the T1DX-QI used QI methodology to increase insulin pump and CGM use (24). CGM use increased from 34% at baseline to 55% after 20 months. Each center was responsible for designing and implementing its own interventions. Centers identified barriers to CGM uptake at their sites and designed interventions to target those specific barriers (1).

Addressing SDOH has been shown to be an essential intervention to achieve health equity in diabetes. In our study, three of the participating centers implemented SDOH screening and referrals to increase equitable CGM use. In keeping with findings in the literature and with a shift in the greater health care system toward greater emphasis on population health outcomes, SDOH screening has risen to the forefront as another essential intervention to achieve diabetes-related health equity (25). We found that addressing SDOH concerns and the provision of referrals to community resources made CGM more accessible to people with type 1 diabetes.

To further reduce the disparity gap in CGM use, it is crucial to ensure that SDOH screening is integrated into routine diabetes care. Addala et al. (3) compared technology use and socioeconomic status (SES) in children with type 1 diabetes in registries in the United States and Germany. They found that, although both registries demonstrated an overall increase in technology use over 8 years, technology use was highest among the higher-SES cohort, and this gap was larger in the United States. Although innovations in diabetes technology have improved quality of life and glycemic outcomes in children with type 1 diabetes, children from low-income families and non-Hispanic Black children are not experiencing the benefits, and both groups continue to be at higher risk for complications and adverse outcomes (17).

Despite recommendations, clinical centers in the United States often do not integrate SDOH screening into routine diabetes care. Thus, HCPs often miss the nonmedical challenges faced by many families (25). Yet, the integration of all aspects of SDOH screening into diabetes care is possible and has been accomplished. In a recent initiative, eight organizations successfully integrated SDOH screening into diabetes care (26).

A comprehensive review by Hill-Briggs et al. (17) described the influence of SES (i.e., income, education, and occupation); neighborhood and physical environment (e.g., housing, the built environment, and toxic environmental exposures); food environment (e.g., food insecurity and food access); health care (e.g., access, affordability, and quality of care); and social context (e.g., social cohesion, capital, and support) on adults with diabetes. Health care organizations are progressively adopting interventions aimed at enhancing outcomes for people with type 1 diabetes and other chronic health conditions by screening to identify social needs (27).

Managing diabetes involves the use of technology, and people with type 1 diabetes who have higher SES and educational levels tend to have greater access to diabetes technology; those facing adverse social influences, from racial and ethnic minority groups, and who have public insurance tend to experience worse outcomes (28). Although the overall rate of CGM use has increased over time, the disparity gap has widened, demonstrating that the introduction of new technology has the potential to widen disparity gaps (3). Multiple health care interventions exist to increase CGM use among people with type 1 diabetes, but only a few are targeted specifically to address inequities (7).

QI methodology is useful and feasible to implement in attempts to reduce racial and ethnic equity gaps in CGM use. To further reduce disparities in CGM use, our study suggests that it will be important to standardize clinic workflow and pay special attention to the needs of historically excluded patients. In our study, all participating centers revised their workflow to address barriers for non-Hispanic Black and Hispanic patients, such as cumbersome paperwork requirements for individuals who are publicly insured; communication challenges among DME suppliers, HCPs, and patients; the lag time between prescription and initiation of authorization paperwork; and language barriers. In addition to standardizing workflow, it would be helpful to identify new ways to integrate DME providers into clinic workflow to make CGM more accessible to patients.

Strengths and Limitations

The strengths of this project include the ability of the participating centers to test site-level interventions based on each clinic's priorities and available resources. As a multicenter study, this platform provided an opportunity for the centers to learn from each other during monthly coaching calls.

A limitation is that participating centers had varying levels of QI infrastructure and capacity, which might make some of our findings nongeneralizable to other institutions. This was a QI project; therefore, no causality could be demonstrated.

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DUALITY OF INTEREST

O.E. is a compensated Health Equity Advisory Board member for Medtronic Diabetes and serves as principal investigator for investigator-led projects sponsored by Abbott, Eli Lilly, Insulet, and Medtronic. He is compensated through his organization, the T1D Exchange. No other potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

O.O. wrote the first draft of the manuscript. O.E. conceptualized the study, was its principal investigator, and substantially reviewed and edited the manuscript. All authors critically edited the manuscript and approved the final version for submission. O.O. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

PRIOR PRESENTATION

A portion of the data included in this article was presented as a poster at the 16th International Conference on Advanced Technologies & Treatments for Diabetes on 23 February 2023, in Berlin Germany.

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