Optimizing Glycemic Outcomes for Minoritized and Medically Underserved Adults Living with Type 1 Diabetes

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KEY POINTS

- The American Diabetes Association Professional Practice Committee recommends that continuous glucose monitoring and automated insulin delivery systems be offered to adults with type 1 diabetes (T1D) who can use the devices safely.
- Individuals living with T1D from minoritized and lower income communities have poorer health outcomes and lower use of diabetes technologies. Some of the reasons for the disparities include limited health literacy, barriers to access to care, inadequate health insurance coverage, provider implicit bias, and broad exclusion from many of the trials evaluating diabetes technologies.
- Educational and specialty referral initiatives can be effective in overcoming clinical inertia and increasing the use of advanced technologies.
- Social risk factors and barriers that can compete with diabetes self-care need to be considered in the formulation of treatment plans and collaborative goal setting.
- Advanced diabetes technologies can be successfully introduced in adult medically underserved populations living with T1D.

INTRODUCTION

Type 1 diabetes (T1D) is a chronic condition characterized by autoimmune destruction of pancreatic beta cells, resulting in near-absolute insulin deficiency and reliance on life-long exogenous insulin therapy.[1] In recent years, advances in diabetes technology, including increasingly sophisticated continuous glucose monitors (CGM) and

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automated insulin delivery (AID) systems, have transformed the management of T1D, leading to improvements in glycemic control and quality of life.[2] Consistent use of these technologies has become part of the standard of care. However, to date, most of the randomized controlled trials evaluating use of technologies in T1D have been in more socially advantaged and predominantly non-Hispanic White patients followed at specialized diabetes care centers.[3–6] Furthermore, these efficacy studies have excluded patients with T1D who have markedly elevated A1c levels. Consistent with the American Diabetes Association Professional Practice Committee recommendations that CGM and AID systems should be offered for diabetes management for youth and adults with T1D who can use the devices safely,[2] the aim of this review is to broadly review factors that underly successful technology implementation in populations who have traditionally been excluded from benefit.

BACKGROUND

It is well established that individuals living with T1D from minoritized and lower income communities have poorer health outcomes and use of diabetes technologies in these populations remains low.[7–11] Some of the more common reasons for these disparities include well-recognized social determinants of health, including barriers to access to care and health insurance coverage limitations, limited health literacy, and the fact that minoritized populations have largely been excluded from many of the randomized controlled trials evaluating diabetes technologies. Recently, clinician implicit bias has been identified as an important contributor to poor device uptake.[12] Health care providers who prescribe diabetes technologies are highly influential and act as "gatekeepers" for their patients, making specific device recommendations, supporting device initiation and training, and providing ongoing longitudinal support.[13] However, many adult endocrinology fellow trainees feel under-prepared in terms of critical aspects of technology use, creating an additional potential barrier to this important gatekeeper role.[14] Technology also advances quickly, which may result in clinician discomfort with recommending devices that they have limited familiarity with. Moreover, even in health care systems with universal insurance coverage for insulin pumps and CGM, this has not necessarily resolved these disparities.[15,16]

Finally, many underserved patients entering diabetes management programs or seeking primary care have limited diabetes self-management skills, nutritional literacy, and high levels of diabetes distress, creating a potential bias where clinicians may feel that the technology is too complex for implementation.[17,18]

APPROACH
Emphasis on Team-Based Diabetes Care

It is well established that people living with T1D[19] benefit from multidisciplinary care teams that include clinicians with expertise in behavioral, nutritional, medical, and other relevant services.[20–22] However, minoritized and medically underserved people with diabetes (PWD) are often unable to access many of these critical clinical resources, or resources are not appropriately or are insufficiently developed to address the issues that are most relevant to underserved PWD.[23] For example, standard nutritional resources often fail to sufficiently address culturally appropriate food choices.[24] Furthermore, important social determinants of health[25] that directly affect glycemic outcomes are often incompletely addressed in busy medical appointments and clinician familiarity with family, inter-personal, employment, and community dynamics that may contribute to diabetes distress are often amplified in underserved PWD.[25] As a result of the frequently increased care complexity, care teams often need to be larger

and particularly attentive to patient concerns that fall outside the scope of typical biomedical model office appointments. For example, a PWD who works a part-time job or in a transitory role may need to navigate changing health insurance benefits (public vs commercial insurance benefits) that may necessitate transitions between "in-network" providers, different versions of insulin, or challenges obtaining consistent CGM or insulin pump supplies.[26] Oftentimes, these challenges result in unnecessary hospitalizations or emergency department visits and periods where patients are required to navigate transitions between multiple dose injection therapy and insulin pump therapy. In addition, many medical centers and medical practices are ill-equipped and under-resourced to support PWD who are expected to navigate these challenges.[27] Therefore, it is perhaps even more critical that clinicians caring for minoritized and medically underserved PWD work together to provide "wrap-around" care structures that can act as both a safety net and provide structured longitudinal care that allows PWD to thrive.[28] **Box 1** provides a recommended list of health care roles that may support underserved PWDs. Dedicated Quality Improvement (QI) teams are also invaluable to provide real-world data insights as they work together within institutions as well as within larger collaborative learning networks and broader health equity advisory committees to plan and study interventions that are aimed to reduce inequities in care.[29,30]

Recognition of Provider Implicit Bias in Diabetes Technology Adoption

It is important to recognize that socioeconomic, demographic factors, health literacy, and health care location are not solely responsible for decreased adoption of diabetes technology in underserved PWD. Minoritized adults living with T1D report that they have never been offered the option of engaging in a shared decision-making process in terms of beginning on a CGM or insulin pump.[31] Oftentimes, health care providers have an unconscious bias, whereby they fail to raise the availability of technologies or recognize the potential for more advanced diabetes self-management capacity in an individual patient,[12] PWD with limited English proficiency are at risk for lower quality patient-clinician communication, decreased shared decision-making, and may be particularly at risk of this implicit bias. Because of cultural differences and socioeconomic and educational imbalances, the relationship between clinician and patient can become paternalistic and prescriptive, distracting from the model of collaborative coaching and decision-making required to foster engagement in diabetes self-care. Clinicians should receive training in implicit bias reduction and communication skills and need to maintain self-awareness about these behavioral

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Box 1
Recommended health care system roles to support underserved people living with T1D

- Endocrinologists/Primary Care Physicians
- Licensed Clinical Social Worker/Psychologist
- Registered Dietitians
- Certified Diabetes Care and Education Specialists
- Clinical Pharmacists
- Diabetes Technology Navigators/Durable Medical Equipment and Pharmacy liaisons
- Implementation Scientists/QI Teams
- Patient Advocates/Community Advisory Groups

dynamics and biases, and guard against therapeutic clinical inertia. It is important to create an environment where modern technologies and therapeutics are discussed with patients at all clinic visits and where patients are encouraged to explore their options in a non-judgmental, linguistically, and culturally sensitive manner.[32]

Clinician and Patient Education in Diabetes Technology Adoption

In order to increase clinician comfort and familiarity with the various devices and latest advances in technologies and care delivery, we suggest prioritization of educational resources or conference time where clinicians can review relevant academic publications that are of interest and relevance to the outcomes they seek to improve (eg, journal club). This may include review of literature that encourages a person-centered approach to care, the latest technology advancements, and articles that address relevant social determinants of health. Similarly, it is often helpful to develop patient-directed, linguistic, and socioculturally-adapted educational materials that address the specific needs of minoritized PWDs.

Adapting existing evidence-based treatment strategies such as patient facing education, as opposed to creating interventions de novo, can enhance acceptability, facilitate efficient dissemination to broader audiences, and better meet the needs of minoritized and medically underserved adults with T1D. Adapting interventions for context and with respect to linguistic and sociocultural background has been recommended as a method to reduce inequities.[33,34] Stakeholder involvement and codesign serve as helpful methods by which to adapt interventions in an acceptable and appropriate fashion for specific populations of patients.[35,36] Data to support adapting interventions to enhance cultural appropriateness exist within chronic disease management, including in type 2 diabetes prevention[37,38] and treatment[39,40] and for adapting interventions for those with T1D to cultural context in international[41,42] and US settings[43,44] though a majority are focused on the care of youth with T1D. The potential benefits of culturally-adapted education and behavioral interventions in the management of adults with T1D warrant further investigation.

At the level of the clinic or diabetes program itself, we highly encourage implementation of structured education and device referral, and training processes while working to ensure timely access to clinic-based diabetes technology trainers. Specialized care pathways focused on training patients in more advanced diabetes self-management skills and the use of diabetes technology help facilitate patient increased referrals and ensure that patients access clinicians with appropriate expertise. Alternatively, given that many practices lack internal skilled Certified Diabetes Care and Education Specialist (CDCES) staff clinicians, we suggest taking steps to develop a strong working relationship with industry-based device manufacturer trainers or external CDCES who can onboard patients onto appropriate devices while working to ensure appropriate and safe transitions of care.

Importance of Behavior Change as a Central Focus of Diabetes Self-Management

Optimization of patient behavior is central to achieving desired glycemic outcomes. However, reaching and maintaining a desired glycemic outcome is facilitated through increasing patient self-efficacy, strengthening patient-clinician relationships, and fostering an increased comfort in living with diabetes.[45] Behavioral goals need to be individualized, and most importantly, attainable so that patients feel rewarded for their efforts and develop a sense of self-efficacy that promotes further engagement in self-care. Clinicians caring for patients with chronic illness have a unique opportunity to exert a positive influence and foster a strong working relationship with their patients. The clinician role becomes a "coaching" role, where over time, mutual trust and

partnerships develop that creates further opportunities for clinicians to support behavior change, yielding increased engagement and incremental, progressive successes. Clinicians caring for PWD play a critical role to influence lifelong healthful habits. In the context of underserved PWD, these concepts become even more relevant. Even though glycemic targets may not change, behavior is influenced by personal as well as broader sociocultural and socioeconomic factors and life stressors that may not align with a traditional biomedical model approach to care. For example, a PWD experiencing homelessness, unemployment, and with food insecurity has unmet basic needs for food and shelter and any treatment approach needs to consider the patient's perspective, challenges, and goals within the context of their individual lived experiences. Furthermore, providers need to guard against making premature judgements whereby advanced diabetes concepts or technologies are deemed to be too complex to consider. The practical benefits of diabetes technology–including, for example, reduction in the need for fingerstick blood glucose measurements and risk for hypoglycemia in the workplace, the ability to take insulin boluses discretely while on the go in a busy service job, and improved sleep quality (both from reduced hypoglycemia and hyperglycemia-induced nocturia)—relieve the daily burdens of managing diabetes and improve quality of life. Framing the advantages in terms of these immediate benefits can trigger patient interest in exploring potential use of technology. Who is an ideal CGM or AID system candidate? Just because it may take more time and require increased resource utilization, is this sufficient justification to dismiss a particular patient in terms of potential device candidacy? If these types of issues and biases are neglected, clinicians risk alienating and frustrating patients, given that diabetes is a self-managed condition, and all treatment strategies are successful only if the patient is cared for in a way that supports self-implementation and improvement over time. There are several considerations in preparing patients to successfully start on advanced diabetes technology, in particular pump therapy and AID systems. Consider competing life demands that may limit the time that can be committed to mastering new skills; schedule the pump start when there are not other distracting priorities, such as starting a new job or searching for new living accommodations. Set realistic expectations about the benefit/burden trade-offs with technology and providing a "road map" for how this evolves over time as their self-mastery advances. In this regard, it can be helpful to prepare patients by pointing out that it is normal for many of the tasks related to use of diabetes technology—such as inserting infusion catheters, loading insulin pumps, trouble-shooting insulin non-delivery—to initially feel burdensome; however, in time, these additional self-management tasks become routine.

Increasing Implementation of Diabetes Technologies into Routine Clinical Care

Most adults with T1D in the United States are treated by primary care providers with the nationwide shortage of specialist endocrinologists already well documented.[46] Primary care providers have reported low confidence in delivering T1D care, and are frequently uncomfortable with management of traditional insulin pumps, resulting in a lack of access to the expert clinical guidance required for successful use of advanced diabetes technologies.[47,48] Furthermore, primary care providers caring for underserved and minoritized populations may be less likely to have extensive clinical experience in the use of advanced diabetes technologies, largely resulting from significantly lower use in this population. There are also widespread, complex, and time-consuming logistical challenges to overcome obtaining durable medical equipment supplies that stymy efforts to onboard technology at scale.[26] Nonetheless, in a recent survey, over 75% of primary care providers reported willingness to prescribe artificial

pancreas technology (AID) to individuals living with T1D.[48] While CGM alone often improves glycemic control, AID systems, that combine an insulin pump, CGM and control algorithm that modulates insulin delivery based on CGM glucose inputs, provides additional benefits—including more effective hypoglycemia mitigation and increased time in range (TIR 70–180 mg/dL).[3,49] Real world data indicate that individuals using CGM who have poor glycemic control can benefit significantly from AID systems.[50] Efforts should prioritize development of interdisciplinary QI and implementation science (IS) teams that are tasked to increase clinician familiarity with the available devices, support necessary infrastructure development, focus on clinician team-building, and develop educational materials that are aimed toward improved uptake of devices. Given logistical challenges, it is often very valuable to solicit institutional support for an administrative role to manage the extensive paperwork required to obtain insurance approval for devices, assist patients in ensuring timely delivery of device supplies as well as replacement of failed devices, along with providing general patient facing support. This role is critical to support the clinicians in a diabetes program caring for underserved populations. Furthermore, it is imperative that successful implementation strategies and real-world outcome data are widely disseminated.

The Value of Physical Activity in Optimizing Glycemic Outcomes

The value of consistent physical activity in improving overall health and wellbeing in individuals living with diabetes is well established.[51] However, exercise, particularly aerobic and interval exercise, increases the risk of hypoglycemia in insulin users, which may result in undesirable exercise avoidance.[52,53] Furthermore, PWD who work in industries or jobs that involve physical labor may deliberately keep their glucose levels elevated during working hours to avoid exercise-induced hypoglycemia, which can disrupt work performance. The tension between recognizing the benefit of exercise while balancing the risk of hypoglycemia at the jobsite and the perceived risk of losing gainful employment because of recurrent hypoglycemia is a challenge that many PWD struggle with. Nonetheless, PWD should be encouraged and supported to incorporate structured physical activity into their daily routines,[52] with the largest drop in glucose expected during and after aerobic activity. Time should be devoted to coaching patients to understand the effects of various types of exercise on their glucose dynamics and how to anticipate, recognize, and respond to potential hypoglycemia.[52] Even though resistance training results in less hypoglycemia and has lower glucose lowering capability, in comparison to aerobic and interval training, time in range (TIR 70–180 mg/dL) is modestly increased in the 24-h period after all forms of structured exercise.[54] However, the challenge for the clinician is allowing space to encourage specific dialogue with regards to a PWD desire to exercise. Addressing patient concerns, including possible hypoglycemia aversion, frustration with unexplained glucose excursions around exercise, and insulin dosing strategies are all integral to successful efforts to support safe and enjoyable exercise.

FUTURE RESEARCH CONSIDERATIONS

In the future, as the focus in research moves from efficacy trials, primarily focused on regulatory approval, to effectiveness studies to support the practical and safe implementation of advanced technologies in the broader diabetes population and community-based clinics, trial design will need to evolve. All the pivotal trials examining the potential benefits of advanced technology versus the "standard-of-care" diabetes therapies have been designed to assure internal validity, with careful matching of study arms for visit frequency and attention, and selected study subjects. In

contrast, trials to evaluate real-world use of these technologies will need to be designed with a view to ensuring that the study protocol and findings have high generalizability and external validity; accordingly, matching study arms for visit frequency and clinical encounter time will not be a study design imperative. As the inclusion criteria for trials are broadened and there are fewer restrictions on enrollment, it is possible that dropouts and non-adherence will be higher than in previous efficacy trials of advanced diabetes technology. Because of this Intention to Treat (ITT) analysis—which estimates the effect of being assigned to a treatment, not the effect of the treatment itself—would under-estimate the magnitude of the potential benefits derived by those study patients who used the technology. In keeping with the recommendations of Hernán and colleagues regarding the analysis of effectiveness research, both ITT and per-protocol (PP) analyses will need to be performed to get a meaningful measure of the potential benefits of the technology in users.[55,56]

DISCUSSION

Active approaches to mitigate disparities in care and advance health equity are required to optimize glycemic outcomes for broad populations of adults with T1D, including those from minoritized communities who carry increased burden of acute and chronic diabetes-related complications.[57,58] Though evidence-based interventions to improve glycemic control in T1D exist, racial and ethnic inequities in care are now well documented, with Black, Latino, and individuals with low socioeconomic status less likely to access routine endocrine subspecialty care[59] and use diabetes technologies that are now considered standard of care.[8,60,61] Disparities in care stem partly from policy and community level determinants, including restrictive insurance coverage and adverse social determinants of health. Approaches from the fields of IS and QI can offer focused methods to improve adoption of evidence-based interventions.

IS is the study of methods to promote and increase the uptake of evidence-based practices into routine care.[62] QI focuses on identifying and remediating systems issues driving outcomes through continuous processes of testing change ideas.[63] While both share a common goal of improving the quality of health care services and improving patient outcomes, IS focuses on how to implement evidence-based interventions and why efforts may or may not be successful through consideration of multiple contextual factors.[62] Multiple IS frameworks have been modified to address contextual determinants influencing equity in adoption of evidence-based practices and are a useful lens to examine and design interventions to both avoid increasing and work toward ameliorating these inequities.[64–66] While a discussion of the similarities and differences between IS and QI and their methods is beyond the scope of this review, both serve as disciplines to examine gaps and inequities in care and to work actively to improve patient outcomes. Both clinicians and PWD are benefitted by the creation of multidisciplinary teams involving IS and QI scientists who can examine the impact of implementation strategies, such as those outlined here, including educational meetings and outreach and creating new clinical teams and care pathways, and repeated tests of change in improving health care delivery.[67] Collaboration between IS and QI scientists can allow for rapid and rigorous evaluation and dissemination of strategies to improve care across health systems that can benefit PWD more broadly.[68]

Ensuring attention to strategies that promote equity in health care and outcomes along the continuum from research to provision of clinical care is imperative. The importance of recruiting diverse populations into clinical trials to ensure generalizability of

interventions to racially and ethnically diverse populations has recently been acknowledged by the US Food and Drug Administration guidance on diversity requirements for clinical trials. Additionally, earlier focus on increasing the speed of innovation uptake is required as it is estimated that it takes nearly 17 years from demonstration of innovation efficacy to uptake into routine clinical practice.[69] As it has been suggested that evaluation of both effectiveness and implementation in clinical research helps to speed translational gains and uptake of interventions into clinical practice, it has been argued that such integration of ISshould occur earlier in the translational pipeline.[70,71]

SUMMARY

Minoritized and medically underserved adults living with T1D frequently encounter multiple obstacles to successful diabetes self-management that directly impact on their ability to thrive while living with diabetes. Clinicians who care for these patients have the opportunity to shift the narrative and significantly improve clinical outcomes. Modern diabetes therapeutics—most importantly CGM and AID systems—are highly effective at helping PWD increase the likelihood of meeting glycemic outcomes. Clinicians should work together in local clinical teams and in larger collaborative networks to dismantle bias, increase internal self-awareness, address misconceptions, and endeavor to reduce barriers to successful diabetes care.

CLINICS CARE POINTS – *BULLETED LIST OF EVIDENCE-BASED PEARLS AND PITFALLS RELEVANT TO THE POINT OF CARE*

- Prioritize development of an interdisciplinary team that is supported to learn, iterate, and implement changes together. (QI Framework)
- Solicit institutional support for an administrative role to manage the extensive paperwork required to obtain insurance approval for devices, assist patients in ensuring timely delivery of device supplies as well as replacement of failed devices, along with providing general patient facing support is critical to support a diabetes program caring for underserved populations.
- Prioritize educational/conference time where clinicians can review relevant academic publications that are of interest and relevance to improving outcomes.
- Develop patient-directed, linguistic, and socioculturally adapted educational materials that address the specific needs of minoritized patients with T1D.
- Devote educational resources to improve clinician and patient familiarity with the various devices, referral, and training processes.
- Ensure timely access to clinic-based diabetes technology trainers or alternatively develop a strong working relationship with industry-based device manufacturer trainers that ensures appropriate and safe transitions of care.

CASE STUDY

A 35-year-old man, living with T1D for 7 years, presents to the refugee health clinic at the Boston Medical Center, a safety net academic medical center, that cares for a large medically underserved and minoritized population. Six months prior to presentation, he relocated as an asylee, with his wife and 2 young children, from Ethiopia to the United States, and is unemployed and living in a local shelter with his family. He has no other medical comorbidities but suffers from post-traumatic stress disorder (PTSD) and depression. His A1c is 9.5% and he is injecting multidose insulin (insulin glargine at bedtime and insulin lispro before meals) via a syringe filled from vials. He

checks his glucose consistently 4 times daily using a glucometer and struggles with frequent hypoglycemia whenever he is physically active, so avoids structured exercise, even though he was an avid runner prior to his diabetes diagnosis. Before relocating to the United States, he worked overnight stocking shelves in a large department store in Africa. His primary priority is the well-being of his family and food and housing insecurity is his major concern. He plans to establish primary care at a local urban community health center, nearby to his shelter. He has no prior experience with diabetes technology or formal diabetes education and is unfamiliar with the US health care system.

How would you approach the multifaceted needs of this patient? Our approach to his care is summarized in the section below.

The Refugee Clinic, located within the internal medicine department, is specifically resourced to address many of his needs. He was connected to social work services, which began to help him obtain Medicaid health insurance, social security, and complete housing and childcare support applications. He was also referred to the onsite therapeutic food pantry, which is integrated with the Boston Medical Center Rooftop Garden and Teaching Kitchen, where nutrition education, cooking skills, and access to registered dieticians are provided to all patients within the health system.[72] The teaching kitchen is also integrated into the specialty diabetes education program, which is staffed by members of the endocrinology department. Evening group educational sessions are scheduled where PWD meet with each other, along with CDCES, chefs, registered dieticians, and clinical pharmacists. A portion of each session is devoted to demonstrating culinary skills and a portion is devoted to basic diabetes and nutritional educational content. After connecting with diabetes care services through his referral to the teaching kitchen, he established a working relationship with a registered dietician/CDCES, with particular expertise in T1D and diabetes technology, who is based in the specialty diabetes clinic and works closely with an endocrinologist who is part of the T1D QI team in the department. Soon after establishing care in the endocrinology department, he was offered the opportunity to begin on CGM and was connected with our diabetes technology administrative navigator who worked with his Medicaid insurance plan and durable medical equipment providers to support initiation of CGM. He was also connected with an integrated behavioral health clinician working in the refugee health clinic to help manage his PTSD and depression while he established primary care at a local internal medicine practice within the medical center. At this practice, he was referred to work with a clinical pharmacist/CDCES with a strong focus on diabetes care. The group of pharmacists in this practice routinely meets every 1 to 2 weeks with a specialist diabetologist in the academic medical center for an hour-long zoom-based tele-mentoring session where patient cases are discussed and specialty input is sought. During one of these sessions, his case and pertinent Dexcom G6 CGM data were presented, and recommendations were relayed for implementation into his care plan. Despite an improvement in his A1c to 8.3%, he was noted to have recurrent post-prandial hypoglycemia with hypoglycemic unawareness and was encouraged to enroll in the AID/insulin pump education program by his care team. Despite initial hesitancy, he entered the educational program, which is staffed by specialty diabetes clinic RD/CDCES clinicians and spent 16 hours in direct one-on-one education sessions over a period of 8 months learning the specific skills to succeed on the Tandem T-slim X2 pump with Control IQ. His educational process was not smooth. His education progress was interrupted numerous times to attend to ill health in his family, failed efforts to secure a steady job, immigration and legal challenges, and mental health struggles. However, with the support of the numerous clinicians, administrators, educators, food services,

and the safety net system at large, he currently is doing well on the Tandem AID system and has an A1c of 7.8% with time in range (70–180 mg/dL) of 50% to 65%, time below range consistently less than 2%, has secured stable housing and has started to take up running again.

DISCLOSURE

The authors do not have any significant disclosures that are relevant to this work.

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