FEATURE ARTICLE

Understanding Providers' Readiness and Attitudes Toward Autoantibody Screening: A Mixed-Methods Study

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Screening for autoantibodies associated with type 1 diabetes can identify people most at risk for progressing to clinical type 1 diabetes and provide an opportunity for early intervention. Drawbacks and barriers to screening exist, and concerns arise, as methods for disease prevention are limited and no cure exists today. The availability of novel treatment options such as teplizumab to delay progression to clinical type 1 diabetes in high-risk individuals has led to the reassessment of screening programs. This study explored awareness, readiness, and attitudes of endocrinology providers toward type 1 diabetes autoantibody screening.

Type 1 diabetes is a complex autoimmune disease with an increasing prevalence in the United States. About 64,000 new cases occur annually, almost half of which are individuals <18 years of age (1). The risk of developing type 1 diabetes is 15 times higher in individuals with a first-degree relative with the disease; however, about 90% of people who develop type 1 diabetes have no known family history of the disease (2).

The time period from presymptomatic autoimmunity to clinical presentation of symptoms can vary in length and severity among individuals and is broken down into three stages. In stage 1, the immune system attacks pancreatic β-cells, with no symptoms present and normoglycemia. Individuals typically will screen positive for two or more type 1 diabetes–related autoantibodies in this stage. During stage 2, β-cell function continues to decline, pancreatic autoantibodies are detected, and dysglycemia (i.e., either impaired fasting glucose or impaired glucose tolerance) are present. In stage 3 is characterized by clinical type 1 diabetes, with elevated glucose levels that meet the definition of diabetes. Clinical symptoms of hyperglycemia that may be present at stage 3, include weight loss, fatigue, and excessive thirst (3). The International Society for Pediatric and Adolescent Diabetes has now classified stage 4 as established type 1 diabetes as defined in its 2022 clinical practice guidelines (4).

At the time of diagnosis, ∼58% of children experience diabetes-related ketoacidosis (DKA), which is a dangerous condition related to hyperglycemia that can lead to coma or death (5). DKA mortality rates in children are lower in more developed countries such as the United States (0.15–0.35%), but much higher in developing countries (3.4–13.4%) (6). DKA may be associated with harmful long-term outcomes, including detrimental neurocognitive outcomes (7–9) and poor glycemic outcomes (10–12).

Autoantibodies can be detected months to years before the clinical onset of the disease. Type 1 diabetes–associated autoantibodies include islet cell autoantibody (ICA), insulin autoantibody (IAA), glutamic acid decarboxylase (GAD), islet antigen 2 antibody, and zinc transporter 8 (ZnT8). In individuals who are positive for more than one antibody, the risk for developing type 1 diabetes within 10 years is ∼70%, and the lifetime risk approaches 100%. Studies have shown that individuals receiving routine follow-up after screening positive for type 1

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diabetes–associated autoantibodies are less likely than those not screened to present with DKA (13).

Screening for these autoantibodies identifies people most at risk for progressing to clinical type 1 diabetes and provides an opportunity for early intervention (14). Informing individuals of their risk of developing type 1 diabetes before the onset of clinical symptoms might reduce the risk of presenting at diagnosis with DKA and its accompanying complications. Screening can also mitigate the psychological distress of an unexpected diagnosis, allowing individuals to obtain more education before diagnosis (15). However, receiving a positive autoantibody test result can also lead to high levels of anxiety among patients and family members around the uncertainty of the disease onset and concerns about future morbidities, given that there currently is no cure (14).

The American Diabetes Association's *Standards of Care in Diabetes* recommends autoantibody screening for presymptomatic type 1 diabetes in the setting of a research study or its consideration as an option for first-degree family members of a proband with type 1 diabetes (16). Although general population screening for these autoantibodies currently is not recommended, programs exploring general population screening in pediatric populations are expanding (4), and there is growing literature to support this approach. A recent study found that presymptomatic pediatric type 1 diabetes screening may be cost-effective in areas with a high prevalence of DKA and an infrastructure facilitating screening and monitoring if the benefits of avoiding DKA events and improved A1C persist over long periods of time (17).

The U.S. Food and Drug Administration (FDA) recently approved teplizumab, an Fc receptor nonbinding anti-CD3 monoclonal antibody, as the first drug to delay the onset of stage 3 type 1 diabetes in adults and children ≥8 years of age who currently have stage 2 type 1 diabetes (18). Immune interventions such as teplizumab provide the opportunity to delay onset and the need for treatment of diabetes and give individuals time to learn more about disease management, as well as time for next-generation treatment options and technology to be developed (19). The availability of teplizumab has led to a reassessment of type 1 diabetes screening programs (1).

This study explored the awareness, readiness, and attitudes of endocrinology health care providers (HCPs) toward type 1 diabetes autoantibody screening. Findings regarding perceived benefits and drawbacks of screening; frequency of screening; clinic limitations and practices, including workflows and staffing; and patient concerns are described.

Research Design and Methods

This study used a mixed-methods approach and was carried out in two phases from August to November 2022. The Western Institutional Review Board approved this study as nonexempt. Eligible participants were recruited from the T1D Exchange Quality Improvement Collaborative (T1DX-QI) (20). The T1DX-QI began in 2016 and has since expanded to >50 pediatric and adult diabetes clinics across the United States. Its goal is to improve care delivery and health outcomes while reducing barriers to care for people with type 1 diabetes by sharing best practices and data benchmarking (21). This study adhered to the Consolidated Criteria for Reporting Qualitative Research standards (COREQ) (22), as shown in Supplementary Table S1.

Phase 1

During phase 1, focus groups were conducted to explore the awareness, readiness, and attitudes of endocrinology HCPs toward type 1 diabetes autoantibody screening. Eligibility criteria included an MD, DO, PA, or NP professional credential with a focus in endocrinology, ≥3 years providing care for people with diabetes, ≥40% of time in clinic spent treating patients, and practicing in the United States. Focus groups were facilitated by a T1D Exchange research scientist (E.O.) who is experienced in qualitative research and attended by research team members (H.H. and N.R).

Focus groups were semistructured using a focus group discussion guide (Supplementary Focus Group Guide) and lasted 90 minutes. Questions listed were used as a guide and were not always asked in the order written, and not all participants answered all probes. All participants were remunerated after their focus group.

Sessions were audio-recorded via the Zoom meeting platform, and recordings were transcribed using TranscribeMe software. Transcripts were uploaded into NVivo qualitative data analysis software for data organization and management and were de-identified.

Transcripts were reviewed, analyzed, and coded by E.O. to identify key topics of interest. A codebook was created based on the main study objectives with three primary codes, including comfort levels and awareness of autoantibody screening, provider attitudes toward autoantibody screening, and readiness and implementation of autoantibody screening. Within each primary

code, themes were identified and direct quotes from the transcripts were selected to reflect and support these themes. Any discrepancies in coding were resolved among the authors (E.O., H.H., N.R., and O.E.) Additionally, a force-field analysis was performed to identify high- and medium-impact forces identified in phase 1. High-impact forces were mentioned in all focus groups at least one time, and medium-impact forces were mentioned in at least two focus groups.

Phase 2

During phase 2, one 15-question cross-sectional survey was distributed to endocrinology providers within the T1DX-QI. Eligibility criteria for phase 2 were the same as for phase 1.

The survey questions were guided by study objectives and the themes that emerged from the focus groups in phase 1. Survey data were analyzed using R software, v. 4.1.2. Descriptive statistics were performed for all data, which included frequencies and percentages for categorical measures. Variables were analyzed through a lens comparing pediatric and adult providers to determine whether any differences occurred based on provider type and patient population.

Results

Phase 1

In phase 1, three focus groups were conducted with a total of 13 providers, including six adult and seven pediatric providers.

During the focus groups, all interviewed providers stated that they were comfortable discussing screening results with patients. Table 1 provides direct quotes from this phase. Providers' comfort level did not necessarily transfer clinic-wide; some providers felt their clinic to be very proscreening, whereas others did not. An adult provider mentioned that she was only familiar with screening because she is personally interested in type 1 diabetes.

Phase 2

During phase 2, 50 providers completed the survey, including 2% DOs, 86% MDs, 12% NPs, with a combined total average of 14 years in practice. Of these providers, 28% were adult providers and 72% were pediatric providers.

When asked to rank their confidence if a patient asks about autoantibody screening, 96% of providers said they were "very confident" or "confident" in describing the available screening tests to patients. Additionally, when asked how confident they felt sharing and discussing results with patients and their families, 94% said "very confident" or "confident." Focus group findings supported these results, with the majority of participants feeling comfortable; however, some providers mentioned that they are not as comfortable discussing screening results with family members as they were having these discussions with their own patients.

Of all survey respondents, 52% stated that the general attitude in their clinic aligned with strong interest and support of autoantibody screening, and 30% stated that the attitude in their clinic was one of mild interest and support. Only one pediatric provider said that the clinic's general attitude was no interest or support for screening.

Benefits of Screening

During focus groups, providers identified many benefits to autoantibody screening. High- and medium-impact driving forces for autoantibody screening included early diabetes management and education, early disease intervention with current and potential type 1 diabetes onset-prolonging drugs, prevention of DKA at diagnosis, the use of screening as a diagnostic tool to helps with clinical guidance for patients and providers, clarity and awareness of diagnosis, and the opportunity to get involved in research (Figure 1). The following statements were made by a pediatric and adult provider, respectively:

> *"Trying to capture the kids before they come in sick with the burden on our health care system."*

> *"I think it provides both clinical guidance and management, both for the patient and the provider, as well as some level of clarity for both."*

Survey results supported these findings, as 90% of providers identified "opportunity for early diabetes management and early disease intervention" as a benefit, followed by "families can elect to enroll in research projects" (84%), "provides clinical guidance and diagnosing abilities" (80%), and "prevent DKA and hospitalizations at diagnosis" (76%).

Additional perceived benefits identified during phase 1 were better management and counseling for adult patients, heightened awareness of signs and symptoms before diagnosis, and helpfulness for families who want to know or those who may have a sibling with type 1 diabetes.

TABLE 1 Direct Quotations From Phase 1 Focus Groups by Study Objective

Comfort levels and awareness of autoantibody screening	
Provider comfort	
Adult	"I'm not as comfortable discussing screening for family members, when they should be considering this. And, I feel like I would much rather them speak to an expert about that, and so I do refer them to resources."
Pediatric	"I feel pretty comfortable. I wouldn't say I'm the expert on it or anything like that, and I would usually refer them to TrialNet if I had questions. But, typically, I talk to them after they're diagnosed when we first see them in clinic. Or, if they come to us from some other place and they've never had them, I might talk about them at that point."
Clinic comfort	
Adult	"Our providers who see diabetes are very pro-screening, and they do screen patients, especially the ones who are young and have not been screened before. We usually do it for all patients transitioning to our clinic."
	"I think I only know about it because, as an adult site, I'm interested in type 1 diabetes. And so, I know about TrialNet, and it was on the boards. And I give the lecture on type 1 to the fellows."
Pediatric	"I would say we are also very much pro-screen. Although, if somebody didn't have it done, then sometimes providers might get irritated it wasn't done already. But I think it's just a standard of care, really, in the pediatric world."
	"I think in our practice, for two decades, we've done antibody testing at new-onset diagnosis. That's just very much a standard part of how we operate."
Provider attitudes toward autoantibody screening	
Perceived benefits	
Adults	"I think it provides both clinical guidance and management, both for the patient and the provider, as well as some level of clarity for the patient and provider."
	"It helps us a lot in the management of adult patients with diabetes, especially if they're antibody positive. Interestingly, it also helps us in getting insulin pumps approved.
	"I mean, from an adult side, it provides a level of clarity, a clinical decision-making tree in terms of where to proceed next in terms of potential treatment if you're unsure of diagnosis, and a way to really know how to focus on patients."
Pediatrics	"Trying to capture the kids before they come in sick with the burden on our health care system and lack of beds for DKA kids and trying to get them into clinic before they become super sick."
	"Well, I think that part of the whole TrialNet screening idea and the JDRF screening is that, for family members, if you have already screened positive and you know you're at risk, then, hopefully, you're not going to come in with DKA because you're already going to be monitoring or maybe being in one of the studies."
	"We've actually had a number of kids like that that were picked up through TrialNet, didn't qualify for any study, but then we started monitoring them. And, we started low-dose inulin on them. And, I think that they would not have come in had they not been screened for antibodies. They seem to be in much better control long term than maybe even their sibling."
	"I think it can be really helpful for families that want to know, because that is obviously a frequent question. More and more, though, I feel like patients often ask, 'Can I get a genetic test to test for diabetes.' I think people find it really helpful to help process."
Perceived barriers	
Adults	"I mean, the biggest barriers are that, at this moment where we're like 50% or 30% staffed because of all the turnover, the biggest time sink on all this is the physician, because everything falls on the physician if there's no support staff, because we just pick it all up. It doesn't mean we won't do the testing, but we'll be the ones that are coordinating all the care related to this. We have very limited support at this moment. So, it really falls on us to do all of this."
Pediatrics	"If you're a parent of multiple children, and you're going to test them longitudinally, that cost becomes a factor for sure."

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TABLE 1 Direct Quotations From Phase 1 Focus Groups by Study Objective (Continued)

	"It can lead to a certain amount of anxiety. And, we definitely have those patients we're following that have positive antibodies and have started to have some dysglycemia. And, then, the parents are checking a lot, and it leads to some amount of anxiety. So, that can be sort of the flip side of it."
	"It's a blood draw. It's mildly invasive. So, I mean, again, I think if you're doing it in the context of diagnosis, and you're getting other things, that's a different thing than if you've got a healthy asymptomatic kid who otherwise doesn't have any reason to get a blood draw."
	"Time. I mean, once they have the positive antibodies, now they're essentially connected to an endocrinologist for the rest of all time."
	"So this, I think, also, if you're trying to talk clinic barriers, it's who's the patient. So, I think there's a couple logistical things. If it's an established patient, it's quite straightforward. There's an order. We have a process. It's no big deal. But, I think it's more if it's a family member who's not already established in the practice, you need to either have them go through their primary care doctor or establish them in your care for that reason."
Readiness and implementation of autoantibody screening	
Frequency and type of screening discussion	
Adults	"Patients where two and two are not adding up to make four in terms of reporting that they have type 2 diabetes, clearly you will complete those tests. Or, if it's even just someone that's not a typical presentation of type 2, there might be some family history, then I would strongly consider adding those additional tests. And, I too would typically start with GAD, but depending on my level of suspicion, might add some of the other ones, particularly ZnT8."
	"I'll see patients who come to us with antibody status known, and we're very clear on the diagnosis from our [pediatric endocrinology] colleagues. And then I'll see patients who have never seen endocrine and on whom I'm taking the history, and the type of diabetes they've been labeled does not make sense. And then, I'll discuss, 'There are different types of diabetes.' And, if I'm concerned about autoimmune diabetes, we'll check the panel."
Pediatrics	"We routinely order type 1 autoantibodies on everybody who's newly diagnosed with diabetes. Even if the clinical picture looks very type 2-like, we are still very proactive with getting four autoantibodies. We do GAD, zinc transporter 8, IA-2, and insulin antibodies."
	"I always bring it up at diagnosis. And then, if they're new to us, I usually will discuss it. So, it's always at the first visit. So, the new diagnosis or new to us, I'll discuss it. And then, if something changes down the way, if something doesn't make sense or something, we bring it up again."
Workflow habits and sharing results	
Adults	"We don't have any kind of workflow. So, we order it for patients, and we follow up the labs. And if it is positive, then I definitely call the patient back to discuss it more in detail and the implications of it being positive. But, unfortunately, we don't have an established workflow."
	"We call them back. We tell them what it is, and I send them to the diabetes educators, who are at the background of care. And they're going to go through the ins and outs. That's what we have in the adult world, which has much fewer resources than in the pediatric area."
	"If they do come out to be positive, then we schedule a second visit like a televisit or something to discuss the meaning of the antibody. Because, if patients are anxious, the family members are anxious. So, we do need a follow-up televisit or something to discuss those most times."
Pediatrics	"I mean, for me, I'm just going to file the results like I would with any other results. So, I'm going to call them. So, if it's a patient, I'm calling them just as I would routinely. If the family members are doing it through TrialNet, then TrialNet is calling them. And, if they're doing it through JDRF, JDRF is contacting them. And, then they may or may not choose to contact me at that point."

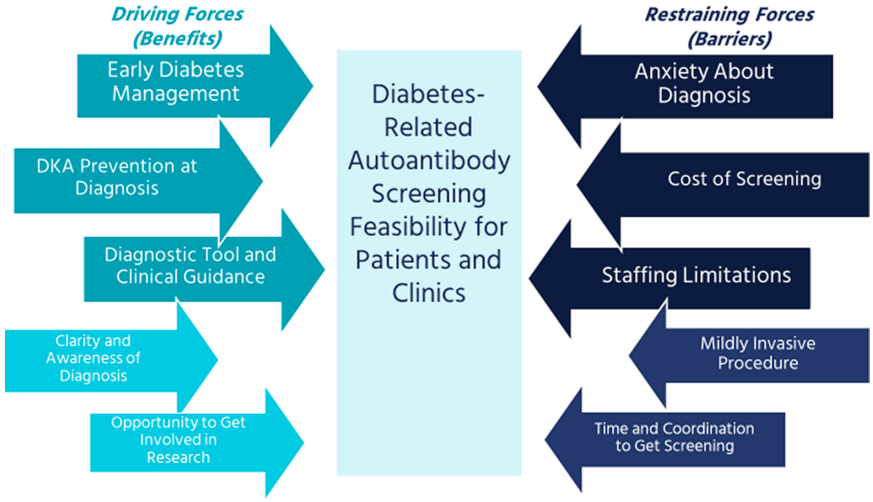

FIGURE 1 Force-field analysis showing high- and medium-impact driving forces (benefits) and restraining forces (barriers).

When asked in phase 2 who would benefit most from autoantibody screening, the majority of providers selected first-degree relatives (90%), individuals with multiple autoimmune diseases (64%), and individuals with elevated blood glucose levels (62%). During focus groups, providers mentioned that first-degree relatives would benefit most from being screened, given the recent trial in first-degree relatives with teplizumab, which during this time had not yet been approved by the FDA.

When asked who would benefit least, most providers selected the general population (60%) and adults >70 years of age (52%). Additionally, attitudes toward general population screening were split mainly between those who were cautious to recommend screening (52%), those who do not recommend (28%), and those who thought it not cost-effective (74%). A small portion of providers recommended screening of the general population in stages (10%). Findings from the focus groups echoed these survey responses. Providers stated that they were cautious to recommend general population screening to individuals with no symptoms outside of a research protocol due to the lack of widespread interventions and therapeutic options available. Suggestions for potential general population screening included doing so in stages so that staff at clinics would not be overwhelmed with an influx of individuals to be screened. Providers briefly mentioned that stages may be based on factors such as risk level and family history.

Workflow and Screening Habits in the Clinic

In the focus groups, most pediatric providers shared that they felt comfortable discussing and offering autoantibody screening for new patients and annually with siblings or family members of patients. However, adult providers indicated that screening was discussed on a more case-specific basis. According to the survey results, 58% of providers discuss screening on a case-specific basis, and 40% discuss it initially at first visits. Of those providers who discuss screening on a case-specific basis, 86% were adult providers, and 44% were pediatric providers. Most providers who discuss screening initially were pediatric providers (56%), compared with 7% of adult providers Only one adult provider reported that she does not discuss autoantibody screening.

In response to a question about which screening tests were available in their clinic versus requiring referral to an external screening program or ordering screening through an external laboratory, providers shared that the following screening tests were offered in their clinic: GAD-65 (98%), ZnT8 (84%), IAA (76%), ICA (66%), and 1A-2A (66%). Only 4% of providers indicated that none of these screening tests were offered.

Providers were asked about their clinic workflow, if any, when individuals request screening and after patients receive their screening results. Findings demonstrated that most clinics offer the screening in their own facility or hospital system (74%). For those that do not offer screening in their clinic, 34% refer patients to external screening programs, and 28% order tests through an external laboratory. Supplementary Figure S1 provides a breakdown of how workflows differ between pediatric and adult providers.

Once providers obtain screening results, 52% said they would share the results with patients via a phone call.

Of these providers, 71% were adult providers and 44% were pediatric providers. Other responses included sending results via a patient portal (48%), setting up an appointment to discuss the results (46%), and referring patients to an external screening program (24%). Only 4% of providers responded that they would refer patients to a diabetes care and education specialist to discuss results. These findings were supported in focus group responses as well, with some providers mentioning that they have an established workflow to follow when individuals receive their results and some saying that patients who receive positive screening results are scheduled for a second visit. However, not all clinics have an established workflow in place specifically for delivering screening results. When asked on the survey, 16% of participants said their clinic does not have an established workflow. This finding was supported in the focus groups, during which some providers mentioned that they do not have any kind of workflow established.

When asked whether the method of delivering results changed based on whether the results were negative or positive, 52% of responds answered in the affirmative. Of those participants, the most common method of delivering positive results was via phone call (92%), and the most common way to deliver negative results was via patient portal (81%). Additionally, 42% of providers stated that their clinic provides follow-up education or programs to support families after they receive their results; 22% said their clinic does not provide such follow-up support; and 28% said they were unsure about whether their clinic offered such support.

Barriers to Screening and Clinic Limitations

The high- and medium-impact restraining forces identified by providers during focus groups included anxiety about a diagnosis for individuals and family members, the cost of screening, staffing limitations, screening as a mildly invasive procedure, and the time and coordination needed to get screening.

When asked which were perceived as barriers to autoantibody screening, the majority of providers selected anxiety or stress for patients and family members (70%), the cost of screening (66%), limited insurance coverage (54%), and uncertainty about a treatment plan (46%). Other barriers included lack of resources in clinics to test (or outsource testing), lack of motivation from parents or family, time constraints, and the mildly invasive nature of the procedures. Of all of the pediatric providers, 47% selected having no known therapeutic treatment as a barrier compared with 29% of adult providers (Supplementary Figure S2).

In addition to barriers to screening itself, clinic limitations may exist that limit the number of individuals who have an opportunity to be screened in clinics. The highest selected clinic limitations that prevented providers from discussing autoantibody screening opportunities in the clinic were time limitations (60%), followed by understaffing (26%) and resource limitations (22%). When compared with their pediatric counterparts, adult providers were more likely to select time limitations (64 vs. 54%). Additionally, more pediatric providers than adult providers selected resources limitations (25 vs. 14%).

Understaffing and limited support staff were also discussed as barriers in the focus groups, with one adult provider saying staffing issues were the biggest barrier to screening, with the biggest burden falling on the physician if no support staff members were available.

Discussion

Findings from this study provide insight into the perspective of pediatric and adult endocrinology providers' attitudes toward diabetes-related autoantibody screening among those practicing within participating T1DX-QI clinics. Screening can be used as a tool for early detection of type 1 diabetes, to help identify those at risk, and potentially to enable intervene to slow disease progression and β-cell loss (23). This study shed light on perceived benefits of and barriers to autoantibody screening and offered insight into clinics' processes for referring people for screening and for sharing screening results with individuals and family members (24).

Provider and clinic staff comfort levels regarding discussing screening were assesses, as well as providers' awareness of screening. Overall, providers reported being comfortable having discussions with patients regarding screening and their screening results and were generally comfortable discussing screening with patients' family members, although some mentioned some discomfort with regard to family members compared with their own patients.

Providers mentioned being hesitant or cautious with regard to recommending screening for people who were not first-degree relatives of someone with type 1 diabetes because, until the FDA's recent approval of teplizumab, there were limited to no therapeutic options to suggest to people who received positive

screening results. The risks and potential benefits of teplizumab treatment require further discussion and study (25).

Providers agreed that a major benefit to screening is its ability to detect diabetes early and thereby prevent DKA at the time of diagnosis and lead to lower A1C levels (26). Early awareness can be lifesaving and can help to prevent the development of complications in the future (27). Early awareness can also offer people the opportunity to get involved in research or clinical trials and can potentially reduce stress associated with diagnosis (28). An additional benefit of screening is the ability to confirm a diagnosis of type 1 diabetes, differentiate it from type 2 diabetes (29), and thus implement appropriate treatment and self-management training in a timely manner (30).

Barriers exist that deter susceptible individuals from being screened. A commonly mentioned barrier was the lack of effective treatments to delay the onset of diabetes. Anxiety and stress around the receipt of positive results were also major barriers (31). The cost and potentially limited availability of screening are additional limitations (32). Although many programs offer financial assistance, geographical location and insurance coverage limitations are also barriers to increased screening.

Regarding clinic readiness to implement screening, the lack of an established clinic workflow and staffing limitations were identified as major barriers to screening. Providers often struggle to complete all necessary tasks and address all patient concerns during patients' care visits (33). Creating combined, streamlined workflows can increase screening referrals and potentially prevent individuals from requiring hospitalization for DKA at the time of diagnosis. Proposed workflow elements for managing diabetes care may include algorithms to determine which providers will care for certain individuals, defining shifts for population management responsibilities, and implementing other changes at the health care system and clinic levels (34).

With teplizumab now available as an option for delaying the onset of clinical type 1 diabetes (35,36), including delaying diagnosis and improving β-cell function in high-risk individuals (37), there is a greater push for screening not only relatives, but also the wider population. Approximately 90% of people who are diagnosed with type 1 diabetes have no family history of the disease (1). Before the recent approval of teplizumab, there were, as several providers put it, "no next steps" to recommend for people with positive screening results; now there is a treatment option.

Provider and patient education materials are available online (36,38). Current research is exploring how primary care providers (PCPs) can support diabetes and endocrinology clinics as a resource and counterpart for screening (39). The literature further indicates that family support is crucial; therefore, PCP-family partnerships may lead to improved adherence to self-care activities and better outcomes (40).

This study identified potential barriers to screening, including gaps in clinic workflows, staffing limitations, high costs, and difficult referral processes. There are many resources available to help providers navigate ordering screening tests (41,42). Although clinical limitations do exist, these issues can lead to conversations about and advocacy for more resources to enhance screening efforts. These insights into barriers to and facilitators of screening and prevention can be applicable to diabetes PCPs, who might be on the frontline of broader population health screening initiations (43). Additional research should explore the role of PCPs in type 1 diabetes screening and monitoring.

Concerns about the cost-effectiveness of screening for the general population do exist, although some studies have shown that screening is effective in reducing the prevalence of DKA, thereby reducing hospitalization rates and costs (44). Given these challenges and potential benefits, further study is needed to examine and optimize screening methods and strategies.

Strengths and Limitations

The findings from this study provide insight and fill a knowledge gap in the literature regarding providers' attitudes toward and perceptions of screening for type 1 diabetes–related autoantibodies. Some perceived barriers to screening that were identified can be targeted with clinic-specific interventions. Important benefits of screening were also identified, adding to existing literature.

A limitation of this study is that most of it was completed before the FDA approved teplizumab; thus, some of the providers' perspectives might have been significantly different if the study had been conducted more recently. Other limitations include the potential inability to generalize these findings to clinics and hospitals across the United States. A majority of clinics with the T1DX-QI are academic medical centers, and providers within this group are experienced in endocrinology.

Additional limitations include the sample size for phase 1 and the uneven distribution between pediatric and adult providers in phase 2.

Conclusion

Findings from this study offer insights into endocrinology providers' attitudes toward type 1 diabetes–related autoantibody screening, the benefits of such screening, and related workflow practices, barriers, and clinical limitations among providers practicing in participating T1DX-QI clinics. More work is needed to identify optimal screening strategies for type 1 diabetes in both pediatric and adult populations and to address the existing provider and patient barriers to autoantibody screening for at-risk individuals.

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DUALITY OF INTEREST

R.S.W. participates in clinical trials that are sponsored, through her institution, by Boehringer Ingelheim, Eli Lilly, Insulet, Medtronic, Novo Nordisk, and Tandem, and uses Dexcom continuing glucose monitoring systems in clinical research studies. O.E. is a Health Equity Advisory Board member for Medtronic Diabetes. No other potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

E.O. wrote the manuscript. E.O., H.H., and N.N. analyzed the data and reviewed/edited the manuscript. H.H., N.R., R.S.W., K.C., P.M., A.S., and N.M. contributed to the discussion and reviewed/edited the manuscript. O.E. conceptualized the study. E.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

Parts of this article were previously presented in abstract for at the American Diabetes Association's 83rd Scientific Sessions, 23–26 June 2023, in San Diego, CA.

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