Public Health and Primary Care

Brief Report

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Resident opinions of diabetes management in training: a survey

https://doi.org/10.1515/jom-2021-0035
Received January 28, 2021; accepted May 19, 2021;
published online June 22, 2021

Abstract

Context: Primary care physicians need a strong foundation in diabetes management, as they are the first line of care for patients with this complex disease, which is increasing in frequency in the United States. This foundational training begins in medical school, but its applications become more important during residency.

Objectives: To quantify osteopathic and allopathic family medicine residents' amount of exposure to diabetes in residency training, investigate referral patterns related to diabetes management, and assess comfort levels with various diabetes treatment modalities.

Methods: An 18-item cross sectional survey was sent via email using Qualtrics to program directors and chief residents of 16 different training programs located in seven different health systems and four different states; the programs were focused on family medicine, internal medicine, pediatrics, and combined internal medicine/pediatrics programs. The link was also posted on Twitter using specific "handles" to "tag" professional associations and groups related to primary care. Emails and tweets were initiated on October 15, 2018 and responses were collected through April 15, 2019. Data collection was reinitiated via email only from May 1, 2020 through July 31, 2020 due to low initial response rate. The study, which included multiple choice and Likert scale questions with some skip logic, was designed by study investigators. Data was exported from Qualtrics to an Excel spreadsheet and analyzed using descriptive statistics, which are reported as percentages.

Results: A total of 61 residents responded to the survey, with most (52; 85.2%) enrolled in family medicine or internal medicine programs. Residents were mostly located in rural (28; 45.9%) and suburban (25; 41.0%) areas. Respondents reported being extremely comfortable with metformin (45; 73.8%), basal insulin (24; 39.3%), and healthy lifestyle education (32; 52.5%) for the treatment of diabetes. They reported being least comfortable with diabetes technology, with 51 (83.6%) uncomfortable or extremely uncomfortable with insulin pumps and 43 (70.5%) uncomfortable with continuous glucose monitoring systems for diabetes treatment. Referral rates to endocrinologists were low, with 47 (77%) reporting referral of diabetes patients 10–15% of the time. Residents reported interest in workshops and online continuing medical education for further training opportunities, but interest in additional formal training was low (3; 4.9%).

Conclusions: Residents in this study reported confidence in diabetes management and referral rates among this group were low. However, reported comfort levels with treatment modalities beyond metformin and lifestyle changes were not strong. Referral rates may have been low due to the low number of endocrinologists in rural areas and therapeutic inertia. Diabetes fellowships could

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increase resource availability for patient referral. Utilization of diabetologists in primary care programs may also add benefit and improve skills among trainees including more familiarity with diabetes technology and use of newer medications used in diabetes management.

Keywords: diabetes; graduate medical education; health care; primary care.

Diabetes was estimated to affect 34.2 million Americans as of 2020 and is predicted to increase in incidence [1]. It has been estimated that $1 of every $7 in healthcare costs in the United States in 2017 (a total of $327 billion) was related to costs incurred by people diagnosed with diabetes [2]. Primary care providers offer the great majority of patient management for diabetes, caring for about 82% of people with diabetes, according to one estimate [3]. Data from 2014 estimated that there were 4,184 adult endocrinologists and 893 pediatric endocrinologists in the United States [3, 4]. Furthermore, the number of endocrinologists has not increased at the same rate of patients with diabetes and, as a result, the majority of diabetes care is delivered by primary care providers. Given these collective statistics, it is important that primary care providers, including physicians and nurse practitioners, have a strong foundation and training in the diagnosis and treatment of diabetes. Physicians pursuing primary care fields of study acquire knowledge during both medical school and residency training programs focused on internal medicine, family medicine, pediatrics, or combined internal medicine and pediatrics.

Learners, including resident physicians, are influenced by knowledge from their undergraduate medical education and training experience provided by the chief residents [5] and attending physicians [5, 6] with whom they train; this role modeling which embodies knowledge, skills, and values [5, 6]. These influences affect trainees' comfort levels and practice behaviors, so if faculty physicians in residency programs have greater comfort levels with different treatment modalities, this could impact comfort levels among trainees as well. One prior study [7] of 154 program directors of primary care training programs reported assessed feelings of preparedness with respect to diabetes management and found that 28% felt very prepared and 9% did not feel at all prepared to use new insulin analogs, while 6% felt very prepared while 39% did not feel prepared to use diabetes technologies (i.e., insulin pumps or continuous glucose monitoring systems [CGMs]) [7]. In 2014, increased referrals to endocrinology specialists were anticipated due to advances in diabetes technology as well as the increase in medications available to manage diabetes [3]. The number of new medications available for diabetes management has also continued to increase, adding to management complexity [7–9]. Examples of newer diabetes management drugs include glucagon like peptide receptor agonists (GLP-1RA), sodium glucose transporter-2 inhibitors (SGLT-2i), and new insulin analogs [8, 9].

Diabetes management represents a fraction of the education provided in primary care specialty training programs for residents [10, 11]. We undertook this survey based study to quantify residents' exposure to diabetes management in residency training, to assess their comfort levels with various diabetes treatment modalities, and to investigate their referral patterns to endocrinologists, diabetologists, and nutritionists.

Methods

This study was reviewed and deemed exempt by the Institutional Review Board at Ohio University (IRB 18-E-241). All participants in this study provided electronic informed consent at the start of the survey.

Survey structure

An 18 item, cross sectional, anonymous survey (Supplemental material) was developed by the authors using Qualtrics. Survey questions were offered as multiple choice and Likert based options, as appropriate to the question, and skip logic was used in instances where the respondents' answer led to presence or absence of specific follow up questions. The survey included questions about demographics, including post graduate year of training; training setting (i.e., rural, suburban, or urban) and resident specialty; comfort level with various options for diabetes management including medication classes, technology, and healthy lifestyle education; reasons for patient referral and referral frequency to endocrinologists, diabetologists, diabetes educators, and nutritionists; and desire for further education about diabetes management. Training setting was determined based on subjective responses from the respondents rather than predefined population categories for urban, suburban, and rural.

Snowball sampling

The survey was emailed to program directors and chief residents at 7 institutions, who were requested to forward the survey to their residents; some the individuals to whom the survey was sent were affiliates of programs with which investigators had current or previous relationships as well as recommended programs to also approach about survey dissemination. Emails were sent to 8 family medicine, 6 internal medicine, 3 pediatrics, and 1 internal medicine/pediatrics programs for a total of 16 known training programs across the 7 health care systems. Recipients were encouraged to share the link with their colleagues in the recruitment email. The survey link was also posted on Twitter by Ohio University Heritage College of Osteopathic Medicine's Primary Care Research Unit (@OUPrimCareRes), with "tags" to the "handles" of the American College of Physicians, the American College of Osteopathic Family Physicians, the American Academy of Family Physicians, the American Pediatric Association, and the

American Osteopathic Association; the Twitter post encouraged participants to share the survey with other residents in primary care residency programs. Emails and tweets were initiated on October 15, 2018 and responses were collected through April 15, 2019. Data collection was reinitiated May 1, 2020 through July 31, 2020 due to low initial response rate.

Data analysis

Data was exported from Qualtrics to an Excel spreadsheet and analyzed using descriptive statistics reported as percentages.

Results

We received 61 responses; due to recruitment method of indirect email and social media use, the available respondent pool is unknown, and a response rate cannot be reported. Most (55; 90.2%) surveys were completed by residents in the home states of the investigators (Ohio, Virginia, North Carolina) but the number of emails forwarded by program directors and chief residents is unknown. The majority of respondents were enrolled in family medicine (32; 52.5%) or internal medicine (20; 32.7%), with the remaining respondents enrolled in pediatrics (4; 6.5%) or combined internal medicine/pediatric residency programs (5; 8.2%) (Table 1). Almost half of respondents (29; 47.5%) reported that they were first year residents (postgraduate year 1, or PGY-1), and the same amount (29; 47.5%) were graduates of osteopathic medical schools (Table 1). The majority (53; 86.9%) of respondents were receiving their post graduate medical training in rural areas or suburban settings (Table 1). Most respondents reported that their patient care took place in an inpatient setting (28; 45.9%), while 14 (23.0%) reported mostly outpatient training and 19 (31.1%) reported equal inpatient and outpatient training (Table 2). Most participants (46; 75.4%) reported that they see up to 50 patients per week, and more than half (37; 60.7%) estimated that 31–50% of their patients have diabetes (Table 2; Figure 1).

Respondents reported the highest levels of comfort with metformin use, basal insulin, and healthy lifestyle education. The lowest levels of comfort were reported with insulin pumps and CGMs**.** Comfort levels with other classes of medications including thiazolidinediones, dipeptidyl peptidase inhibitor-4s, glucagon like peptide-1 receptor agonists, sodium glucose transporter-inhibitor-2s, sulfonylureas, and prandial insulin were variable. Figure 2 displays complete data about resident respondents' comfort levels.

Most respondents (47; 77.0%) reported that they uncommonly referred a patient endocrinologist (10–15% of the time). About the same number of respondents (46; 75.4%) reported rarely (<10% of the time) referring a patient to a diabetologist. Respondents reported most frequently referring patients to a nutritionist ("very often" [>25% of the time]: 20; 32.8%). Referrals for diabetes education were reported as "often" (20–25% of the time) or "very often" (>25% of the time) by half of the respondents (36; 59.0%) (Figure 3).

The most common reasons for referral to an endocrinologist by resident physicians were pump and sensor technology (45; 31.7%), uncontrolled diabetes (38; 26.8%), and attending physician comfort (28; 19.7%) (Figure 4). For those who answered that uncontrolled diabetes was their most common reason for referral (38; 26.8%), of whom 36 (94.7%) answered the follow-up question, most respondents (27; 75.0%) defined "uncontrolled diabetes" as a

Table 1: Characteristics of resident respondent population (n = 61).

Training program	**n, %**
Family medicine	32 (52.5%)
Internal medicine	20 (32.7%)
Pediatrics	4 (6.6%)
Internal medicine/pediatrics	5 (8.2%)
Postgraduate year (PGY)	**n, %**
PGY-1	29 (47.5%)
PGY-2	18 (29.5%)
PGY-3	12 (19.7%)
PGY-4	2 (3.3%)
Type of medical degree	**n, %**
DO	29 (47.5%)
MD	32 (52.5%)
Practice setting	**n, %**
Urban	8 (13.1%)
Suburban	25 (41.0%)
Rural	28 (45.9%)

Table 2: Patient encounters among resident survey respondents (n = 61).

Inpatient vs. outpatient training experience	**n, %**
Inpatient	28 (45.9%)
Outpatient	14 (23.0%)
Equal inpatient and outpatient	19 (31.1%)
Number of patients seen per week	**n, %**
0–50	46 (75.4%)
51–75	12 (9.7%)
76–100	3 (4.9%)
More than 100	0 (0%)

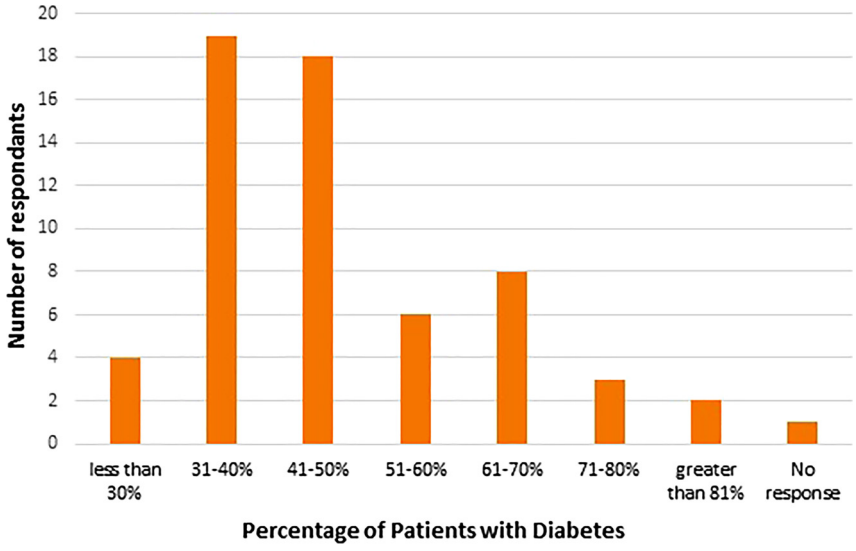

Figure 1: Respondents' reported percentage of current patients with diabetes.

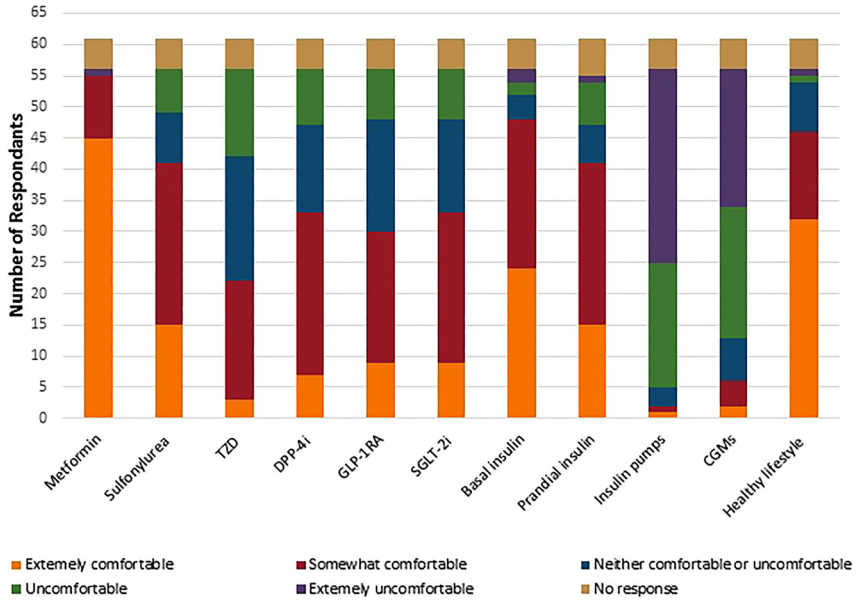

Figure 2: Respondents' reported comfort levels with various diabetes management modalities. Medications included metformin, thiazolidinediones (TZDs), sulfonylureas, dipeptidyl peptidase-4 inhibitor (DPP-4i), glucagon like peptide-1 receptor agonist (GLP-1RA), sodium glucose transporter-2 inhibitors (SGLT-2i), basal insulin, and prandial insulin. Technology included insulin pumps and continuous glucose monitoring systems (CGMs). Extreme comfort was reported most frequently with metformin (45; 73.8%), basal insulin (24; 39.3%), and healthy lifestyle (32; 52.5%). Extreme discomfort was reported most frequently with insulin pumps (31; 50.8%) and CGMs (22; 36.1%).

hemoglobin A1c of greater than 9.1%, while six (16.7%) chose a hemoglobin A1c of 8.1–9.0% and three (8.3%) chose hemoglobin A1c of 7.0–8.0%.

Comfort levels with diabetes management were variable, with 21 (34.4%) respondents reporting that they did not need additional training to feel comfortable with diabetes management. Thirty-one respondents (50.8%) wanted additional training, 4 (6.6%) did not plan to manage diabetes in their future practice, and 5 (8.2%) did not answer the question. Of the respondents who wanted more training, most (21; 52.5%) reported that they would prefer to receive additional training after graduation through conferences and online courses. Three respondents (7.5%) expressed desire to complete an endocrine fellowship and no respondents (0%) planned to pursue fellowship training in diabetology.

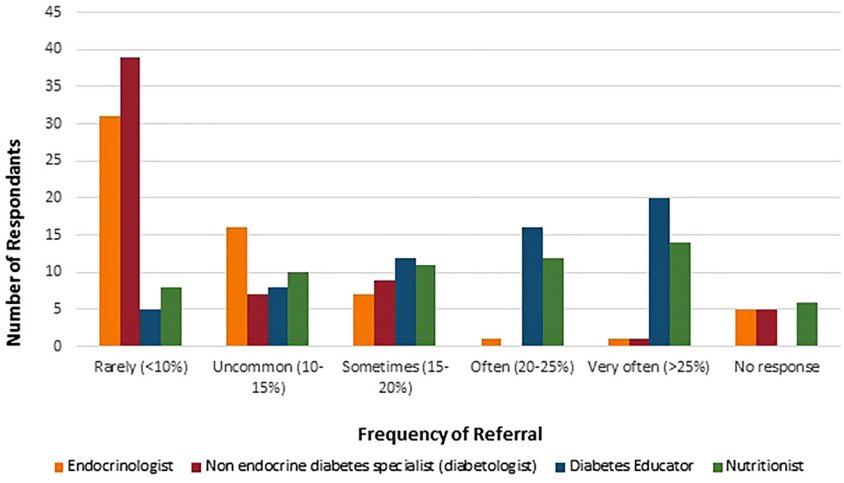

Figure 3: Respondents' reported referral frequencies to diabetes specialists, including endocrinologists, diabetologists, diabetes educators, and nutritionists. Referral frequencies to endocrinologists and diabetologists were lowest ("rarely": 31 [50.8%] and 39 [63.9%], respectively); referrals to diabetes educators and nutritionists were more frequent ("very often": 20 [32.8%] and 14 [23.0%], respectively).

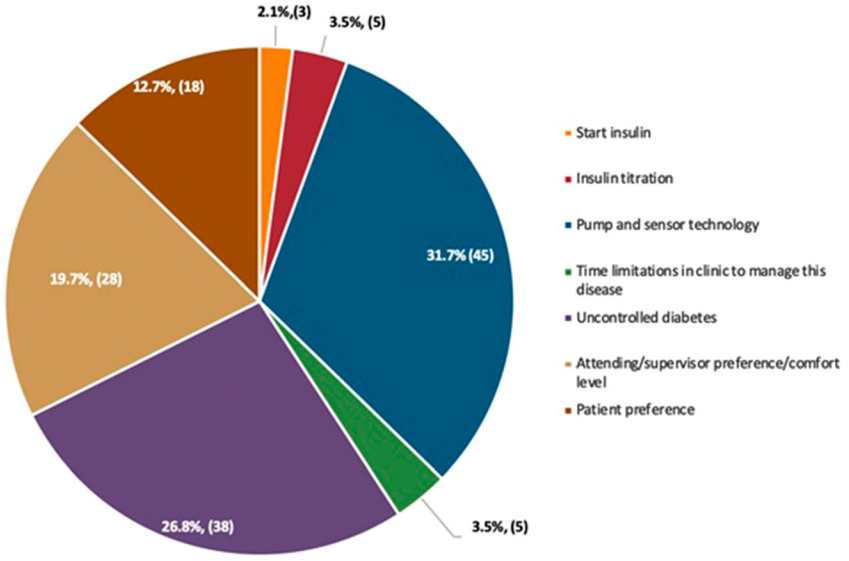

Figure 4: Respondents' reported reasons for referral. Pump and sensor training (45; 31.7%) was the top reason selected.

Discussion

A physician workforce comfortable in diabetes management is important to health outcomes in the United States. Residents in our study reported comfort in their diabetes management skills, with about half reporting interest in participating in further conferences and online courses for additional learning opportunities. Maintaining comfort with diabetes will continue to be important as more medications and technologies come available for its management. Our results suggest that referrals to endocrinology and diabetology are quite low, while referrals to nutritionists and diabetes educators occurred at higher rates. This is unsurprising, as lifestyle modification is part of first line and ongoing treatment for type 2 diabetes according to multiple guidelines [12–14]. However, our survey did not account for patient diagnoses of type 1 vs. type 2 diabetes in referral rates nor the availability of endocrinology in the respondent's area of practice. Previous data has estimated that 90.9% of people with diabetes have type 2, 5.8% have type 1, and 3.3% have other (i.e., monogenic or secondary) forms of diabetes [15]. People with type 1 diabetes are usually more likely to have insulin pumps and CGMs, since the evidence for use of these modalities is more robust in type 1 diabetes management as cited in the ADA guidelines [16]. However, use of these devices is increasing among patients with type 2 diabetes as guidelines have evolved [16], and the increased use of

technology has been predicted to increase referrals to endocrinology [3, 4]. About half (28; 45.9%) of respondents in our survey were training in rural areas where specialists are a limited resource, making confidence in diabetes management even more important for primary care practitioners. Had more of our respondents been from urban areas, our results might have been different, as most endocrinologists are located in urban areas. A study published in 2012 [17] showed that 99% of adults in urbanized areas had access to an adult endocrinologist within a 20 mile radius, while only 53% of rural adults had access to an adult endocrinologist within the same distance [17]. Access to pediatric endocrinology was even more limited, with 80% of urban and 20% of rural children having a pediatric endocrinologist within a 20 mile radius [17].

The fact that most (27; 75.0%) of our respondents characterized a hemoglobin A1c level of 9.1% and higher as "uncontrolled" is not surprising, given that the Merit-Based Incentive Payment System (MIPS) criteria for diabetes considers adequate control as a hemoglobin A1c value of less than 9.0% [18]. There is also the consideration of therapeutic inertia – defined as failure to initiate or escalate therapy in a timely manner when therapeutic goals are not reached - wherein patients with hemoglobin A1c levels between 7.1 and 9.0% are not advised to initiate new treatments, or to intensify current treatment and as a result more patients have hemoglobin A1c levels over 9.0% [19]. Also, mention multiple guidelines have changed over time as a result of new data. Guidelines from the American Diabetes Association (ADA) have set the goal for glycemic control at less than 7.0% [20], while clinical guidelines from the American Academy of Clinical Endocrinology (AACE) have set it at less than 6.5% [21]. These levels were derived from the Diabetes Control and Complications Trial [22] and United Kingdom Prospective Diabetes Study [23] trials, which showed a lower incidence of complications from diabetes in the intensive control groups vs. the conventional groups, whose hemoglobin A1c levels were 7.9% and above 9.1%. Later studies explored the effects of intensive glucose control vs standard control in cardiovascular disease and were not unanimous regarding glycemic targets. The Action to Control Cardiovascular Risk in Diabetes trial showed increased mortality with intensive control [24]. In addition, neither the Action in Diabetes and Vascular Disease: Preterax and Diamicron Modified Release Controlled Evaluation trial [25] nor the Veterans with Type 2 Diabetes trial [26] demonstrated a macrovascular benefit with intensive vs. standard control. As a result of those trials, both ADA and AACE guidelines set respective hemoglobin A1c goals, but also emphasize individualizing the target to the individual patient [20, 21]. Given the changing definitions of what constitutes a "controlled" hemoglobin A1c, the spectrum of choices that were selected by the respondents demonstrates an element of confusion. A redefinition of or education about control targets may be helpful to cultivate earlier referral patterns for complication prevention and to combat therapeutic inertia.

Another consideration as residents learn about diabetes management is the curriculum itself. A study published in *Postgraduate Medicine* [7] surveyed 154 program directors about their preparedness with diabetes management; results revealed a perceived need to add education about aspects of diabetes care including newer insulin analogs, diabetes technology, and social determinants of heath [7]. Our study results also showed low comfort levels with diabetes management technology among residents. Diabetes specialists who have undergone training in family medicine and internal medicine could be helpful to residency programs in curriculum improvement. Initiatives to incorporate pharmacology updates, teach diabetes technology, and address social determinants of health in diabetes would require a large number of physicians with specialized skillsets in diabetes management in primary care settings or more physicians who subspecialize in diabetes management. Time was a barrier to developing new diabetes management curricula, as noted by program directors who participated in the surveyed by Morales et al. survey [7]; if specialists are unavailable to programs looking to improve their own curricula, time and support will need to be provided to existing faculty for independent education.

In terms of continuing education, primary care providers will need to explore multiple avenues to stay current on diabetes management. However, based on preferences expressed by our small group of residents, didactics and other educational avenues will continue to be important as well. Most of our respondents (21; 52.5%) preferred conferences and online courses as continuing medical education (CME) rather than pursuing additional training via fellowships.

Limitations

The biggest limitation of our study was the small sample size. Our results are most applicable to physicians trained in rural and suburban areas. A larger population representing programs in both rural and urban settings would yield broader results in future studies. Our study focused on the perception of resident comfort regarding pharmacology and technology in diabetes; asking knowledge

based questions could be an avenue for future study. We also did not query about specific referral rates for different types of diabetes, which is another limitation to our study. The fact that our survey was mostly distributed to colleagues and programs with ties to the investigators could have influenced some responses; a more anonymous recruitment process may have yielded different results. Further, participants were recruited in part through the use of social media, so the true number of total surveys sent is unknown. A more focused recruitment strategy would have benefitted the study design.

Conclusions

Residents in this study expressed comfort with aspects of diabetes care relating to metformin, basal insulin, and lifestyle modification, which is consistent with guidelines for the treatment. However, reported comfort levels with newer medications were lower; these medications are tools for diabetes management that can be useful to consider in preventing therapeutic inertia, and primary care providers should be comfortable with them, especially in rural or suburban areas where endocrinologists are a limited resource. Diabetes technology continues to progress; this was one of our respondents' most frequently reported reasons for patient referrals to endocrinologists. Comfort levels among primary care residents could be increased through teaching and exposure, as primary care providers will continue to care for the majority of patients with diabetes. Providing time and opportunities for both attending and resident physicians to learn about new treatments for diabetes, increasing both knowledge and comfort levels, will continue to be important.

Acknowledgements: The authors thank Kelly Nottingham, MPH, for her help with utilizing Twitter as a recruitment modality in this study through the department of Primary Care Research at Ohio University Heritage College of Osteopathic Medicine.
Research funding: None reported.
Author contributions: All provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; all drafted the article or revised it critically for important intellectual content; all gave final approval of the version of the article to be published; and all agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
Competing interests: None reported.
Informed consent: All participants in this study provided electronic informed consent at the start of the survey.
Ethical approval: This study was reviewed and deemed exempt by the Institutional Review Board at Ohio University (IRB #18-E241).

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Supplementary Material: The online version of this article offers supplementary material (https://doi.org/10.1515/jom-2021-0035).