



# Has Technology Improved Diabetes Management in Relation to Age, Gender, and Ethnicity?

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## Abstract

**Purpose of Review** To review the current state of diabetes technology adoption and describe impact on outcomes in the context of age, gender, and ethnicity. We will discuss barriers and propose solutions that may help facilitate the adoption.

**Recent Findings** We are witnessing rapid evolution and increase in adoption of diabetes technology in all its forms, including insulin delivery and glucose monitoring devices, mobile medical applications, and telemedicine. This technology has a great potential to improve diabetes-related outcomes, including acute and chronic complications as well as quality of life for people living with diabetes. However, currently available outcome data are showing modest efficacy and evidence for disparities when it comes to age, gender, and ethnicity.

**Summary** Despite multiple barriers, the adoption of technology is steadily increasing. It is clear that disparities exist in terms of access to and use of technology, but they may be at least in part driven by unmet needs of end users and as such are not unsurmountable. While more research is needed to identify the specific causes for the disparities, future development of diabetes technology that is based on adaptation of behavioral theories has a potential to address the gaps. The disparities can be lessened by understanding the needs of end users and with improvement in personalization of technology, allowing the right device to be used by the right patient. Targeted interventions to increase awareness and education and help navigate the processes involved in currently available technology may help diminish the gaps in health equity.

**Keywords** Diabetes · Health disparities · Age · Technology · Ethnicity · Gender

## Introduction

Face-to-face visits, the most common health care delivery model, are limited in their reach, accessibility, and efficiency for many of the patients they serve. **Telehealth**, defined by the

American Telemedicine Association as “technology-enabled health and care management and delivery systems,” offers to bridge some of the barriers by extending capacity and access [1].

Diabetes technology is the term used to describe the “hardware, devices, and software that people with diabetes use to help manage blood glucose levels, stave off diabetes complications, reduce the burden of living with diabetes, and improve quality of life” [2]. More specifically, diabetes technology includes insulin delivery and glucose monitoring devices such as insulin syringes, pens, and glucometers, as well as newer devices and software such as insulin pumps, continuous glucose monitoring (CGM), mobile applications (apps), smart pens, and telemedicine. While we often think of technology in terms of novel devices used to treat diabetes, its adoption has also been evolving the models of healthcare delivery.

This exciting technology has been shown to improve outcomes such as HbA1c, time in range, and rates of severe hypoglycemia; however, it is not widely accessible, and disparities exist [3].

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In this paper, we will describe the adoption and influence of technology on management of diabetes in relation to age, gender, and ethnicity, and present available data on outcomes. We will discuss the above variables for the following categories: insulin delivery devices, glucose monitoring devices, mobile apps, and telemedicine.

## Insulin Pumps and Sensors

Most of the available data on insulin pumps and sensors exclusively focuses on people with type 1 diabetes (T1DM). Only 10% of insulin pump users are estimated to have Type 2 diabetes (T2DM) [4]. Despite the large number of people with T2DM on intensive insulin therapy, little is known about the outcomes of insulin pump therapy in this group. Recently, more outcomes are being reported on efficacy and safety of continuous glucose monitoring (CGM) in T2DM. Most of the longitudinal data examining the adoption of technology comes from the T1D Exchange, a large registry of pediatric and adult patients with T1DM from several endocrinology centers across the USA. Foster et al. recently showed an increase in adoption of insulin pumps and CGM over the years 2010–2018 among patients with T1DM. Among approximately 25,000 participants, pump use increased from 57 to 63%, while the use of CGM went from 7 to 30%. Patient-reported barriers to adoption, across all age groups, were cost-related, followed by concerns about the hassle of wearing devices and body image concerns [5]. Across all age groups, HbA1c was lower in pump and CGM users. Use of insulin pumps was associated with lower rates of severe hypoglycemia (defined as seizure or loss of consciousness) and CGM use trended toward a lower frequency of severe hypoglycemia. Rates of diabetic ketoacidosis (DKA) were lower in those on insulin pump therapy (vs injections), as well as in those using CGM [6••].

## Insulin Pumps and Sensors across Age

### Children

The most impressive advancement in adoption of technology from 2010 to 2018 was driven by CGM adoption in children with T1DM which increased from 4 to 51% in those younger than 6 years, and from 3 to 37% in the 6–13 age group. Pump use also increased from 50 to 60% in children < 6 years old and 58 to 68% in children 6–12 years [6••].

### Teens and Young adults

The use of CGM increased substantially from 2010 to 2018 in teenagers and young adults with T1DM, although less impressively compared with younger children. CGM use increased from 3 to 24% in the 13–17-year-old group and from 4 to 22% in patients aged 18–25. Insulin pumps remained the preferred method of insulin delivery for 62% of those 13–17-year-old and 60% of those in the 18–25-year-old group. Despite this impressive technology adoption, metabolic control in teenagers and emerging adults has actually worsened over those 8 years, with mean HbA1c increasing from 8.5 to 9.3% [6••]. This age-related worsening in metabolic control was noted even though other factors traditionally associated with HbA1c level such as race/ethnicity and socioeconomic status appeared balanced between the two periods studied (2010–2012 and 2016–2018).

### Older Adults

Older adults with T1DM constitute a growing population, as clinical care improves, and life expectancies increase [7, 8]. Data are now collected on several cohorts of people with T1DM for over 50 years, aiming to study protective factors for complications [9–11]. In the T1D Exchange cohort, adults > 50 years of age constituted 15% of all patients followed. Older patients with T1DM have increased rates of severe hypoglycemia (SH) [6••] and more hypoglycemia unawareness [12]. The American Diabetes Association (ADA) recognizes the challenges that exist in managing older adults on complex insulin regimens, and this has led to recommendation for higher HbA1c and glycemic goals, based on comorbidities and social support [13]. However, SH has not been found to correlate with HbA1c [6••] so higher glycemic goals alone are not enough to decrease rates of SH in this population. Technology offers a promise to improve the outcomes, and older adults have embraced it, with reported rates of pump use at 62% in adults over age 50. The use of CGM has also increased in patients age 50 and older, from 15% in 2010–2012 to 34% in 2016–2018 [6••] facilitated by changes in commercial insurers and Medicare [14].

Evidence of efficacy of pumps and CGMs in this population has been shown in multiple trials: A cross-sectional study of 124 patients with T1DM showed that insulin pump therapy worked equally well in subjects aged > 50 as it did in younger patients for glycemic control (HbA1c 7.01% vs 7.34%), and safety parameters such as severe hypoglycemia and hospitalization for glycemic decompensation [15]. In a subset of a large multicenter randomized trial, 116 people over age 60 with either T1DM or T2DM on multiple daily injection therapy (MDI) showed that CGM use resulted in greater reduction in HbA1c from baseline ( $-0.9 \pm 0.7\%$ ) compared with self-monitoring of blood glucose (SMBG) ( $-0.5 \pm 0.7\%$ ). There

were also significant improvements in time in range of 70–180 mg/dl ( $889 \pm 251$  min/day vs  $732 \pm 252$  min/day,  $P < 0.001$ ), mean glucose ( $168 \pm 29$  mg/dl vs  $180 \pm 28$  mg/dl,  $P = 0.01$ ), and glycemic variability (CV 31% vs 33%,  $P = 0.02$ ) in the CGM group compared with the SMBG group. There was high CGM use rate (97% used > 6 days/week) and high satisfaction with CGM use [16•]. A retrospective observational study that reviewed the electronic health records of 127 patients with T1DM over age 50 showed that insulin pump therapy was superior to MDI for glycemic control (change in HbA1c  $-0.6\%$  (0.8) vs  $-0.1\%$  (0.5),  $P = 0.000$ ) and also had lower rates of hypoglycemia (6.9% (4.3) vs 9.8% (5.9),  $P = 0.008$ ). [17]. A small retrospective study of thirty-eight patients aged 65 or older with diabetes (31/38 with T1DM) from a community endocrine practice showed that personal CGM use resulted in improved glycemic control (mean HbA1c decreased from 7.6% (0.9) to 7.1% (0.9),  $P < 0.0001$ ) and decreased rates of SH (0.37 to 0.12 per year,  $P = 0.0007$ ) [18]. In a randomized controlled trial of 100 T2DM patients (78% age > 50) not on prandial insulin, the use of intermittent real-time CGM compared with SMBG showed greater HbA1c reduction ( $-1\%$  vs  $-0.5\%$ ) at the end of the 12-week study period. This effect lasted up to 40 weeks after the intervention was stopped ( $-0.8\%$  vs  $-0.2\%$ ,  $P = 0.04$ ). This study shows that real-time data available for both providers and patients help to achieve better glycemic control by both adjustments of diabetes regimens and behavior change [19].

## Commentary

Professional societies recognize the benefits of device use in older adults. We agree with the recent Endocrine Society clinical practice guidelines on treatment of diabetes in older adults, which advocates for the use of CGM in this population as an important tool to improve glycemic control without increasing the risk of hypoglycemia [20]. In younger and older patients alike, dispelling some of the misconceptions about these devices in regard to their comfort, hassle, and complexity of use can be done through proper education and a trial with demonstration devices. Another important step is the involvement of family members and caregivers, ensuring that they are comfortable with use of the device as well as trouble shooting.

Finally, the fact that, despite the adoption of technology, achievement of glycemic targets has not improved over the past decade and has actually worsened for many with T1DM and T2DM alike [6•, 21] offers a cautionary tale of the limitations of technology. This is further accentuated by the fact that the average HbA1c in young adults actually worsened by 1.3% [6•]. This, at first glance, may be puzzling, but it offers a hint that we must consider limitations of technology and explore human factors that may be contributing to this issue.

## Insulin Pumps and Sensors Across Ethnicity

Poorer glycemic control and increased risks for complications have been seen in racial and ethnic minority youth with T1DM, those with a lower household income, and those with government subsidized or no insurance. A recent retrospective review found that despite overall increases in pump use rates, disparities in insulin pump use continue to exist in youth with T1DM. Age  $\geq 10$  years, identifying as a racial or ethnic minority or male, having a primary language other than English, and having government or no insurance were all associated with lower rates of insulin pump use [22]. Another recent cross-sectional study done at a large, diverse pediatric diabetes center showed that Hispanic and non-Hispanic black patients were less likely to use pumps and CGMs compared with non-Hispanic whites [23]. Similarly, a cross-sectional study of 178 families with 10–17-year-old children with T1DM showed that black and Hispanic youth were prescribed fewer intensive regimens, including pumps, than white, non-Hispanic youth [24].

Similarly, racial disparities were seen in frequency of pump and CGM use across all age groups in the T1D Exchange data, despite the overall increase seen in pumps and CGM utilization from 2010 to 2018. In this group, white non-Hispanic patients had lower HbA1c values than other ethnic groups. Mean HbA1c was higher in African Americans than non-Hispanic whites or Hispanic whites across all age groups, even after adjusting for socioeconomic status [6•].

## Commentary

The low rate of technology use among ethnic minorities is due to a multitude of factors and may be contributing to poor glycemic control, leading to higher diabetes-related complications, morbidity, and mortality. Many patients have multiple barriers (ethnicity, lack of insurance, and non-English primary language), placing them at even larger disadvantage [23]. Evidence suggests that provider factors such as implicit bias contribute to these persistent disparities. For instance, Valenzuela et al. identified two important factors associated with differences in therapeutic modalities that providers choose for their patients: caregiver perceptions of cost associated with intensive treatment and provider perceptions of family competence [24]. Concerns for cost may be overestimated, as most public insurance programs cover costs of insulin pump therapy and the coverage for CGM continues to improve.

Along with ethnicity-specific barriers, more global barriers have also been reported, such as logistical issues related to requirement for attending trainings prior to initiating insulin pump therapy, as well as perceived barriers such as discomfort, interference with activities, difficulty of use, risk of hypoglycemia, insertion site reaction, and cost [25].

The role of physician perceptions in clinical decision-making should be studied more to provide intervention at the physician or practice level [24]. Spending time during visits to review the benefits of pump therapy, dispelling myths about technology, and helping to navigate logistical challenges have all been proposed as ways to decrease this disparity [22]. One promising way to address specific needs of a population is the development of special clinics designed to provide culturally oriented patient care, such as Joslin's Latino Diabetes Initiative. Comprehensive education delivered via language of choice in both written and in-person formats (i.e., Spanish-speaking diabetes educators) may improve uptake of this technology in non-English speaking minorities [23].

### Insulin Pumps and Sensors Across Gender

There is interest in the literature regarding general technology adoption and its relation to gender, suggesting frequently that men are more likely to adopt technology. However, when it comes to diabetes technology and gender, little data is available.

In a survey on 1503 T1D Exchange patients, more women reported using insulin pump therapy compared with men (73% vs 65.3%) but CGM use was similar even though expressed more barriers to using technology and had more concerns related to "not liking how device looks on their bodies" [5]. Similar findings of greater pump use in females were seen in New Zealand [23, 26].

Most of the data about the impact of gender specific technology use comes from studies on pregnant women. In a multicenter randomized controlled trial involving 215 pregnant women with T1DM, the addition of real-time CGM compared with capillary glucose monitoring alone showed improved glycemic control and neonatal outcomes [27]. However, the use of intermittent and blinded CGM was not as effective as real-time CGM [28]. A meta-analysis of 47 studies reporting on 7824 pregnancies about insulin pump use in pregnant T1D women showed better first trimester glycemic control compared with MDIs. Interestingly, although pump use resulted in lower insulin requirements, it caused higher gestational weight gain and increased rates of LGA babies [29]. Another meta-analysis of six studies evaluating 231 pregnant women with T1DM showed that insulin pump use as compared with MDI did not result in better glycemic or pregnancy outcomes [30]. There are limited data on the use of automated insulin delivery/hybrid closed loop therapy in pregnancy. The available studies are small and show safety and feasibility in using these recent advancements but no superiority [31, 32].

### Commentary

Authors speculate that reproductive age may be the contributing factor driving increased adoption of technology in women, as they strive to improve their glycemic control pre-conception and during pregnancy. Besides advanced technology, high-quality diabetes education on optimal dietary intake, exercise, and self-management are still crucial for improving pregnancy outcomes [33]. Research is needed to see why men have lower rates of insulin pump despite endorsing fewer barriers to technology.

### Mobile Medical Apps

Mobile apps are software programs that run on mobile communication devices such as smart phones and other wireless devices. Apps that are intended for the diagnosis, cure, mitigation, treatment, or prevention of disease are considered as devices. Mobile medical apps are mobile apps that transform a mobile platform into a medical device [34]. Mobile medical apps as a technology aim to lessen the daily burden of living with diabetes and empower people with diabetes to manage their chronic disease successfully. They help with the key components of diabetes self-management skills, including adherence to behavioral treatment recommendations and timely decision-making such as insulin dosing and communication with caregivers, and can collect, organize, and transmit data to a health care team.

Very few apps have literature-based evidence on the impact of outcomes such as HbA1c, hypoglycemia, or quality of life. A review of literature focusing on mobile medical apps that have clinical outcome data published in the peer-reviewed literature and/or have been either cleared by the US Food and Drug Administration (FDA) or have received a Conformite Europeene (CE) mark in Europe has found only 14 apps and a total of 14 studies [35]. A similar review has identified only nine insulin calculator apps [36]. The impact of mobile apps on HbA1c as well as hypoglycemia varied widely between studies and showed no to modest improvement. Most studies were underpowered and of too short duration to show a large clinical benefit and to exclude the impact of non-technological factors such as healthcare professional support [35, 36].

### Mobile Medical Apps Across Age

Despite the availability of many apps, data from the T1D Exchange registry revealed adoption of apps to be very low. Out of 11,000 patients, only 16% used mobile medical applications to assist with diabetes care. The usage steadily decreased from childhood to adulthood and older age, reflective of the fact that use of apps was driven by caregivers and limited to viewing and sharing the data. Other than the use

of the Dexcom Share app by Dexcom CGM users (reported by 20–40% of app users), use of other apps was very uncommon. With increasing age, there was a slight uptake of use of apps to record food and track exercise [6••].

### Children and young adults

A retrospective analysis of eighty-one youths with T1DM showed that using a mobile app to synchronize glucometer data may improve engagement in other aspects of care such as SMBG frequency [37]. A review by Sheehy et al. concluded that there is a lack of evidence on the efficacy of mobile apps on glycemic control or complications in children and young adults [38].

### Older Adults

Pew research on mobile use shows that smart phone ownership declines after age 50 and is only 53% after age 65, compared with 96% in the 18–29 age group [39], indicating that older patients in general may have low rates of uptake of new technology. However, a small study by Quinn et al. showed that older adults have positive attitudes toward technology, with high self-efficacy and confidence, and demonstrated the ability to use mobile apps [40]. An expert-based usability evaluation for patients aged 50 or older by Arnhold et al. showed that features of apps most important for older people, such as options for larger font size, are available in only 41% of the diabetes apps, and the option to read the screen content aloud (voice over in iOS and talk back in Android) is available in 72.7% of the apps [41].

### Mobile Medical Apps and Ethnicity

Hispanic patients have higher rates of diabetes, as well as higher rates of diabetes-related complications and mortality. They face multiple health care-related barriers and have a lower rates of health literacy (66% at basic or below basic level) [42], as well as limited English proficiency. However, only 30% of diabetes-related mobile apps had descriptions available in Spanish in the app stores and even fewer had actual Spanish interface in the app. The material presented in the description was also above the reading level recommended [43]. A study by Williams et al. showed that mobile app use by Latinos is very low, with only 3.6% of those with diabetes and mobile phone use reporting use of a diabetes app in a 2014 online survey [44].

### Mobile Medical Apps and Gender

No information on adoption of diabetes-related mobile app use regarding gender was found on our review of the literature.

### Mobile Medical Apps: Commentary

Ethnically diverse populations show interest in using mobile apps but report a lack of confidence with the technology and frustration with their navigation and design. These issues can be overcome if app developers use participatory design strategies to impact vulnerable populations [45]. Low health literacy creates additional barriers for app adoption across age and ethnicity. A 2003 national assessment of adult literacy data shows that health literacy of adults aged 65+ is lowest among all age groups (59% at basic or below basic level) [42]. Although the Joint Commission recommended that the reading level for apps should be at 5th grade or below, a review of diabetes apps by Rodriguez et al. found that 94% had descriptions at the 9th grade reading level [43]. In addition, most healthcare providers are not familiar with currently available apps and thus are unable to guide their patients.

We propose that app selection by users and recommendations by health care providers be customized to the specific needs of the individual. Features of apps appropriate for older adults are clear large fonts, easy navigation, and automatic data input from glucometers and CGMS. Patients should be offered extra training in the use of specific apps to reduce the anxiety and overcome the literacy barrier related to technology. Young adults may prefer apps that have a gaming component to improve engagement. Ethnic minorities should choose apps with language and cultural appropriateness. App developers should consider perspectives and usability requirements of end users. To foster higher engagement, shared decision-making with stake holders should be implemented in the development process. Although there are differences in app use based on gender, age, and ethnicity, the study of Carroll et al. showed that the influence of sociodemographic factors is decreasing, and app use is associated with intentions to change behavior [46]. Thus, mobile apps that promote behavior change through coaching, facilitated by either humans or by artificial intelligence, offer potential to achieve better outcomes [47]. This is supported by meta-analysis by Greenwood et al. showing that technology-enabled diabetes self-management is effective in the context of complete feedback loop, allowing for a two-way communication with a health care provider [48].

### Telemedicine

Telemedicine is “the delivery of health care services using information and communication technologies, where distance is a critical factor, for the exchange of valid information for diagnosis, prevention and treatment of diseases and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing health of individuals and their communities” [49]. A detailed review of all aspects of the broader category of Telemedicine for diabetes-related care

delivery is beyond the scope of this review. We will limit discussion to the available evidences on telemedicine interventions for diabetes with regard to age and ethnicity.

## Age

The IDEATel project, a large randomized trial that evaluated the effectiveness of telemedicine in diabetes management of 1665 ethnically diverse, underserved, and older (mean age 71) Medicare beneficiaries, showed improvement in HbA1c (7.09% vs 7.38%) [50]. A small randomized pilot study by Dy et al. showed that teleconsultations for skilled nursing facility patients (mean age 83) decreased episodes of hypoglycemia and severe hyperglycemia and more patients reached their target HbA1c goal at the end of the 6-month study period [51].

## Ethnicity

In the IDEATel study, Hispanic patients, despite having higher baseline HbA1c values, showed the most improvement with the intervention [50]. Adherence to self-care was lower in African American and Hispanic groups despite individualized and accessible interventions such as personal goal setting, and Spanish-speaking educators [52].

## Gender

No pertinent information on gender and adoption of telemedicine was able to be found on our review of the literature.

## Telemedicine: Commentary

Telemedicine offers a unique approach to reducing barriers to access to healthcare and as such has a great potential to improve diabetes-related outcomes. This is particularly important for elderly, socioeconomically disadvantaged, and rural populations who have issues with transportation, making quarterly visits challenging. Greater national adoption of telemedicine and improvement in workflow integration are needed to realize this potential. The authors have extensive experience with telemedicine clinic visits, currently providing care to nine different community hospitals in Nebraska and Iowa. While we successfully utilize video conferencing programs to perform standard clinic visits remotely, it is not a seamless process. Every location uses a different electronic medical record (EMR), and the ability of the remote sites to download devices such as meters, insulin pumps, and CGMs varies widely.

More research is needed to understand the impact of telemedicine and identify type of interventions that provide the best improvement in outcomes. A literature search yields several studies of widely varying telemedicine interventions ranging from telephone calls and remote patient monitoring to videoconferencing, and thus, outcomes vary also; so one has

to read the fine print in order to understand what the exact intervention was [53–57].

## Discussion

Diabetes technology offers a great potential to facilitate diabetes care on a personal and population level. It accomplishes this lofty goal by addressing barriers to self-management, promoting patient centered care, and using artificial intelligence-enabled decision support systems and big data analytics. Despite great potential and continuous growth of technology adoption, current evidence is showing mixed results with modest improvement in outcomes with ongoing evidence for disparities across age, gender, and ethnicity. These disparities are offering a glimpse into psychosocial elements influencing technology adoption and can create a roadmap for personalization of technology. Technology can be a friend or a foe both for patients and providers. In order to optimize its use and improve outcomes, one needs to understand the unique and unmet needs of the end user.

Age-related disparities offer to illuminate above issue and dismiss preconceived notion that elderly patients are afraid of technology and that younger ones are “tech wizzes” embracing it and maximizing its potential. It underscores the fact that diabetes digital technology products are tools that can improve glycemic control and quality of life, but providers and patients need to work together to decide what tools are right for them at their current life state. Older age should not be assumed to be a contraindication to insulin pump therapy [17]. Older patients are not averse to using mobile medical apps; however, usability of multifunctional apps is not good for those above 50 and simpler interface may be more aligned with their needs [41]. Emerging adults offer perhaps the most sobering realization of the limits of technology. Young adults with type 1 diabetes are in a critical transitional time, one of instability associated with changes developmentally, personally, and professionally. Those challenges cannot be addressed by technology only as noted in T1D Exchange group showing worsening of HbA1c in this population despite increase in adoption of technology [6••]. Addressing disruption, stress, and impulse control through behavioral interventions targeting habits and triggers may be used in conjunction with technology to improve diabetes outcomes [58]. Gender disparities and increased use of technology with improvement in outcomes in pregnant females illustrate the fact that technology which addresses well-defined goals in an activated and motivated patient can be a powerful tool. Ethnic disparities illustrate the need for understanding specific cultural needs of target populations.

Disparities in the access to and use of technology are frequently referred to as a digital divide. While digital divides clearly exist when it comes to diabetes technology, they are at

least in part due to different needs of different users. Similar to any product, the adoption of digital diabetes technology is related to its usability. A way to address end user needs and help diminish digital disparities is to develop population-specific technology based on adoption of behavioral theories using the IDEAS (integrate, design, assess, and share) framework. This process includes the following elements: understanding the needs and motivation of target users, specifying target behavior, and grounding the intervention in behavioral theory. The IDEAS framework further calls for creating implementation strategies, developing prototypes, gathering user feedback, and piloting technology to determine efficacy and usability, followed by a randomized controlled trial. Publishing results and working with industry partners is needed to continue to refine the product for potency and usability [59].

## Conclusion

The evolution of diabetes technology in the form of medical devices, mobile medical applications, and telemedicine has a great potential to improve diabetes-related outcomes, including acute and chronic complications as well as quality of life for people living with diabetes. While adoption of technology is steadily increasing, the outcome data are showing modest efficacy and ongoing disparities when it comes to age, gender, and ethnicity. These disparities can be lessened by understanding the needs of end user and improvement in personalization of technology allowing the right device to be used by the right patient.

## Compliance with Ethical Standards

**Conflict of Interest** Leslie Eiland and Thiyagarajan Thangavelu declare that they have no conflict of interest.

Andjela Drincic reports being on the advisory board for CORCEPT national advisory board.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

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- Of importance
- Of major importance

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