COMMENTARY

Opportunities and Challenges of Telemedicine: Observations from the Wild West in Pediatric Type 1 Diabetes

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RECENT DATA FROM THE SEARCH Study in the United States have identified a 21.1% increase in the prevalence of type 1 diabetes (T1D) in youth <20 years old over the 8-year interval from 2001 to 2009, highlighting the need for adequate access to care for the growing numbers of affected pediatric patients.¹ Furthermore, the overwhelming majority of pediatric patients with T1D fail to achieve the recommended A1c targets of <7.5% (<58 mmol/mol), indicating a need for increased diabetes follow-up care.^{2,3} Indeed, longitudinal analyses from the T1D Exchange clinic registry show that A1c deteriorates during adolescence and only begins to improve once patients reach the third decade of life.^{3,4} Moreover, the rapid expansion of advanced treatment technologies, such as pumps and sensors, creates additional need for expert diabetes management teams to provide care, education, and support for pediatric patients with T1D and their families. Thus, this combination of increasing numbers of youth with T1D, their suboptimal glycemic control, and complex technologies for management creates a perfect storm to overwhelm the traditional treatment paradigm of in-person diabetes visits. As a result, the report by Wood et al.⁵ in this issue of *Diabetes Technology and Therapeutics* regarding the use of telemedicine visits for pediatric patients with T1D is timely.

Previous publications have documented opportunities with telemedicine, including a Cochrane review, although many reports, similar to the one by Wood et al.,⁵ demonstrate feasibility and satisfaction but only noninferior health outcomes compared with usual care.⁶⁻⁸ Since the Diabetes Control and Complications Trial, intensive insulin therapy has been the standard of care, delivered by an experienced, multidisciplinary team. However, access to specialty services is often limited, even in first world countries like the United States, because of size and nonhomogeneous geographic distribution of such services, which tend to be located in large urban areas. According to the 2010 Census, about 20% of the U.S. population lives in rural areas,⁹ potentially yielding a large number of pediatric patients with T1D lacking access to subspecialty care. Patients with limited access to specialty care may be

less likely to achieve adequate diabetes control, thereby increasing their risks for acute and chronic complications.

Telemedicine, including videoconferencing, phone contacts, remote glucose downloads, and web-based education systems, offers potential solutions to connect providers and patients who are geographically separated. In recent years, telecommunications technology has seen significant advances and has become more affordable; as such, telemedicine has been applied commonly in the treatment of adults with type 2 diabetes.^{10,11} There are fewer applications of telemedicine in the pediatric population with diabetes; thus, the pediatric diabetes community may welcome the report by Wood et al.⁵ These authors evaluated the use of videoconferencing in a natural experiment of pediatric patients with T1D in the state of Wyoming. In this observational study, the authors assessed A1c outcomes and visit frequency over 1 year of follow-up care using telemedicine, comparing these outcomes with historical outcomes in the year prior to the implementation of the telemedicine among the same patients.

The study recruited 70 young persons with T1D, 1–22 years of age, out of the estimated 200 youth with T1D in Wyoming (approximately 35%). Their mean age was 12.1 ± 4.1 years, and mean T1D duration was 5.4 ± 4.1 years. Age and duration were similar among the 54 patients who completed 12 months of follow-up, and these 54 served as the basis for the satisfaction analyses. Notably, only 42 and 43 patients, however, provided 1-year data related to A1c outcomes and visit frequency, respectively. The telemedicine sites were located in Cheyenne and Casper, WY, between approximately 100 and 300 miles away from the Barbara Davis Center in Colorado, where face-to-face pediatric diabetes specialty care would have been delivered.

One year after telemedicine visits, the mean A1c did not change significantly from baseline, leading the authors to conclude that telemedicine visits were noninferior to face-to-face care for pediatric patients from rural areas. Visit frequency was greater in the year with telemedicine compared

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with the prior year (2.9 ± 1.3 visits vs. 2.0 ± 1.3 , respectively; $P < 0.0001$).

Survey data also addressed travel time and missed work/school time for diabetes visits, contrasting telemedicine visits with face-to-face visits. Participants reported significantly fewer missed work hours (2.9 ± 3.5 h with telemedicine vs. 8.5 ± 6.1 h before telemedicine; $P < 0.0001$) and missed school hours (2.4 ± 3.0 h with telemedicine vs. 7.9 ± 4.8 h before telemedicine; $P < 0.0001$). Such time saving has substantial positive economic and educational implications for parents and youth. Thus, it is not surprising that satisfaction was high with telemedicine (94% were “satisfied” or “very satisfied” based on a 5-point Likert scale).

Next, we will describe and contrast the reported outcomes by Wood et al.⁵ with the published literature.

Other studies have yielded even more optimistic findings. A recent review on telemedicine use in school-age children and adolescents reported improvements in either blood glucose readings or A1c compared with either control groups or baseline values, suggesting that telemedicine may improve diabetes management.¹² In a study published by Izquierdo et al.,¹³ the A1c level decreased significantly over 6 months in children 5–14 years of age whose usual clinic care was supplemented with monthly videoconferencing sessions that included the child, school nurse, and diabetes provider, compared with youth receiving only clinic-based care. These authors also reported improvements in quality of life scores in association with the telemedicine support.¹³ Telemedicine has also been effective in delivering behavioral health programs to adolescents with diabetes.¹⁴ In a study by Harris et al.,¹⁴ the authors compared delivery of behavioral family systems therapy (BFST) via Skype™ (Microsoft, Redmond, WA) or in-person in a randomized controlled trial among teens 12–18 years of age in poor glycemic control (A1c $\geq 9\%$). The BFST was equally effective when delivered by either modality with respect to improving adherence and glycemic control.¹⁴

The successful implementation and adoption of telemedicine services depend on acceptance and satisfaction by both healthcare consumers and service providers.^{8,15} However, evaluating and comparing satisfaction across studies can be problematic because of the range of telemedicine modalities and communication technologies as well as the variability in survey construction assessing satisfaction. With greater penetration of telemedicine solutions, one might envision a need to develop a universal tool to measure both caregiver and patient satisfaction. Recently, Fatehi et al.⁸ tested a multiple choice questionnaire specifically created to assess satisfaction of patients with diabetes receiving interactive video teleconsultations. Although only 24 out of 62 (39%) questionnaires were completed, the overwhelming majority (>90%) were satisfied/highly satisfied with the teleconsultations with their specialists and with the technical features of the telecommunications. In contrast, about one in five patients was dissatisfied with the lack of physical contact during the video consultation. Similarly, in the current report by Wood et al.,⁵ a few patients were dissatisfied with either the technical aspects of the telemedicine visits or their impersonal nature. The lack of face-to-face contact, which may affect the doctor–patient relationship, may be a detractor from universal enthusiasm for telemedicine visits by both providers and patients.¹⁶

Finally, evolving reimbursement models to emphasize value-based instead of volume-based care may favor the adoption of telemedicine in ambulatory settings.⁹ In the study by Wood et al.,⁵ Wyoming Medicaid and other insurance programs reimbursed the telemedicine visits, but there are no unequivocal reimbursement systems in place, suggesting a need for future studies to evaluate their cost-effectiveness.

The current report by Wood et al.⁵ serves as an observational pilot study. Indeed, there are several limitations, which are well described by the authors, related to the small numbers, lack of randomization, potential recall bias, and likely selection bias. Furthermore, it is puzzling that 70% of the 70 enrolled patients and 80% of the 54 1-year completers were male. Additionally, there are no data reported regarding the sex of the parents involved in the telemedicine visits. One might wonder if female patients prefer face-to-face visits, or if male patients are too busy with athletics and school activities to attend in-person clinic visits. It will also be important to assess if telemedicine visits may be a means to attract more fathers to their children’s diabetes visits, if indeed there will only be modest time away from work. Previous studies have highlighted the benefits of including both parents in the diabetes care of their children.^{17,18}

Telemedicine is becoming an increasingly important alternative to deliver healthcare, including diabetes care, and it has the potential to address disparities related to access by overcoming barriers of distance, time, and possibly expense. The present report by Wood et al.⁵ confirms the opportunities to advance telemedicine in rural communities, while others have identified opportunities to improve adherence and glycemic control for those in greatest need.

Challenges remain related to reimbursement, identifying which patients may benefit most, and understanding the optimal frequency of telemedicine visits as replacement for in-person encounters. Finally, all salient stakeholders, including providers, patients, and payers, should contribute to the ongoing development of standardized tools to assess satisfaction and utility of this burgeoning form of diabetes care.

Author Disclosure Statement

No competing financial interests exist.

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