

# Role of telemedicine in treatment of pediatric type 1 diabetes

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Telemedicine has the potential to play an important role in the treatment of pediatric diabetes. Over 1.1 million children and adolescents have type 1 diabetes (T1D) worldwide <sup>1</sup>, and studies have shown that the incidence of T1D has been increasing. The Search for Diabetes in Youth (SEARCH) study found a 1.8% increase and the EURODIAB study showed a 3.4% increase in T1D in recent years <sup>2,3</sup>. Unfortunately, in many areas across the United States, pediatric endocrinologists are scarce <sup>4</sup>. In addition, the current COVID-19 pandemic has dramatically limited access to in-person medical care. Fortunately, due to advances in technology, T1D is uniquely suited to be cared for via telemedicine.

Much of the vital data necessary to evaluate and treat patients with T1D can now be fairly easily captured and transmitted remotely to healthcare providers. Detailed records of glucose levels, carbohydrate intake, and insulin doses can be shared via numerous platforms. Information can be shared via secure electronic health record videoconferencing portals, protected cloud-based sites, email, text through HIPAA-protected sites, or by telephone.

Prior to COVID-19, many patients were already sharing insulin pump and continuous glucose monitoring (CGM) data with their diabetes provider on a regular basis between clinic visits. In the United States, as well as in many other countries, the majority of patients have access to the technology that is needed for telemedicine visits. A review of our patient population showed that ethnic minority adolescents with T1D across a range of income levels (54% with a yearly household income less than \$49,000) have access to smartphones <sup>5</sup>. Adolescents reported having access to the internet (98%) and their own personal smartphones (86%)<sup>5</sup>.

In order for a T1D telemedicine appointment to be as productive as possible, preparation before the visit is critical. Patients need to be instructed on what data needs to be obtained and how to access and share it. This may be technologically challenging for some families, and they will need to be provided instruction on how to accomplish this. This should be done prior to the visit as the instruction may require step-by-step guidance, which can be both time consuming and tedious. However, learning how to obtain and share this data will be beneficial for future in-person visits.

Insulin pumps can be downloaded and considerable information can be obtained from pump reports, including pump settings, insulin doses (amounts and times), total insulin dose, percent basal versus bolus insulin dosing, carbohydrate intake (amounts and times), frequency of pump site changes, and instances when recommended insulin doses have been overridden. For patients using hybrid pumps, additional information, including automatic adjustment in basal rates, is also available. For patients giving insulin injections, there are smart pens which can record injections, carbohydrate intake, and glucose levels. A recent study showed that smart pens can increase time in range and reduce missed bolus injections <sup>6</sup>. Smart pen apps also have alarm and alert features. Patients who are not using insulin pumps or smart pens should still be completing logs that record glucose data, carbohydrate/food intake, and insulin doses. Exercise, illness, and other events may also be noted on their logs. These logs can and should also be shared electronically before a telemedicine appointment.

CGM data, including glucose patterns, time in range, glucose variability, and even estimated hemoglobin A1c, can likewise be shared remotely.



CGM data can be monitored remotely and shared with other people like family members and caregivers. Some sites can link sensor data with insulin pump and smart pen data. Most glucose meters can also be downloaded, and the downloaded data will typically show glucose levels, frequency of glucose monitoring, and average glucose levels.

In addition, comprehensive diabetes education can be done via telehealth including but not limited to the treatment of hypoglycemia, glucagon usage, carbohydrate counting, ketone monitoring, sensor usage, meter usage, use of insulin pens, sick day management, monitoring of injection/pump/sensor sites, and pump troubleshooting. Besides physicians and diabetes educators, telehealth can also be provided by other members of a diabetes team, including psychologists, social workers, and dietitians which is particularly useful for patients who may not otherwise have access to these providers. When needed, interpreters can also join visits virtually. Diabetes team members can meet with the patients individually or, on some telehealth platforms, multiple members of the team who are located in different locations can meet together with the patient. Patients and their families have found virtual support groups beneficial as well.

Telemedicine visits can also be economically beneficial for patients and providers. The cost of travel to a pediatric endocrinologist can be prohibitive for many patients in third world countries. Even patients within a short distance of their endocrinologist may have transportation and schedule challenges. For physicians, while CGM review has been reimbursable for more than a decade, other telehealth encounters have not. However, the recent expansion of reimbursement for telehealth encounters, including prolonged phone calls and email exchanges, has allowed the provision of telehealth services to become economically feasible.

Children and their families often find the remote visit from their homes more comfortable, especially those who are anxious in medical situations. Children can also spend a large portion of the visit playing separately, which is less distracting for parents. Patients and their families also appreciate minimizing time away from school and work. Teenagers are pleased to have less disruption of their sleep for early morning appointments. An additional benefit of home telemedicine visits is that other family members who provide care but rarely attend clinic visits may be able to participate in the encounter. Med-

ications taken at home can be visually confirmed, including dosages and expiration dates, eliminating the need to rely on potentially flawed memories.

The major drawback of a telemedicine visit is the lack of a full physical exam. The inability to accurately determine pubertal stage, assess injection sites, and palpate the thyroid gland are particularly concerning limitations for pediatric endocrinologists. However, there are ways to obtain needed information remotely when a physical exam is not practicable. Pertinent physical data, including height and weight measurements and heart rate, can be obtained at home. Parents should be educated on how to obtain home measurements in as accurate a manner as possible, and they should be provided with the pertinent instruction, including pictorial information on how to measure height accurately at home, before the telehealth appointment. Blood pressure and temperature can also be determined if appropriate equipment is available to the patient. A patient may be remotely observed swallowing to assess for a thyroid goiter. Parents can be taught how to monitor injection/pump/sensor sites for hypertrophy, rashes, or skin irritation, and those sites can also be observed remotely.

The escalation of telemedicine as a response to COVID-19 is likely to permanently shift the treatment of pediatric diabetes as it increases patient-provider communication and enhances patient engagement. Telemedicine should remain available as an adjunct to in-person diabetes care after the pandemic has passed, as it has the potential to improve both diabetes management and the overall well-being of children and adolescents with T1D.

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#### **REFERENCES**

1. International Diabetes Federation. IDF Diabetes Atlas, 9th ed. Brussels, Belgium: International Diabetes Federation; 2019.
2. Mayer-Davis EJ, Lawrence JM, Dabelea D, Divers J, Isom S, Dolan L, Imperatore G, Linder B, Marcovina S, Pettitt DJ, Pihoker C, Saydah S, Wagenknecht L,

- SEARCH for Diabetes in Youth Study. Incidence trends of type 1 and type 2 diabetes among youths, 2002-2012. *N Engl J Med* 2017; 376: 1419-1429.
3. Patterson CC, Harjutsalo V, Rosenbauer J, Neu A, Cinek O, Skrivarhaug T, Rami-Merhar B, Soltesz G, Svensson J, Parslow RC, Castell C, Schoenle EJ, Bingley P, Dahlquist G, Jarosz-Chobot PK, Marciulionyte D, Roche EF, Rothe U, Bratina N, Ionescu-Tirgoviste C, Weets I, Kocova M, Cherubini V, Putarek NR, deBeaufort CE, Samardzic M, Green A. Trends and cyclic variation in the incidence of childhood type 1 diabetes in 26 European centres in the 25-year period 1989–2013: a multicentre prospective registration study. *Diabetologia* 2019; 62: 408-417.
  4. Lu H, Holt JB, Cheng YJ, Zhang X, Onufrak S, Croft J. Population-based geographic access to endocrinologists in the United States, 2012. *BMC Health Serv Res* 2015; 15: 541-553.
  5. George SM, Delamater AM, Pulgaron ER, Daigre A, Sanchez J. Access to and interest in using smartphone technology for the management of type 1 diabetes in ethnic minority adolescents and their parents. *Diabetes Technol Ther* 2016; 18: 104-109.
  6. Adolfsson P, Hartvig NV, Kaas A, Møller JB, Hellman J. Increased time in range and fewer missed bolus injections after introduction of a smart connected insulin pen. *Diabetes Technol Ther* 2020 Mar 11. doi: 10.1089/dia.2019.0411. Epub ahead of print.