# Telehealth to Avoid Emergency Department Visit and Hospitalization for a Person With Newly Diagnosed Type 1 Diabetes During the Coronavirus Disease 2019 Pandemic

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## Case Presentation

Z.R. is a 20-year-old White man with no prior relevant medical or surgical history. He presented to his pediatrician's office in April 2020 with a 1-month history of thirst and polyuria and an unintentional weight loss of 25 lb. His weight was 167 lb, and he was 6 feet tall. He was not in distress, dehydrated, or hyperventilating. His vital signs and physical examination were normal, but point-of-care glucose levels were in the 300-mg/dL range, with urine positive for glucose and ketones. Z.R. is a college student majoring in sports medicine. He reports not smoking tobacco or drinking alcohol. At the time of his clinic visit, he was home from college and staying with parents during the coronavirus disease 2019 (COVID-19) pandemic lockdown. He had no family history of diabetes or autoimmune diseases. He is of Ashkenazi Jewish descent.

The pediatrician contacted the endocrine service at 5:00 p.m. on a Thursday night. The pediatrician and endocrinologist mutually agreed that it would be in the best interests of the patient to avoid both an emergency department visit and a hospital stay. The COVID-19 outbreak was straining hospital resources and posing a potential nosocomial infection risk. Furthermore, telehealth resources were in place to safely and effectively manage Z.R.'s needs remotely.

The endocrinologist contacted Z.R. and his parents and conducted an initial telehealth consultation by telephone that evening. The family was informed of the likely diagnosis of type 1 diabetes and agreed to initiate glucose monitoring and insulin administration that evening and that Z.R. would undergo laboratory testing the next morning. The value of blood glucose monitoring and continuous glucose monitoring (CGM) was discussed along with the requirement for insulin therapy. The endocrinologist also reviewed how to recognize and treat hypoglycemia, the basic nutrition principles of matching insulin to carbohydrates, and the potential for a honeymoon period after the initiation of insulin and resolution of glucose toxicity. Through discussion and mutual decision-making, the endocrinologist determined that Z.R. and his parents were willing and capable of learning basic diabetes survival skills remotely.

Z.R. was electronically prescribed diabetes supplies, including basal insulin (degludec), rapid-acting insulin (aspart), pen needles, a blood glucose meter (One-Touch Verio), test strips, urine ketone strips, a flash CGM system (FreeStyle Libre 14-day), and a prefilled glucagon kit (Gvoke). The family picked up these prescriptions at their local pharmacy that night.

Because Z.R. was insulin-naive, the endocrinology calculated an initial total daily insulin dose of 0.4 units/kg, with 50% as basal insulin and the remainder divided among meals. He began a regimen of aspart and degludec insulin, starting with a 1:10 insulin-to-carbohydrate ratio, a correction factor of 1:50, and 15 units of basal insulin at bedtime.

The endocrinology clinic's registered dietitian/certified diabetes care and education specialist was called for briefing on the case and treatment strategy. A telehealth diabetes education consultation was scheduled with the patient and his family and performed that evening. The educator approached the session in several steps:

1. Before the telehealth appointment, the educator advised the family to watch Novo Nordisk's insulin demonstration video and the Abbott FreeStyle Libre instructional video.

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2. After they had viewed the videos, the educator spent 2 hours (from 7:00 to 9:00 p.m. CT) with Z.R. and his parents via telehealth, providing verbal instructions on the use of prandial and basal insulin. Z.R. injected a dose of correction insulin under the educator's supervision and independently administered a dose of basal insulin at bedtime.

3. The family was taught how to use a blood glucose meter and how to insert a glucose sensor and use a CGM system. Z.R. inserted a CGM sensor into his arm and activated his sensor reader.

4. The educator reviewed carbohydrate counting, use of a correction factor, treatment of hypoglycemia and hyperglycemia, testing for ketones, and use of glucagon.

5. A diet recall was performed, and the family was introduced to the concepts of glycemic index of foods and healthy eating patterns.

6. The family demonstrated good coping skills and did not report feeling overwhelmed.

7. Z.R. and his parents were available and agreeable to close follow-up via telephone, secure texting, and video calls. Z.R. was asked to communicate his blood glucose results daily via secure text messaging for further education and adjustments of his doses and dose calculation formulas.

Notable results of laboratory tests obtained the next morning at an outpatient facility were as follows:

- Glucose: 239 mg/dL (normal 65–100)
- Bicarbonate: 22 mEq/L (normal 24–30)
- Anion gap: 17 mEq/L (normal 5–16)
- Blood urea nitrogen: 10 mg/dL (normal 2–25)
- Creatinine: 1.04 mg/dL (normal 0.6–1.3)
- C-peptide: 0.31 ng/mL (normal 0.8–3.85)
- Anti-GAD antibody: 7 IU/mL (normal <5)
- Vitamin D: 24.3 ng/dL (normal 30–100)
- Thyroid-stimulating hormone: 4.14 IU/mL (normal 0.4–4.0)
- Complete blood count: normal
- Aspartate aminotransferase: 11 units/L (normal 0–39)
- Alanine aminotransferase: 8 units/L (normal 0–52)
- Vitamin B12: 506 pg/mL (normal 180–933)
- Total cholesterol: 263 mg/dL (normal <170)
- Triglycerides: 198 mg/dL (normal <100)
- HDL cholesterol: 34 mg/dL (normal >50)
- LDL cholesterol: 189 mg/dL (normal <100)
- Non-HDL cholesterol: 229 mg/dL (normal <120)
- A1C: 12% (normal 4–5.6, prediabetes 5.7–6.4, diabetes ≥6.5)
- Celiac screen: negative

Within a few days, Z.R.'s blood glucose levels were consistently <200 mg/dL, and urine ketones tests, which were initially positive, became negative. The day after he began insulin therapy, he began carbohydrate counting. During follow-up telehealth visits, he increased his knowledge and awareness of the need to match insulin to food, the glycemic index of foods, and hypoglycemia prevention. Gradually, he increased his physical activity, learning to adjust his insulin and food accordingly to avoid hypoglycemia. He downloaded the smartphone application for his flash CGM system, but later migrated to using a Dexcom G6 CGM system instead. Both CGM systems were linked to the clinic Cloud service to facilitate remote review of his data (1).

Follow-up telehealth visits and text messages demonstrated that Z.R. understood how to manage his blood glucose based on CGM data and using dose calculation formulas. Two months later, in June, he left town for his annual summer job as a camp counselor in Wisconsin. He continues to do well.

## Questions

1. Can a diabetes treatment plan be safely and successfully implemented for a newly diagnosed patient in the home setting?

2. Can newly diagnosed patients and their families learn the diabetes self-management skills necessary to develop and maintain reasonable glycemic control without in-person contact with the diabetes team?

3. Would patients, their families, or the diabetes team feel overwhelmed by the burden of new-onset diabetes self-management requirements amid pandemic restrictions?

## Commentary

Our goals in this case were to 1) initiate insulin therapy rapidly; 2) avoid an emergency room visit or hospital admission, if safe and feasible; 3) promptly educate the patient and his family on essential issues related to a new diagnosis of type 1 diabetes; and 4) provide follow-up communication and care, leveraging the convenience and immediacy of telehealth (1–3). The normal vital signs and physical examination by the pediatrician on the day of his initial clinic visit made dehydration, severe diabetic ketoacidosis (DKA), and significant hypokalemia unlikely. Thus, it was decided that having an examination by the endocrinologist and obtaining laboratory testing that night was unlikely to change the management

strategy and that insulin administration was the key intervention needed.

There was some chance that this approach could have led to undetected moderate DKA and subsequent delay in DKA resolution. This risk was balanced against the risk of prolonged delays in insulin administration and inappropriate dosing that can occur in a busy emergency department. If insulin could not be safely delivered that night (i.e., if there was a lack of access to supplies or family inability to administer insulin or check glucose levels) or if there were a change in clinical status (e.g., vomiting, mental status changes, dyspnea, and tachypnea), the patient and family were instructed to present to the emergency department urgently.

Multiple coordinated steps were required to safely manage this patient with newly diagnosed type 1 diabetes while avoiding an emergency department visit or hospital admission. Prompt and effective communications occurred between the referring physician and the endocrinologist, the endocrinologist and the patient and family, the endocrinologist and the diabetes educator, and the educator and the patient and family. The infrastructure to initiate and document the remote telehealth visits were already available to the care team, having been activated a month before in response to the pandemic. The endocrinologist had access to sufficient clinical information to decide that care could be delivered safely via telehealth. There was a willingness of the endocrinologist and diabetes educator to "think outside of the box" and be willing to provide telehealth services after regular clinic hours. The patient and family were receptive to education and remote management and had prompt access to the diabetes supplies they needed. They were able to demonstrate safe and effective use of the glucose meter and CGM system and to begin injecting insulin that evening, first with a supervised correction dose of rapid-acting insulin and later with a basal insulin dose at bedtime, independently. Finally, there was prompt access to laboratory services the next day.

The laboratory studies confirmed the absence of dehydration and overt DKA. The slightly low bicarbonate and positive urine ketones indicated likely ketonemia and that DKA could have been imminent without prompt initiation of insulin. A serum β-hydroxybutyrate level was not checked. The diagnosis of type 1 diabetes was confirmed with the positive anti-GAD antibody test result. We considered the off-label addition of verapamil for β-cell preservation (4). Although studies are

limited, verapamil is inexpensive, safe, well tolerated, and, if effective in preserving β-cell mass with new-onset diabetes, clinically valuable. We did not initiate it initially, as we were focusing on basic survival skills.

We recognize that some patients will have more psychosocial and health literacy barriers than this patient faced. This reinforces the need for a robust, team-based, individualized, and flexible longitudinal care plan based on best practices. Ideally, follow-up care can be multimodal and include traditional in-person visits (ideally sooner rather than later in the clinical course to be able to perform an examination and facilitate relationship-building), phone calls, secure texting, video visits, remote monitoring, and use of asynchronous education and management platforms. In our case, we anticipated an up-front need for frequent monitoring, insulin titration, and communication within the first days and weeks. Most patients transition rapidly to routine follow-up care intervals successfully. In our experience, non-office–based care is generally convenient, efficient, effective, safe, and supported by patient satisfaction reports.

The use of telehealth services to avoid emergency department management of DKA is not unique (5,6). We believe our experience has relevance beyond the exceptional circumstances of the COVID-19 pandemic. More mundane indications for telehealth include patient convenience and preference (when it is safe to omit a direct physical examination), consideration of barriers for patients presenting to in-person facilities (such as lack of transportation), travel distance, and time constraints (such as related to work, child care, or study commitments). Telehealth may also be helpful during rare, unpredictable events such as snowstorms or other extreme weather conditions.

Additionally, the national shortage of clinical endocrinologists (7) in the face of the obesity and type 2 diabetes pandemics can create delays in access to endocrinology care and demands innovation in care delivery beyond care of patients with type 1 diabetes and beyond simply the use of telehealth services. We believe health care innovation and care provision by members of a diverse multidisciplinary team (e.g., dietitians, diabetes educators, health coaches, exercise physiologists and trainers, mental health providers, and clinical pharmacists) are also important parts of the solution.

Telehealth is augmented by additional technology solutions, including asynchronous education, virtual reality

technology, smart-phone and computer-based solutions (such as insulin-dosing algorithms), smart devices, continuous glucose monitoring with remote data-sharing, secure texting (8), and video-based teaching tools (9). If this approach to a low-volume but high-acuity situation is to be generalizable, team members will need to be available after hours, and validated clinical risk assessment tools and triage algorithms must be applied (10). Contraindications to the use of telehealth should be defined and applied consistently and may include a need for an in-person examination, concerning vital signs, strong patient preference, inability to effectively educate and manage remotely, and a need for urgent laboratory testing. Suitable reimbursement will be required to support the long-term viability of telehealth services.

## Clinical Pearls

- Complex clinical interventions for managing a newly diagnosed person with type 1 diabetes can be performed via telehealth with a collaborative primary care provider, diabetes specialty team, and supportive family.
- Diabetes self-management skills can be taught and learned remotely using on-demand video demonstrations and real-life examples in the home environment.
- Frequent text messages and touch points provide feedback in the patient's environment that foster real-world modifications to expedite an effective management plan.
- A dedicated diabetes team improves patient care and outcomes in such cases.
- Telehealth and related technologies (i.e., remote monitoring, secure texting, structured telephone support, and asynchronous video- and application-based education) have the potential to improve the efficiency of care, even in high-acuity situations, with suitable and robust safeguards.

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