



# Telehealth for the Management of Diabetes in Pregnancy

Noelia M. Zork<sup>1</sup>

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## Abstract

**Purpose of Review** Telehealth initiatives are becoming ubiquitous in clinical practice and can be a useful tool in the management of diabetes in pregnancy. The purpose of this review is to summarize new techniques in telemedicine delivery and offer details on how to leverage telehealth in delivering care to pregnant women with diabetes.

**Recent Findings** Using mobile phone technology to collect glucose values in women with gestational diabetes has been found to be beneficial by increasing the amount of glucose data available for interpretation. Remote patient monitoring in non-pregnant people with type 2 diabetes has shown a modest improvement in glucose control. In pregnant women with diabetes, the use of remote patient monitoring does not appear to improve outcomes but can decrease in-office visits and lower healthcare costs. However, telehealth may not be the only solution to helping patients with diabetes in pregnancy who have difficulty engaging in their care.

**Summary** Telehealth affords improvements in convenience, efficiency, and frequency of communication with healthcare professionals, and the amount of data available to patients and providers alike, yielding the potential for better outcomes when telehealth modalities are adopted.

## Introduction

Diabetes or hyperglycemia in pregnancy affects 1 out of 6 live births worldwide [1]. Women with pre-gestational diabetes (type 1 and type 2 diabetes) make up only 16% of these cases, and the remaining 84% have gestational diabetes mellitus (GDM). GDM complicates up to 10% [2] of pregnancies in the USA. In certain high-risk populations, the rates of GDM can be as high as 17%. Over time, the prevalence of GDM has been increasing in parallel with the rising rates of obesity in the USA and the advancing age of motherhood [3]. The complications of diabetes in pregnancy for the mother and baby are significant and include pregnancy-induced hypertension, c-section, cholestasis, preterm delivery, macrosomia, shoulder dystocia, birth injury, neonatal hypoglycemia, and hyperbilirubinemia [4–6]. Women with type 1 and type 2 diabetes have the added risk of congenital anomalies and have worse perinatal outcomes compared to

the general population, having up to a fourfold increase in the rate of perinatal mortality [7]. The diagnosis of GDM also has implications for the long-term health of the newborn and the mother. More recent data show an increased risk for obesity, impaired glucose intolerance, vascular disorders, [8–11] and even neurodevelopmental abnormalities in the offspring [12, 13]. And mothers with GDM are 7.4 times more likely to develop type 2 diabetes and are at increased risk for future cardiovascular disease compared to women with normoglycemic pregnancies [14].

The management of diabetes in pregnancy includes intensive glucose monitoring, either by self-monitoring of blood glucose (SMBG) or with a continuous glucose monitor, and dietary counseling [15]. Glucose levels and meal logs are usually reviewed weekly and the need for medication is determined. This management continues until delivery of the baby at which point the patient either stops checking her blood glucose levels altogether—as in the case of GDM—or continues to manage her diabetes but not as intensely, as in the cases of women with pre-gestational diabetes.

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✉ Noelia M. Zork  
nmz2110@cumc.columbia.edu

<sup>1</sup> Columbia University Irving Medical Center, New York, NY, USA

## Telehealth

Telehealth has been proposed as a helpful tool in managing patients with diabetes. Education and counseling are the mainstays of diabetes management in pregnancy, which lends itself well to telemedicine modalities. With the advent of the COVID-19 pandemic, practices around the world have integrated telehealth initiatives in order to provide medical care [16]. Many practices will retain most of the telehealth initiatives that were born out of the pandemic.

*Telehealth* is an umbrella term defined by the National Consortium of Telehealth Resource Centers as “a collection of means or methods for enhancing the health care, public health, and health education delivery and support using telecommunications technologies” [17]. Telehealth includes remote patient monitoring of glucose levels and the use of smartphone applications. *Telemedicine* falls under telehealth and refers to the traditional clinical assessment and monitoring that are delivered using remote communication technology [18•]. Telemedicine can be as simple as reviewing lab results with a patient over the phone or conducting a video visit.

Patients’ satisfaction is overall high when telemedicine is utilized as it amounts to less time spent traveling to appointments or leaving work [19]. Although telemedicine has not been thoroughly studied in pregnancy, trials utilizing home measurements of vitals with virtual prenatal care visits reported that participating patients had a greater sense of control, confidence, and reassurance [20••]. The ability to attend visits virtually may also aid women who otherwise may not be able to come to their visits due to childcare responsibilities.

## Telehealth and Diabetes in Pregnancy

In women with diabetes in pregnancy, daily SMBG at least four times a day is recommended as this level of intensive monitoring has been shown to improve outcomes compared to weekly in-office monitoring [21]. Recording blood glucose levels multiple times a day is time-consuming for patients. Compliance can prove to be difficult for some and patients fabricate data instead. One study reported that 22% of women with GDM fabricate their glucose levels [22].

Cell phone-internet technology has been proposed as a way to improve compliance with SBMG and eliminate inaccurate data that can accompany patient-reported readings. A group in Hawaii reported that using this technology improved the collection of glucose values in women

with GDM [23]. In this randomized controlled cross-over study, women were randomized to usual reporting (control group) versus cell phone–based reporting (intervention group) for 3 weeks, then switched to the opposite method for another 3 weeks. The usual reporting method involved writing their blood sugars down on paper and dictating the values on a voicemail system that was monitored once a week by nurses, who would record the values on a log and review them with the physicians. Recommendations were made to the women over the phone. In the intervention group, women were given OneTouch glucometers that communicated via Bluetooth to an application on smartphones that were provided. The data were uploaded from the glucometers to the phone application and thus to a website where the data could be reviewed by both the patient and the provider at any time. Women in this group also received automatic reminder texts. For women who used their cell phones to upload their data, 91.7% of the expected data was obtained vs 87.6% with the voicemail method ( $P=0.048$ ). Satisfaction was much higher in the women who used the cell phone technology with 68.9% preferring this method vs 24.3% preferring the voicemail method.

One step beyond simply obtaining the glucose values is having the ability to act on that information to expedite clinical care. Remote patient monitoring (RPM), another telehealth modality, uses digital technologies to collect a patient’s health data while they are home (e.g., glucose levels, blood pressure, weight, heart rate) and transmit the data to healthcare providers in another location [24]. One such example is the linking of continuous glucose monitors (CGM) to a cloud-based system that allows the practitioner to have 24-h access to the patient’s glucose levels. The practitioner can access these data and communicate their recommendations to the patient at any time. A systematic review and meta-analysis of systematic reviews of randomized controlled trials showed a modest improvement in HbA1c levels in people with type 2 diabetes managed with RPM [25]. The largest effect size was noted in patients who received feedback via telephone calls from their providers, followed by provider messaging (e.g., electronic mail, texting, patient portal messages), and then automated messaging [25].

One of the limitations of RPM is the difficulty in providing real-time feedback and an increased workload as greater amounts of data are generated. A more complex version of RPM involves a 3<sup>rd</sup> party, usually a registered nurse, who monitors the incoming data and follows specific care protocols and escalation pathways to make recommendations in response to the uploaded information. Providers are updated regularly but become acutely involved only according to the escalation pathways. Because much of diabetes management is numerically based and can be protocolized, this 3<sup>rd</sup> party could be a computer. Using clinical decision

support systems, a group in Spain developed the SineDie© application which accesses uploaded glucose data from the glucometer and instantly makes recommendations for treatment in women with gestational diabetes based on uploaded values. If insulin is needed, the provider is notified. In their randomized controlled trial in 90 women with gestational diabetes, use of SineDie© resulted in a 88.6% decrease in in-person visits and a 27.4% decrease in time spent by the providers evaluating patient information compared to usual management [26]. Importantly, the application detected 100% of the patients who required insulin therapy. Clinical decision support systems can automatically imitate the decision-making ability of an experienced provider, thus saving that provider time.

There is very limited data on the efficacy of RPM in women with GDM. One randomized controlled trial from Canada aimed to assess the cost-effectiveness of RPM in this population [27••]. Women who were randomized to RPM were instructed to upload their blood glucose levels into a web-based portal that they could access on their phone, tablet, or computer. Automatic or personalized feedback was provided through the portal. When comparing RPM to usual care, both groups had similar rates of hypo- and hyperglycemia and there was no difference in the mean plasma glucose levels. There was no difference in maternal and neonatal outcomes. The group managed with RPM had a 56% decrease in in-person visits but nursing interventions (mostly e-mail and phone calls) were tenfold higher. RPM appeared to be cost-effective despite the increased nursing time needed for follow-ups, saving 167.75 CAN\$ per patient.

## Our Experience with Telehealth in Pregnant Women with Diabetes

At our institution, we employ a variety of telehealth modalities. We have been able to leverage Epic, our electronic medical record system, to provide care virtually. For women with gestational diabetes mellitus or type 2 diabetes, the appropriate testing supplies are sent to their pharmacy and diabetes self-management education is provided by a certified diabetes educator through a virtual visit conducted over Zoom. The use of Zoom also allows for other family members who may not be with the patient to join the consultation. Diabetes educational materials are e-mailed to the patient as additional resources for them to review independently. Patients are also provided with a virtual visit with a registered dietician. Patients may use a paper log or a phone application that creates a report to document their blood glucose values. Either the paper log or a report is emailed on a weekly basis to the diabetes educator for review. Patients who prefer to use their phones can have a feature activated in the MyChart smartphone application (powered by Epic) to enter their blood glucose values

into the application. Because the application is linked to our electronic medical record system, the glucose values are automatically uploaded into the record and are accessible at any time. Once the patient is checking their blood glucose levels, they are scheduled for a telehealth visit with a maternal–fetal medicine specialist to review their glucose log and review the plan of care for the remainder of her pregnancy 1 to 2 weeks after receiving diabetes self-management education and nutrition counseling. E-mail or phone communication is used on a weekly basis to review blood glucose measurements.

If the patient is prescribed insulin and requires education on insulin administration, a video visit is scheduled with the certified diabetes educator or a link to an instructional video is e-mailed to the patient [28]. Virtual visits offer an advantage over an instructional video, as they allow the certified diabetes educator to verify that the patient is administering the insulin correctly. We find that the instructional video is better suited for patients with experience injecting medications, like those that required in vitro fertilization.

Patients who require more frequent follow-ups and closer surveillance are enrolled into RPM through Philips Healthcare. In this program, patients are mailed a Philips mini-tablet with an accessory that connects to their glucometer. This accessory transmits the glucose data into the tablet via Bluetooth. This data is uploaded into a cloud-based platform that is monitored daily by a Philips Healthcare registered nurse. Based on pre-specified thresholds, if the patient is hypo- or hyperglycemic or has 3 days of glucose levels above goal, the nurse will call the patient to provide feedback and education. The nurse also alerts the provider so that treatment can be initiated or altered as needed. This system has been integrated into Epic so that the blood glucose levels are in the medical record. The tablet has video capability and thus can be used for insulin teaching sessions or additional counseling. The tablet releases automatic surveys that contain instructions on glucose management that are administered to patients if their glucose levels are too low or too high. Automatic reminders to check glucose levels and to exercise are also sent through the tablet. And a toll-free phone number on the back of the tablet serves as a resource for patients in case they need immediate assistance with their diabetes.

For women with type 1 diabetes, the majority of patients use CGM and upload their data on a weekly basis to a variety of platforms such as Glooko, Dexcom CLARITY, and Care-Link™ if they are using a Medtronic insulin pump. Data are reviewed at least once a week by their assigned certified diabetes educator.

## Telemedicine and the Patient Struggling with Diabetes

Because diabetes is a disease that affects all aspects of a person's life, many patients have difficulty achieving optimal glucose levels. At least 45% of non-pregnant patients with type 2 diabetes do not achieve adequate glucose control, usually due to poor medication adherence [29]. This can be due to a myriad of barriers that pertains to any person with diabetes and includes inadequate access to education and counseling, high cost of medications, work or home responsibilities, financial stressors, mental health issues, and unaddressed fears or confusion surrounding their medications. Women with gestational diabetes can also experience similar problems and this can lead to dire consequences for both the woman and her developing baby. An Australian study reported that out of 366 women with gestational diabetes that received care in their facility, 21.9% missed at least 2 diabetes-related appointments [30]. Women in this group had a higher rate of insulin usage, higher birthweights, and a greater proportion of macrosomia compared to women who had missed 1 appointment or less [30].

Telemedicine offers the opportunity to engage these patients but has, unfortunately, not been the panacea that we hoped for. In our experience, regardless of what type of telehealth modality is employed, patients who are struggling with their diabetes management require personalized attention by a consistent provider that cannot be outsourced to technology. These patients are often experiencing high levels of diabetes distress, which may be worsened by introducing yet another new “assignment.” And telemedicine can often involve more frequent contacts with healthcare providers, which can also increase the patient's stress levels. For these patients, every effort should be made to meet them where they are in their diabetes journey and set small and achievable goals at regular intervals. With regard to the use of telemedicine, it may be helpful to encourage a gradual adoption of the modality by patients who are already struggling.

The potential ineffectiveness of telemedicine with challenging patients is demonstrated in a study of adolescents with type 1 diabetes [31]. This small trial randomized patients to an internet-based blood glucose monitoring system (Medtronic CareLink) where they uploaded their glucose values on a weekly basis and received weekly feedback versus usual care. Thirty-three percent of the patients in the intervention group were classified as “non-compliant” as they uploaded their blood glucose levels less than 3 times or not at all in a 6-month period. There was no difference in HbA1c levels between the two groups after 6 months. For patients who require more support and assistance with their diabetes, web-based glucose monitoring and communication alone does not appear to be sufficient.

## Conclusion

Telehealth/telemedicine modalities will increasingly become part of the routine delivery of medical care for patients with diabetes. As pregnant women tend to be younger, this group of patients may be more accepting of novel telehealth initiatives. There are certainly questions surrounding state licensure and reimbursement for telehealth activities. And the start-up cost for some of these telehealth programs can prevent its implementation [32]. Regardless, telehealth can increase patient engagement with their care, improve the frequency and efficiency of provider communication, and make essential data more readily available, ultimately improving outcomes.

## Declarations

**Competing Interests** The author declares no competing interests.

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- Of importance
- Of major importance

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