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What Is New in Diabetes Technology?

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ABSTRACT

The purpose of this article is to provide nurse practitioners with an update on the current state of diabetes technology. The update includes information about insulin pumps, also known as continuous subcutaneous insulin infusion and continuous glucose monitoring. In addition, emerging technologies such as mobile diabetes apps and telemedicine will be reviewed. Finally, a brief review of the current state of research and type 1 diabetes will be presented.

Keywords: type 1 diabetes, type 2 diabetes, diabetes self-management, research, technology

Living well with diabetes can feel overwhelming. Food, exercise, and emotional stress can increase or decrease glucose levels. Although insulin has been available since the 1920s and glucose meters from the 1970s, the dream of having a true close-looped *artificial pancreas* is still on the horizon. The purpose of technologies such as glucose sensors and insulin pumps is to offer a variety of tools and options for patients in their efforts to achieve metabolic control. However, it is important to note that these tools may not be for everyone. The American Diabetes Association states that there currently is not enough evidence to support the use of technology for patients who are not on intensive insulin therapy, such as patients with type 2 diabetes using oral agents or on basal insulin.[1] However, Hunt[2] described the benefits of technology such as visual feedback of clinical information that can improve patients' ability to see how diabetes is affected by their behaviors and promotes decision making and problem-solving. Monitoring of self-management behaviors can be motivational and can allow for more frequent contact between patients and health care providers.

The purpose of this article is to update nurse practitioners about the technological advances in devices used for diabetes self-management. The update includes information about technology that patients use in their daily life, such as insulin pumps, also known as continuous subcutaneous insulin infusion, and continuous glucose monitoring (CGM). A recent review article proposed that diabetes technology should be considered through a patient-centered care viewpoint.[3] It is most effective when it is used with the appropriate individual for the right reasons. In addition, diabetes care increasingly involves the Internet and phone-based technology. Therefore, emerging technologies such as mobile diabetes apps and telemedicine will be reviewed. Finally, a brief review of the current state of research related to type 1 diabetes will be presented.

INSULIN PUMPS

Insulin pumps are small devices that provide continuous subcutaneous insulin infusion.[4] They were first invented over 40 years ago and were about the size of a backpack. Since that time, the design of insulin pumps has been vastly improved. They are similar to the size of a pager. Currently, there are several types of insulin pumps used in the United States.

Intensive insulin therapy, whether delivered by injection or pump, requires a fairly high degree of health literacy.[5] Patients need to learn which foods contain carbohydrates and which do not. Then, they need to calculate how much insulin is required to cover that meal or snack.

In general, the initial dose of daily insulin is estimated to be 0.5 to 1.0 U/kg/d.[6] Approximately one half of the daily dose is the basal or background insulin, and the one half is delivered with meals and snacks throughout the day.[4,7] The pump provides a

continuous dose of insulin (basal insulin) every hour. For example, if a patient had been on 24 units of long-acting insulin, such as insulin glargine, the pump would be programmed to deliver 1 unit of short-acting insulin per hour. The patient enters extra insulin to cover carbohydrate intake (boluses).[8]

The trend with technology is to prevent and reduce glucose variability, particularly hypoglycemia.[9] For example, the next generation of insulin pumps communicate with a glucose sensor that has the capability to detect rapid changes in blood glucose levels. It is described as 1 step closer to an automated closed loop system and has received Food and Drug Administration approval. The pump uses sophisticated algorithms and can suspend the basal insulin if a rapid drop in glucose is noted. The device is approved for people age 14 and older and is expected to be released in the spring of 2017. Another upcoming feature will be the release of glucagon from the insulin pump when low blood glucose is detected.

As stated earlier, technology is best used with the right patient for the right reasons. It is important for providers to provide patients with accurate information in order for them to make informed decisions about their care. As with all treatments, insulin pumps have benefits and risks associated with their use.[10,11]

Advantages of Insulin Pump Therapy

Patients using insulin pumps versus multiple daily injections may have fewer severe hypoglycemic events and a lower A1C level. Additional advantages include fewer injections, convenience, ability to adjust basal rates depending on the time of day, and continuous insulin infusion similar to normal pancreatic function. In addition, the pump can be preprogrammed with the carbohydrate ratio and correction factor required for meals and snacks. The patient can enter or send the blood glucose reading to the pump and enter the amount of carbohydrates consumed, and the pump will calculate the food bolus and correction dose. These calculations require a higher degree of math literacy, and this feature can be helpful to some caregivers who are less confident in these skills.

Disadvantages of Insulin Pump Therapy

Patients should also be aware of the disadvantages of insulin pump therapy. These include cost, lack of insurance coverage, ability to insert and manage infusion sets, and risk of diabetic ketoacidosis with pump failure.

CGM

Glucose sensor technology emerged in the mid-1990s. It uses a small wire or needle-type electrode sensor that is inserted under the skin by the patient to measure interstitial glucose. The sensor is connected to a transmitter that sends information via radio-frequency to a small wireless monitor. A consensus conference of the American Association of Clinical Endocrinologists and American College of Endocrinology held in February 2016 advocated expanding the use of CGM in the management of diabetes.[12] Based on their summary, CGM use was shown to improve glucose control and reduce hypoglycemic events. This, in turn, has the potential to reduce the risk of acute and chronic complications of diabetes. Although the long-term benefit of CGM has yet to be determined,[13] a patient with a higher baseline A1C with frequent sensor use may have a significant reduction in A1C and fewer severe hypoglycemic events.[14]

The Food and Drug Administration has approved CGM for monitoring glucose trends and patterns, but it is not approved for the use of a single glucose reading at a specific moment in time, such as a glucometer reading, and therefore should not be used to calculate an insulin dose. Providers need to stress that the sensor needs to be calibrated to actual blood glucose readings 2 to 4 times per day. After the calibrations are completed, the sensor can identify rapidly shifting glucose readings. The ability to see rapid shifts in glucose, trending up or down, can provide useful information and does not require that a patient also be on an insulin pump. Patients who are on multiple daily injections may also use this technology. The sensors can stay in place for approximately 1 week and then should be replaced.

Patients with diabetes believe that the technology replaces glucose testing. Their hope is that the pump and sensor combined will work like an artificial pancreas and that they will not be required to actually poke their fingers anymore. One important role for primary care providers is to emphasize to patients that daily blood glucose testing is still a