

# 21st-Century Diabetes

## Technology Leads the Way

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*Advances in technology continue to improve quality of life for people with diabetes and enhance their ability to perform diabetes self-management activities. Both insulin pumps and continuous glucose monitors (CGMs) are increasingly more popular among students with diabetes. This article will provide school nurses an overview of how insulin pumps and CGMs operate and the implications of their use in the school setting.*

**Keywords:** NDEP school guide; diabetes management; insulin therapies; meters

About 208,000 people younger than 20 years have been diagnosed with diabetes, and the majority of these have type 1 diabetes (Centers for Disease Control and Prevention, 2014). For most, this means multiple daily injections of insulin by syringe or insulin pen. It also means 6 to 10, or more, finger sticks per day to monitor blood glucose.

The good news is technological advances, such as insulin pumps and continuous glucose monitors (CGMs), continue to improve quality of life and enhance the ability to self-manage diabetes. While pumps and CGMs are not prescribed for all children with diabetes, most school nurses will see one or both of these devices in the school setting. The purpose of this article is to provide an overview of insulin pumps and CGMs and discuss implications of these devices in the school setting.

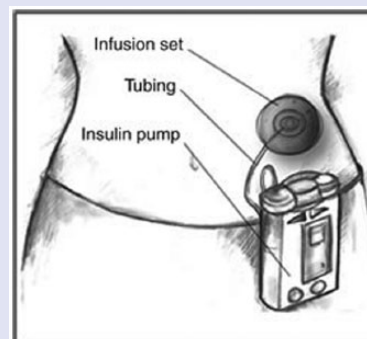
### Insulin Pumps

An insulin pump is a computerized device that is programmed to deliver small, steady doses of rapid-acting insulin throughout the day. Additional doses are given to cover food intake and lower high blood glucose levels. Most pumps now receive blood glucose values directly from the glucose meter, but if not, the student can enter the blood glucose value in order for the pump to calculate bolus doses.

Some insulin pumps look like a pager, and students usually wear it on their waistband or belt or in their pocket. The pump holds a reservoir of insulin attached to an infusion set that leaves a very small needle or plastic cannula (a tiny, flexible plastic tube) under the skin (see Figure 1). Infusion sets are started with a guide needle, then the cannula is left in place, taped with dressing, and the needle is removed. The cannula usually is changed every 2 or 3 days or when glucose levels remain above the target range or ketones are present. Routine site changes are a responsibility of the family and generally are done at home.

Other insulin pumps look like a pod or a patch. These pumps are attached directly to the skin, and a guide needle inserts the cannula under the skin automatically. The student usually wears the pod on his or her abdomen, buttocks, leg, or arm. The pod contains the insulin (there is no tubing). The pod type pump is controlled by a small handheld computer device that is kept nearby. This type of insulin pump also needs to be changed every 2 to 3 days.

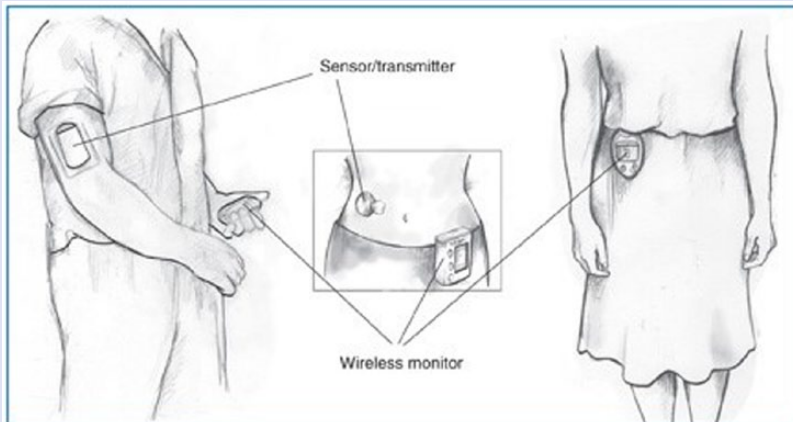
**Figure 1.** Insulin pump with tubing. (National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health)



There are many reasons students and families prefer insulin pump therapy, such as:

- freedom from multiple daily insulin injections;
- ability to preprogram insulin-to-carbohydrate ratios and glucose correction factors to allow easier calculation of doses;
- fine-tuned insulin delivery, similar to what the body does naturally, allowing for adjustments for the differences in insulin sensitivity over the course of 24 hours;
- participation in unplanned physical activity without eating extra food;
- child safeguards such as requiring confirmation prior to insulin delivery to avoid accidental dosing;
- potentially improved glucose control.

**Figure 2.** Continuous glucose monitors. (National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health)



Because insulin pumps only deliver rapid-acting insulin, a pump malfunction or extended disconnection from the pump (longer than 2 hours) increases the student's risk of developing diabetic ketoacidosis (DKA) much more quickly.

School nurses and other trained school personnel who assist with the student's diabetes care tasks should be knowledgeable about and trained in using a student's insulin pump (National Diabetes Education Program, 2016).

### Continuous Glucose Monitors

Continuous glucose monitors record blood glucose levels and trends throughout the day. They are programmed to set off an alarm when glucose levels are too high or too low for the individual student or when blood glucose levels are increasing or decreasing at a rapid rate.

The CGM works through a sensor inserted under the skin that measures interstitial glucose levels (the glucose found in the fluid between cells) at regular intervals and sends the current glucose level wirelessly to a monitor (see Figure 2). The monitor may be part of an insulin pump or a separate device, which may include a smartphone, and is carried or worn by the student in a pocket, a backpack, or a purse.

CGMs do not replace glucose meters, but their use can reduce the number of blood glucose finger sticks required. At a minimum, students with diabetes must still perform blood glucose monitoring daily to calibrate their CGM. In addition, treatment decisions and diabetes care plan adjustments should not be based solely on CGM results. Blood glucose levels should be confirmed with a glucose meter whenever the reading suggests insulin needs to be given or hypoglycemia needs to be treated.

The CGM is a useful tool for identifying trends and can enhance the ability of the student's health care providers to make needed adjustments to the student's diabetes medical management plan (DMMP).

### Integration of Technology

Innovations in insulin pump and CGM technologies are allowing for automation of insulin delivery by the pump. For example, communication between the pump and the CGM has led to a "threshold suspend pump" feature. This feature allows for the automatic cessation of insulin delivery from the pump when a preset low blood glucose threshold is detected by the CGM. When this occurs, the pump alarms and stops insulin delivery for 2 hours unless the user manually restarts insulin delivery. Some

CGMs can transmit data remotely to multiple devices at the same time. The school nurse, trained school personnel, the student's health care providers, as well as the parents/guardian can have access to the CGM data and alarms in real time at locations remote from the student.

### Implications for the School Nurse

Many students will be able to handle all or almost all of their nonemergency diabetes care tasks by themselves. Others, because of age, developmental level, inexperience, or issues with adherence to their diabetes regimen, will need help from the school nurse and trained school personnel.

All students with diabetes will need help during an emergency, which may happen at any time. The school nurse and school personnel need to be prepared to provide diabetes care at school and at all school-sponsored activities in which a student with diabetes participates (National Diabetes Education Program, 2016).

For students using insulin pumps or CGMs, the DMMP and Individualized Health Care Plan (IHP) should include device-specific information about:

- glucose monitoring, insulin administration, treatment of hypoglycemia and hyperglycemia, alarm settings, and required responses to alarms;
- supplies needed and where they will be kept;
- use of smartphone, school phone, CGM, or computer to log data and/or notify school nurse or parents/guardian about glucose levels;
- list of trained school personnel and the diabetes care tasks they will perform.

The plan should address unique concerns related to these devices. For example, if a student uses an insulin pump, the hyperglycemia care plan will specify when to check if the pump is connected properly, and when to change the pump site and inject insulin by

syringe or insulin pen. If a student uses a CGM, the hypoglycemia care plan should include a requirement to check blood glucose with a glucose meter before treating rather than determining treatment based solely on a CGM value.

## Resources

The National Diabetes Education Program has recently updated *Helping the Student with Diabetes Succeed: A Guide for School Personnel* ([www.ndep.nih.gov/schoolguide](http://www.ndep.nih.gov/schoolguide)). This comprehensive resource for the school setting includes a thorough overview on diabetes care, including information about insulin

pumps and CGM, and actions for various school personnel. It also includes an overview of applicable federal laws and samples of a DMMP, IHP, and emergency care plans for hypoglycemia and hyperglycemia. School nurses can access the tools and information on an ongoing basis to meet the needs of students with diabetes and ensure other school personnel are trained, as applicable. ■

## References

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*the United States, 2014*. Atlanta, GA: U.S. Department of Health and Human Services.

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