

Troubleshooting Diabetes Technology

Rosanna Hannum RN, MS, CDCES
Stephanie Carter RN, BSN, CDCES

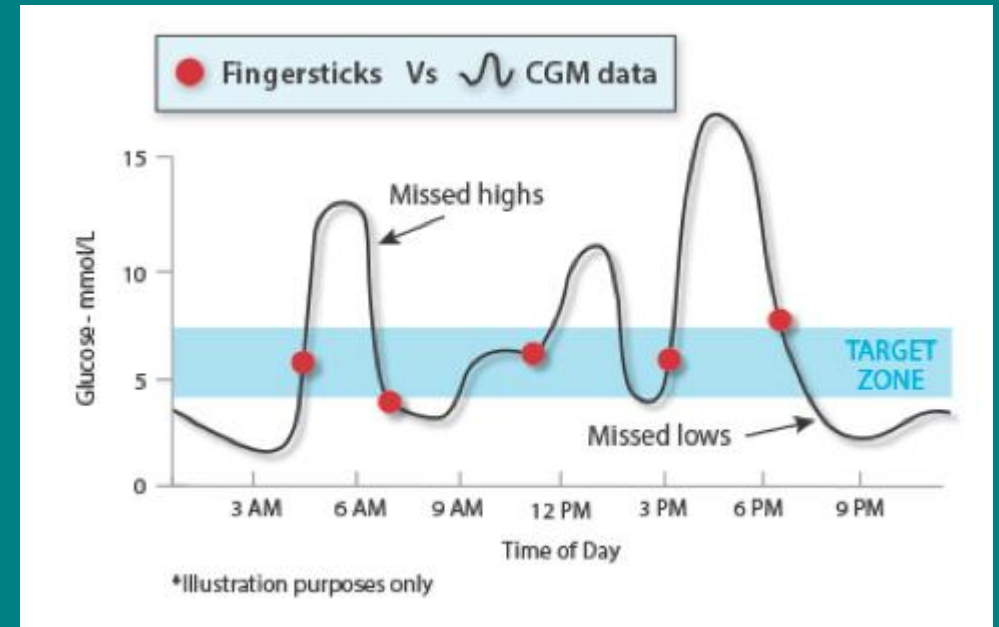
Objectives

- Understand common diabetes technologies used in children with diabetes
- Recognize frequent issues and errors in insulin pumps and continuous glucose monitoring systems (CGM).
- Apply practical troubleshooting strategies.
- Know when to escalate issues or contact device support.

Continuous Glucose Monitoring Systems (CGM)

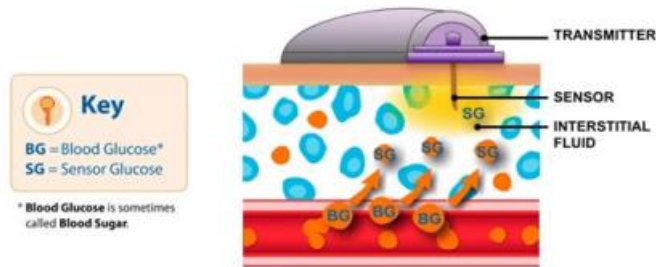
Benefits of CGM

- Continuous updates every few minutes.
- Alerts for highs and lows, helping reduce or prevent emergencies like hypoglycemia.
- Reveals patterns and trends in glucose fluctuation.
- Shows how lifestyle factors like sleep and stress can affect glucose levels.
- Can make diabetes management more convenient and less painful.
- Reduced A1C levels and improved overall glucose management



Features of CGM Systems

- “Real time” glucose values are measured every 1-5 minutes from the interstitial fluid space
- Data is viewed on a display device or a mobile phone using a compatible app.
- Trend arrows indicate where glucose is now and where it will trending in the next 30-60 minutes.
- Customized alerts and notifications allow for more prompt attention of high or low glucose levels.
- Many CGMs allow users to share their glucose data with family members, friends, or healthcare providers, creating a safety net and facilitating communication
- Some CGMs can connect to insulin pumps, enabling automated insulin delivery based on glucose trends and levels. This can help reduce the burden of manual insulin adjustment



What do the Trend Arrows Mean?

- ❑ Visual indicators that show the current glucose level AND **how fast and in what direction** the glucose is changing.
- ❑ These arrows help people with diabetes make more informed decisions about insulin, food, and activity.

Trend Arrows and Treatment Decisions

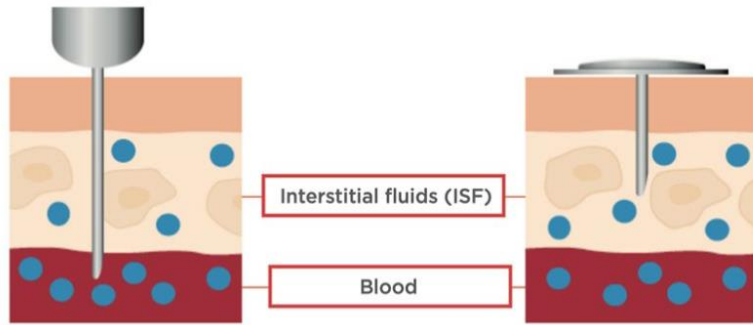
Make diabetes treatment decisions with zero fingersticks and no calibration.*

What do the arrows mean

	Increasing/decreasing less than 1 mg/dL each minute
	Glucose could increase/decrease 30-60 mg/dL in 30 minutes
	Glucose could increase/decrease 60-90 mg/dL in 30 minutes
	Glucose could increase/decrease more than 90 mg/dL in 30 minutes

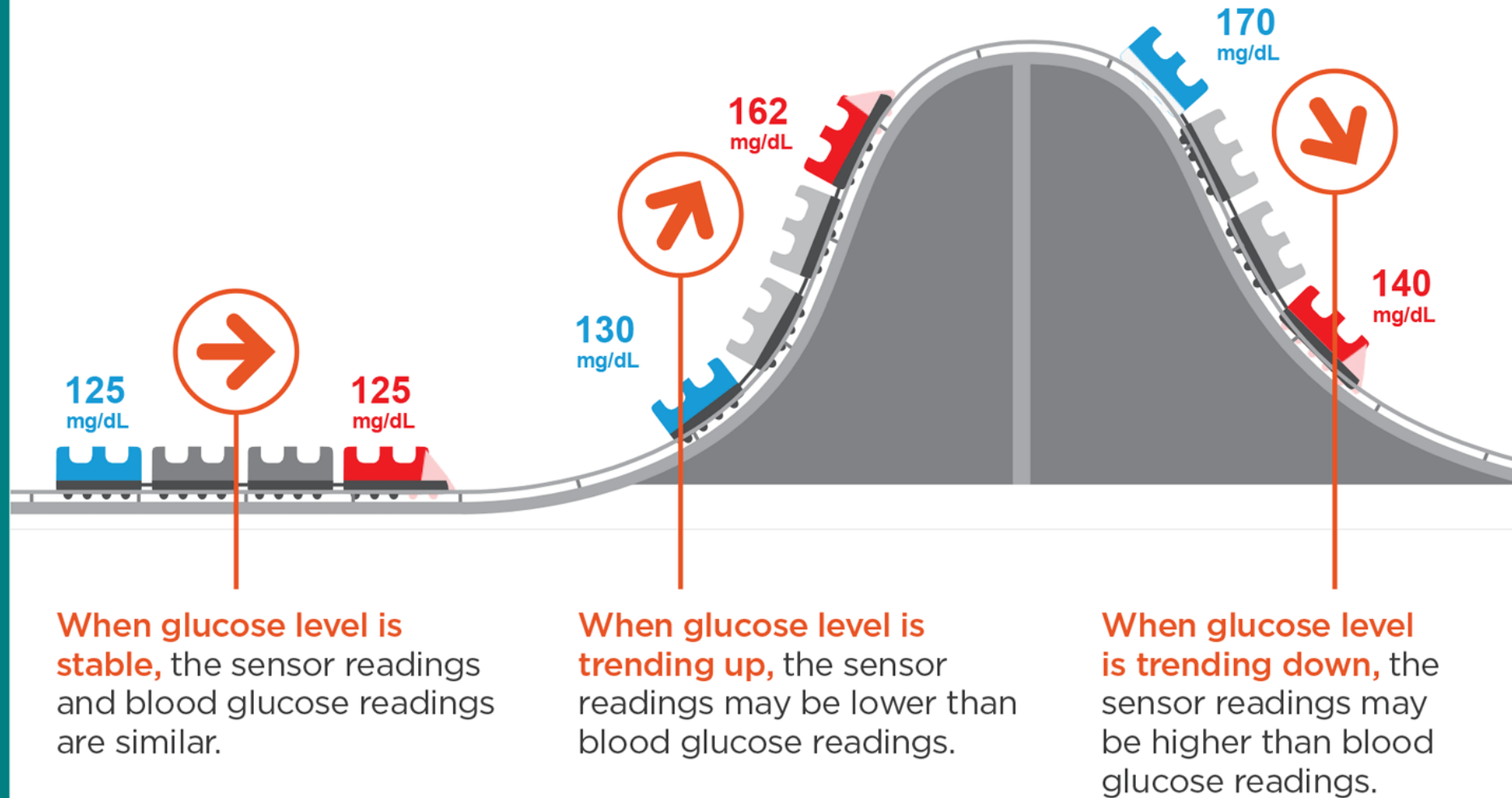
FreeStyle Libre System Trend Arrows		
Reader	Glucose Direction	Change in Glucose
	Rising quickly	Glucose is rising quickly Increasing >2 mg/dL/min or >60 mg/dL in 30 minutes
	Rising	Glucose is rising Increasing 1–2 mg/dL/min or 30–60 mg/dL in 30 minutes
	Changing slowly	Glucose is changing slowly Not increasing/decreasing >1 mg/dL/min
	Falling	Glucose is falling Decreasing 1–2 mg/dL/min or 30–60 mg/dL in 30 minutes
	Falling quickly	Glucose is falling quickly Decreasing >2 mg/dL/min or >60 mg/dL in 30 minutes
No arrow present indicates that the system cannot calculate the velocity and direction of the glucose change.		

Understanding Sensor Accuracy



- Blood glucose and sensor glucose are closely related but not identical.
- Sensor values correlate closely with venous glucose and can be used to make insulin dosing decisions.
- A sensor glucose reading always lags behind a finger prick
- If glucose levels are rising or falling rapidly, then the two readings may be different. This is completely normal and to be expected, particularly after meals, after taking insulin or when you've been exercising.
- When your glucose levels are stable then the two readings may be very similar.
- Calibrating the sensor is not recommended as it calibrated at the factory.

The FreeStyle Libre Sensor measures ISF glucose instead of blood glucose. Here is an example to illustrate the lag between blood glucose and sensor glucose:



Understanding MARD

MARD= Mean Absolute Relative Difference

- *Statistical measurement used to evaluate the accuracy of a CGM device*
- *Compared with a reference glucose value from a venous blood sample*
- *The lower the MARD (%) the greater the accuracy.*
- *Current CGM sensors have MARDs ~ 8-9%*
- *Current Fingerstick Glucometers have MARDs ranging widely-up to 20%*

When to trust or not to trust

Check a finger stick glucose if:

- The sensor value does not match how the person with diabetes is feeling.
- After treating a low blood sugar if unsure if needing to treat again
- The sensor value does not have a directional arrow. Directional arrows show the predicted glucose value in 30-60 minutes. A missing arrow= the sensor is “confused”.

Dexcom G6



- Approved for use in children ages 2 and above.
- 2 piece system with a separate transmitter that clips into the sensor base.
- Pairs with a phone or compatible receiver
- Worn for 10 days. Transmitter changed every 3 months
- 2 hour warm up
- Continuously reads glucose values every 5 minutes
- Paired phone or receiver must be within 20 foot range to receive data
- Compatible with the following pumps: Omnipod 5, Tandem T: Slim and Mobi, and iLet Bionic Pancreas.

Dexcom G7



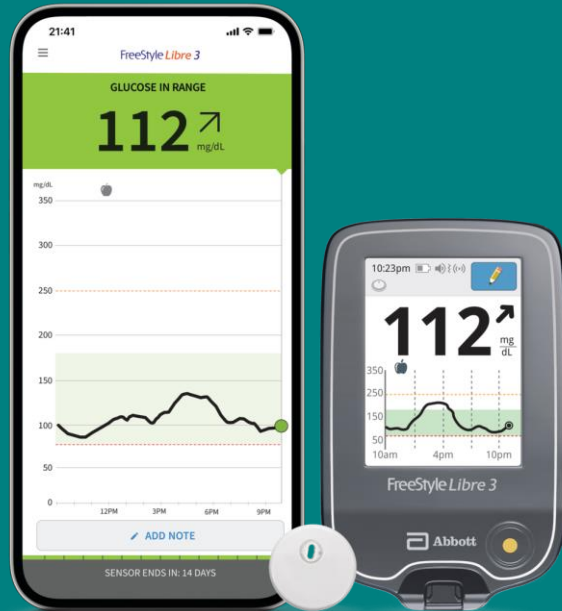
- Approved for use in children ages 2 and above.
- Pairs with a phone or compatible receiver
- Worn for 10 days plus an additional 12 hour “grace” period
- Continuously reads glucose values every 5 minutes
- 30 minute warm up
- Paired phone or receiver must be within 20 foot range to receive data
- Compatible with the following pumps: Omnipod 5, Tandem T:Slim and Mobi, and Ilet Bionic Pancreas.

Freestyle Libre 2 +



- Approved for children 4 years and older
- Pairs with a compatible reader or insulin pump
- Reads values every 1 minute
- Can be worn continuously for up to 14 days.
- Reader or pump must be within a 33 foot range

Freestyle Libre 3 +



- Approved in children ages 2 and above
- Can be worn continuously up to 15 days
- Reads values every 1 minute
- Pairs with a phone app or reader device
- Reader/phone or pump must be within 33 foot range
- Will soon integrate with certain pumps

Medtronic Guardian

- Two generations available (3 and 4)
- Both can be worn continuously for up to 7 days
- Proprietary sensor that is only compatible with the Medtronic 670, 770 and 780 insulin pumps.
- The Guardian 4 is only compatible with the 780 series pump.



Data Sharing

- **Person with diabetes must have mobile app on phone open in order to share data with others.**
- **Invitation to share can be initiated from the mobile app directly**
- **Followers can personalize alerts and notifications**
- **Ensure CGM app and your phone's operating system are updated to the latest versions**

	Dexcom G6 and G7	Freestyle Libre 2+ and 3+	Medtronic	Beta Bionics
Sharing App	Dexcom FOLLOW	Freestyle Libre LINK	Carelink CONNECT	Bionic Circle
# of Followers	10	20	5	10

Why am I not seeing data?

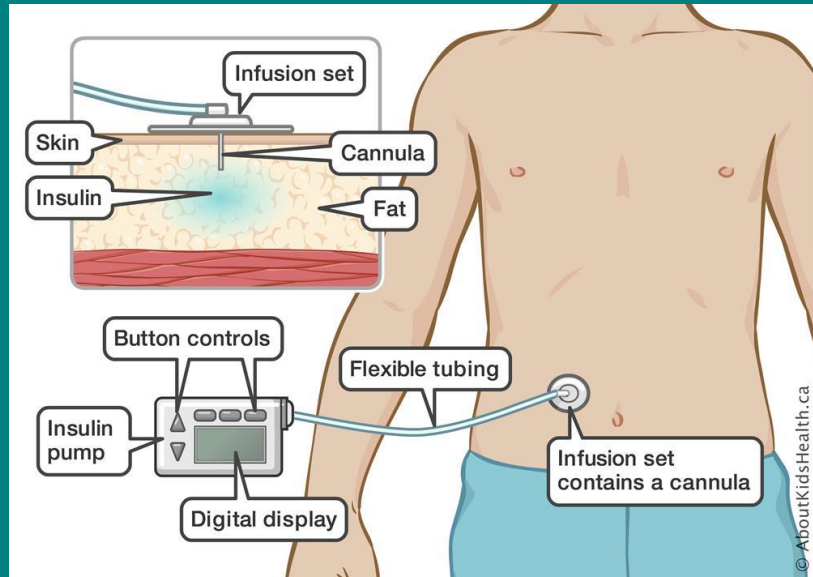
- Ensure both sharer and follower have adequate data or wifi connection
- Ensure sharer has their app open and running in the background
- Ensure Bluetooth is turned “on”
- Ensure the app is updated
- Check for power saving settings.

Common Sensor Issues

	Sensor Accuracy	Signal Loss	Sensor Failure	Adhesion Issues
Causes	Sensor placement Dehydration Frequent calibration	Transmitter battery failure Poor attachment Sensor interference	Failure to warm up Poor sensor placement	Sensor not adhering Irritation Allergic reactions Difficult removal
Troubleshooting	• Ensure sensor is placed correctly (Avoid scars, muscles or bones) • Any bleeding at the insertion site? • Ensure good hydration • Avoid unnecessary calibration • Replace sensor	• Check transmitter battery (G6). • Reattach or replace transmitter. • Close any unnecessary phone apps • Ensure phone battery is charged. • Turn Bluetooth off/on • Avoid low power or battery saving modes • Ensure signal in range	• Avoid pressure during warm up • Ensure Bluetooth is in range • Was it placed correctly? • Is the transmitter attached? • Is the adhesive secure? • Attempt to re-pair sensor with phone or receiver • Force close the app and restart • Replace sensor	• Skin prep • Timing of placement • Barrier wipes • Underlayment • Over patches • Topical corticosteroids • Antiperspirants • Consider a different sensor

Insulin Pumps and AID (Automated Insulin Delivery)

Pump Basics

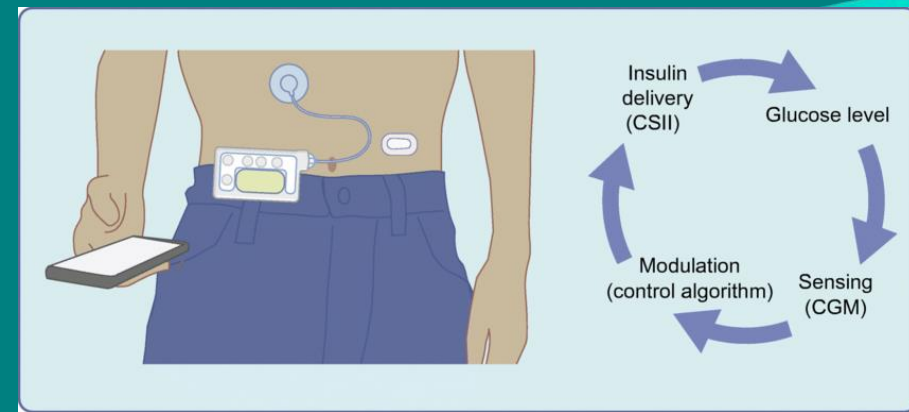


- Used in place of multiple daily injections (MDI) of insulin
- Insulin is delivered through a small cannula/needle that is inserted by patient into the subcutaneous tissue.
- The pump automatically delivers a small, steady flow of insulin 24 hours a day (basal insulin), and the person wearing the device can deliver additional doses of insulin (called boluses) to cover meals and treat high blood sugar as needed
- Uses only rapid acting insulin
- Infusion sets are typically worn up to 3 days (72 hours) 7 day infusion sets will be more prevalent soon.

Typical Settings on the Pump

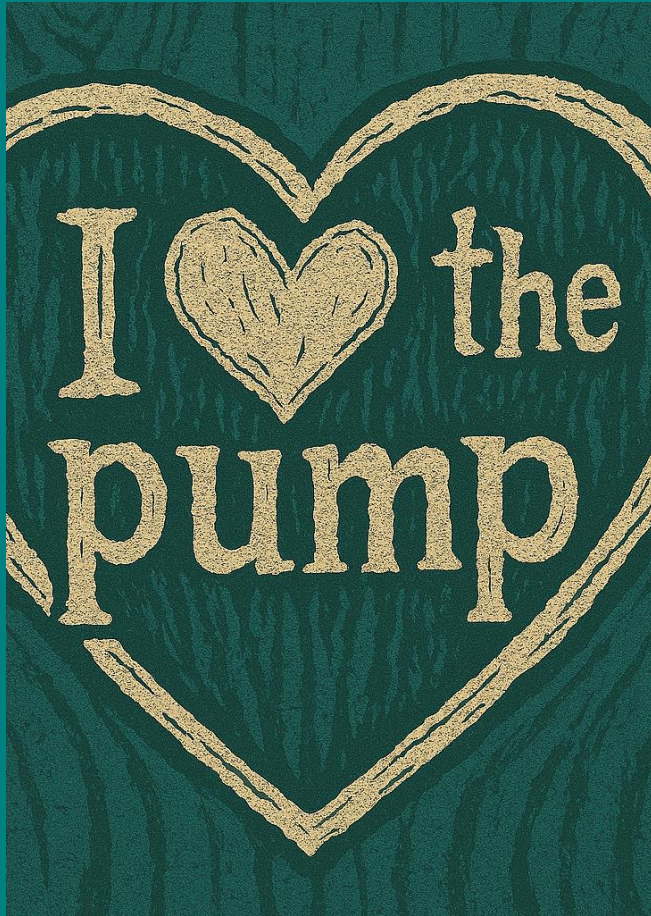
- **Basal Rate** is the rate the insulin is delivered from the pump slowly every hour. It takes the place of the child's long-acting insulin.
- **Bolus** insulin is given for food eaten and/or a correction for a high blood sugar. All of the pumps can calculate a recommended dose based on the correction factor and insulin to carb ratio programmed in the pump settings.
- **Correction factor** how much does 1 unit of insulin lower blood glucose. This will be programmed into the pump to help correctly calculate insulin doses for high blood sugars
- **Blood Sugar Target** is the number we are trying to target when we give correction doses. Each pump has a unique target. Some can be adjusted. Others are fixed.
- **Insulin on Board or Active Insulin** is the amount of time the insulin is active for in the child's body. This time period is used to help calculate high blood sugar correction doses. It prevents over dosing or "insulin stacking" which can result in a low blood sugar after a correction is given.
- **Insulin to Carbohydrate Ratio** is the ratio pump uses to calculate food insulin
- **Exercise Mode** changes target blood sugar and sometimes reduces background insulin

Features of an AID (Automated Insulin Deliver) Hybrid Closed Loop Systems



- Pairs with a CGM which allows for adjustment of insulin delivery automatically depending on **predicted** glucose trends. **Does not work without consistent sensor wear**
- Delivers less insulin when blood sugar is low and more insulin when blood sugar is high. Suspends insulin delivery if glucose is trending below target range.
- Not completely automated and still requires user input for meals and snacks and troubleshooting
- Works best when one does not try to “game” the system (entering manual boluses or entering ghost carbs)

Benefits of Hybrid closed loop systems



- Improved glucose/lower A1c
- Increased time in range (70-180mgdL
- Reduced **diabetes burden** (increased time in happiness)
- More independence and ability for child to be away from their parent
- Less severe low and high blood sugar
- Improved sleep and reported quality of life
- Ability for clinicians to see how much insulin is being delivered to support patients

Common Issues with Insulin Pumps

Problem	Reason	Solution
No insulin delivery- Urgent Issue Will Result in DKA quickly	• Empty insulin reservoir. • Pump is not charged • Infusion set occluded	• Check insulin cartridge • Ensure tubing is free of air bubbles • Keep extra charge cord at school • Call parent to replace infusion set if needed. Give insulin by injection until pump is delivering insulin properly.



Infusion Set Issue Algorithm

Test for ketones with every unexplained blood sugar
>300 mg/dL

Negative

1. Give a **BOLUS** of insulin using the insulin pump and avoid any carbs
2. Monitor CGM Sensor for the next 1-2 hours
3. If sensor glucose is not decreasing, **CHANGE** infusion set or pod.

Positive

1. Give an **INJECTION** of insulin using your pen or syringe.

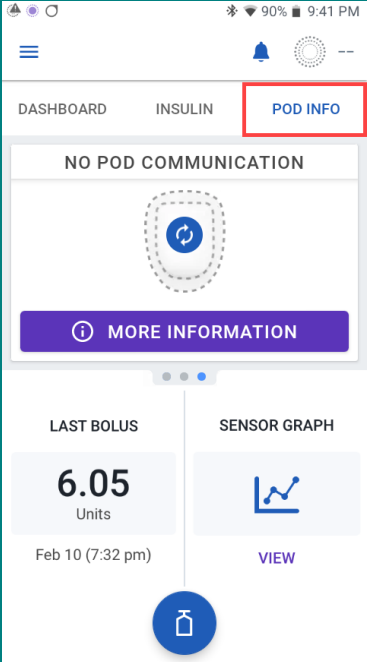
Why? How much?

2. **CHANGE** infusion set
3. Drink water
4. Monitor CGM Sensor for the next hour
5. Test ketones in 3 hours



Common Issues with Insulin Pumps

Problem	Reason	Solution
Data not visible on app	Connection loss between phone app and pump	Refresh the app Ensure Bluetooth is turned “on” Turn Bluetooth off and on again May need to delete app and reinstall to restore connection.



Common Issues with Insulin Pumps

Problem	Reason	Solution
Alarms and Warning Messages	• Low battery • Occlusion or failed delivery • CGM alarms • Low insulin	• Charge the pump • Check infusion set for occlusions • Reconnect CGM if necessary • Ask child to work with healthcare team to revisit alarm settings

Beware of
alarm
fatigue

Alarm Management

- ✓ Pod Failure Alarm
- ✓ Low/high glucose alerts
- ✓ Predictive alerts (e.g., Dexcom Urgent Low Soon)
- ✓ Missed insulin delivery warnings (if missed meals timing set)
- ✓ Occlusion alarms
- ✓ Max delivery alarms
- ✓ Acknowledge and clear the alarm after assessing the issue.
- ✓ Confirm glucose readings with a fingerstick if in doubt
- ✓ When in doubt, contact technical support/ parent

What do I need to know about OMNIPOD 5



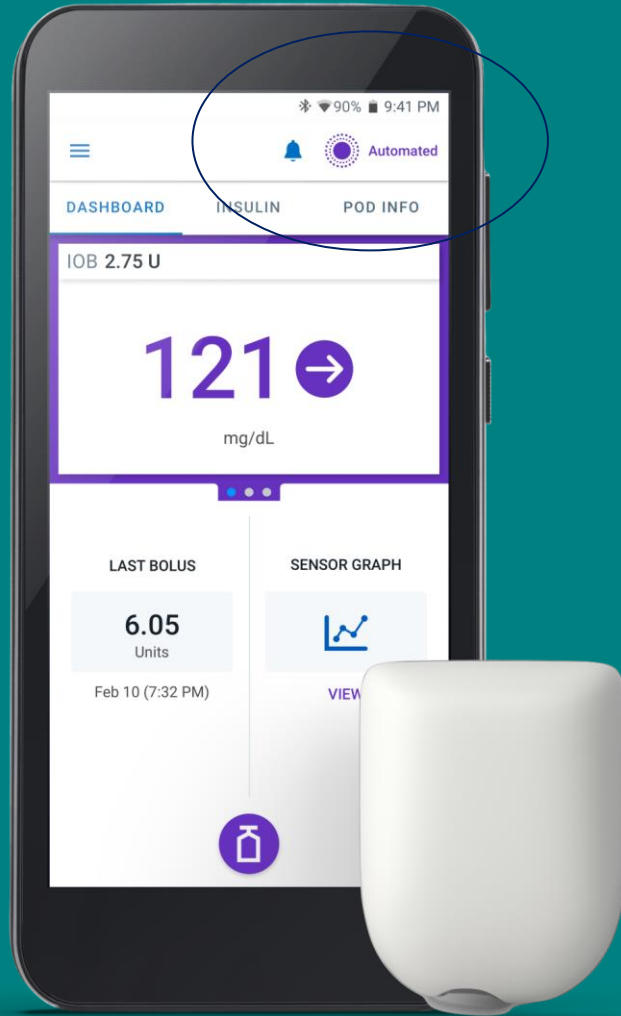
1. Tubeless pump
2. Consists of two components: the Pod and a smartphone-like Controller or phone app.
3. The Pod communicates with the sensor to adjust automatic insulin but receives insulin delivery instructions for boluses from controller.
4. Automatic insertion, decreased user error
5. Pod stays attached for up to 3 days and will stop working after a 6 hour grace period.
6. Waterproof
7. Need a phone to start and stop sensors and to get personalized blood sugar alerts

Consideration of Omnipod 5

Exiting auto mode

Cause: Sensor not communicating with pod, sustained high blood sugar requiring a manual correction

Troubleshooting: Always check that pump is in auto mode



Omnipod will enter Manual Mode:

- If there is a loss of connection with the CGM or the controller app
- The user must use manual mode to pause insulin delivery or make adjustments to settings.

❖ Delivers programmed rates only-does not automatically adjust insulin delivery based on CGM readings.

Omnipod will enter Limited Mode if:

- The sensor is not transmitting data or has expired.
- The sensor is not within range of the pump.
- The pod is changed. This is usually brief while it re-establishes communication with the sensor.

❖ Continues to deliver insulin based on the last known basal rates-does not automatically adjust insulin delivery based on CGM readings.

Why Patients May Choose Omnipod

PROS

- Tubeless
- Can use with Android phones
- Do not need a phone to operate (but need one to start sensors)
- Sleek simple look



CONS

- Algorithm has limitations with minimal settings
- Frequent exits of auto mode if blood sugar are high especially if person misses boluses
- Cannot remove or replace insulin separately from infusion set
- Holds only 200 units

What do I need to know about Tandem T:Slim

1. Tubed pump
2. Utilizes a touchscreen
3. Can be paired with a phone app allowing for easier insulin delivery while keeping pump discreetly secured
4. Consists of three components: the pump, cartridge or reservoir and the infusion set



Why Patients May Choose Tandem Tslim

PROS

- Is fully operational without a phone
- Holds 300 units
- Control IQ+ has been approved in insulin sensitive and insulin resistant patients
- Gives automatic corrections and settings can be adjusted to increase or decrease insulin at certain times

CONS

- Tubing
- Size



What do I need to know about Tandem Mobi



1. Tubed pump that has an ultra short (5cm) tubing option which can be utilized with an adhesive sleeve mimicking a patch pump.
2. Consists of three components: The pump, cartridge/reservoir and infusion set
3. Smaller than the Tandem T:Slim but utilizes the same technology
4. Must be controlled using an **iPhone** smart phone
5. Has a small button on the pump that allows for a “quick” manual bolus delivery.

Why Patients May Choose Tandem Mobi

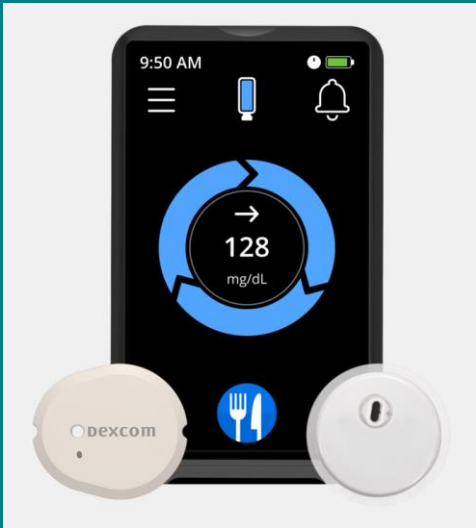
PROS

- Same advanced algorithm as Tslim that allows for personalization
- Have very short tubing and looks more like a patch pump
- Insulin dose increments are very small .001 for basal

CONS

- Requires an iPhone
- Only holds 200 units





What do I need to know about Beta Bionics iLet?

1. Tubed pump
2. Consists of 3 components: pump, reservoir and infusion set
3. Utilizes a touch screen
4. No pre-programmed settings
5. Algorithm uses weight to automate insulin delivery and continuously adapts to the users needs
6. No carbohydrate counting necessary. Users announce meals based on size of the meal (usual, more than usual, less than usual)
7. Must be paired with a CGM at all times.
8. If sensor cannot connect or is lost, user will have to manually enter blood glucose values into the pump every 2 hours. After 48-72 hours the pump stops delivering insulin.

Why Patients May Choose iLet

PROS

- Do not have to carb count but need to have carb awareness
- Simple set up with minimal settings (target blood sugar)
- Adapts with age, change in insulin needs

CONS

- Only holds 200 units
- There is no manual mode and eventually turns off without cgm data
- No exercise mode



Upcoming advancements 2026

- Tubeless infusion set for Mobi
- Libre 3+ integration with pumps
- 7 day infusion sets
- Dual analyte cgm measures glucose and ketones



Back Up Supplies

Keep these at school:

- **Blood Glucose Monitoring**: Glucose meter, test strips, lancets, and alcohol wipes.
- **Insulin**: Insulin (pens or syringes), needles, and alcohol wipes.
- **Emergency Carbohydrates**: Glucose tablets, glucose gel, juice boxes, or other fast-acting carbohydrate sources.
- **Glucagon**: For treating severe low blood sugar (hypoglycemia).
- **Ketone Test Strips**: To monitor for high blood sugar.
- **Treatment for Low Blood Sugar and/or Snacks**: Healthy snacks like crackers, peanut butter, or granola bars for after low blood sugar treatment.

Technical Support

Tandem Diabetes 877- 801-6901

Omnipod (Insulet) 800-591-3455

iLet Beta Bionics 855-745-3800

Dexcom 844-607-8398

Freestyle 855-632-8658

Medtronic 800-646-4633

Additional Resources

American Diabetes Association

- Free CEU-accredited webinars on topics like insulin pumps, CGMs (continuous glucose monitors), and legal protections.
- Includes updated **guidelines** for CGM use in schools, plus a comprehensive guide: *Helping the Student with Diabetes Succeed*.

ADCES (Association of Diabetes Care & Education Specialists)

- Danatech.org
- Online learning and device training

National Association of School Nurses (NASN)

- Includes toolkits on medication administration, early detection, and technology integration.
- Links to a specialized site for diabetes technology education

PantherProgram.com

- Helpful tools and resources for health care professionals working with diabetes technology

Beyondtype1.org (formerly JDRF)

I wonder if the school nurse is missing me today? I haven't seen her yet and it's already 12:30

someecards
user card





THANK YOU