



# What to do when technology fails?

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# Objectives

- Examine basic information related to the “normal” operation of insulin pumps and continuous glucose monitors (CGMs)
- Analyze common causes and symptoms of diabetes technology failure
- Describe appropriate action to mitigate risk when devices fail

# What is an insulin pump?

- Insulin pumps are small computers that are filled with insulin
- The pump pushes insulin under the skin through a small flexible straw that is inserted with a needle and changed every 2-3 days
- Pumps can give very exact insulin doses, and can help give insulin more like a normal pancreas

*But, remember – the pump is only a way to give insulin – A HUMAN must be the one who tells the pump what to do and when*

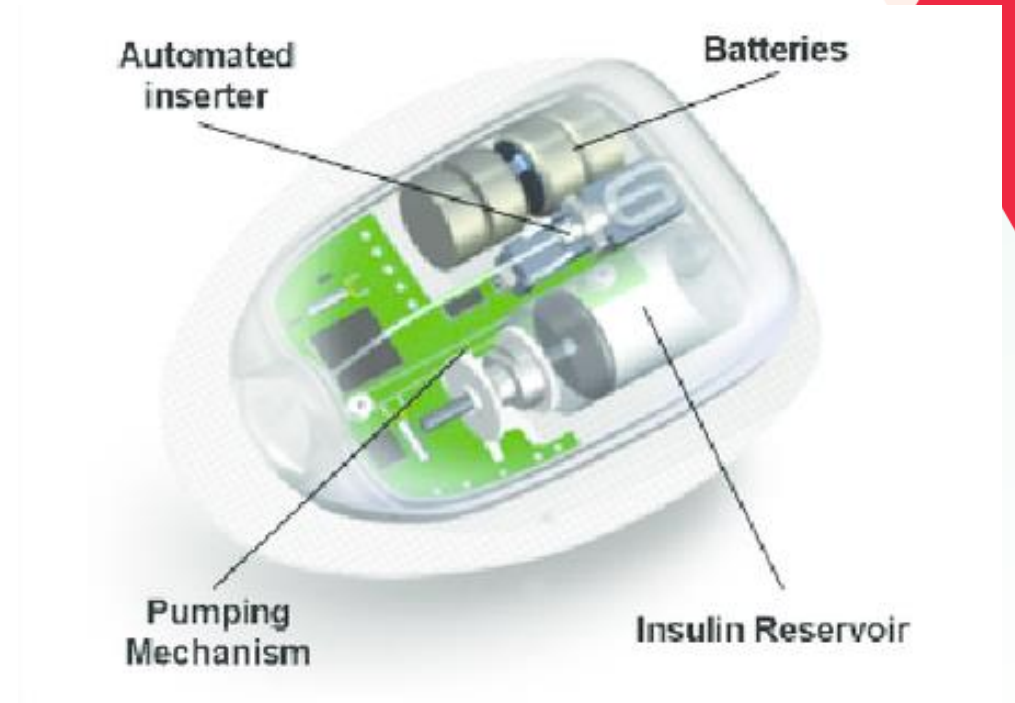
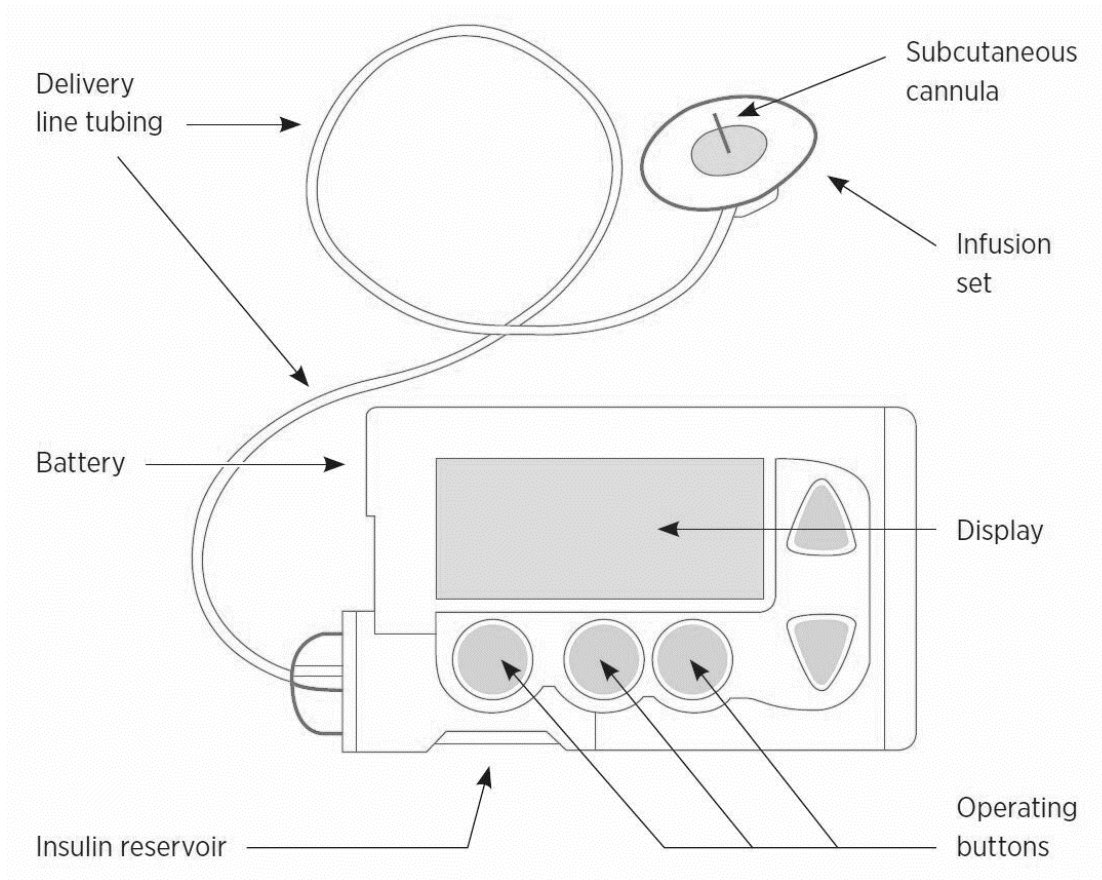
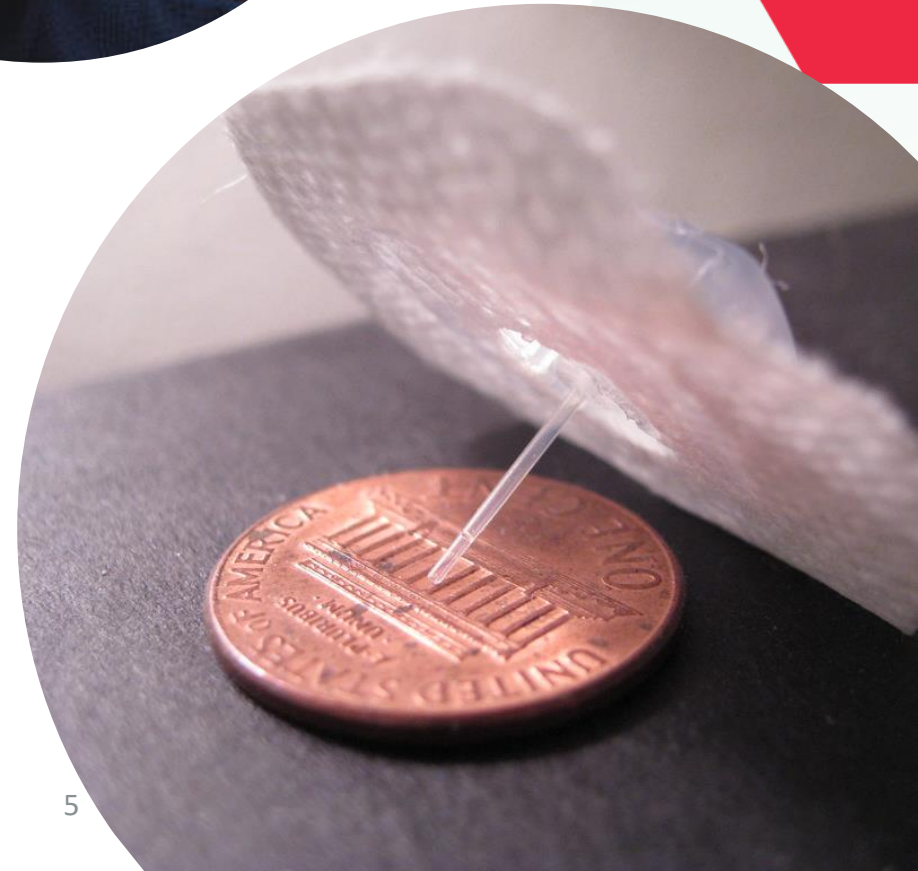
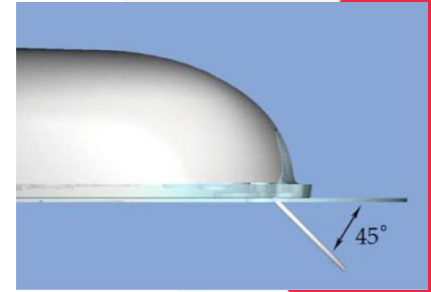
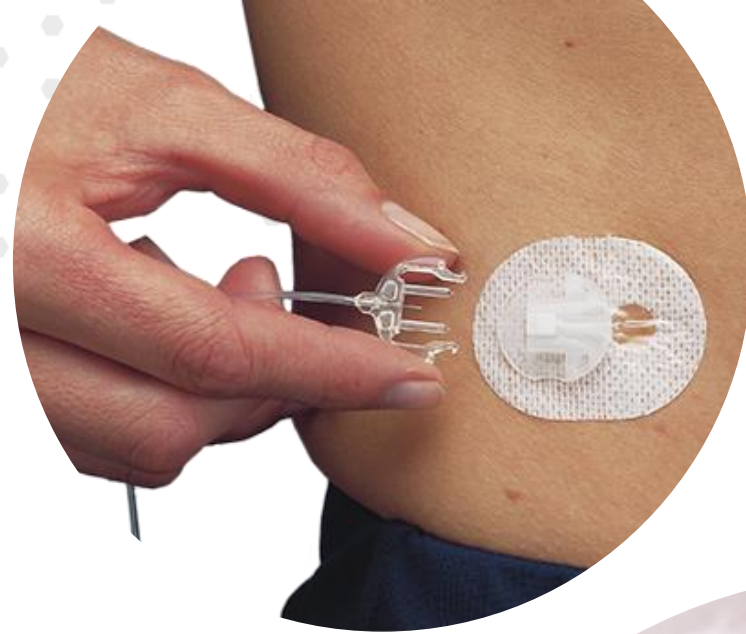


Image: Myomnipod.com

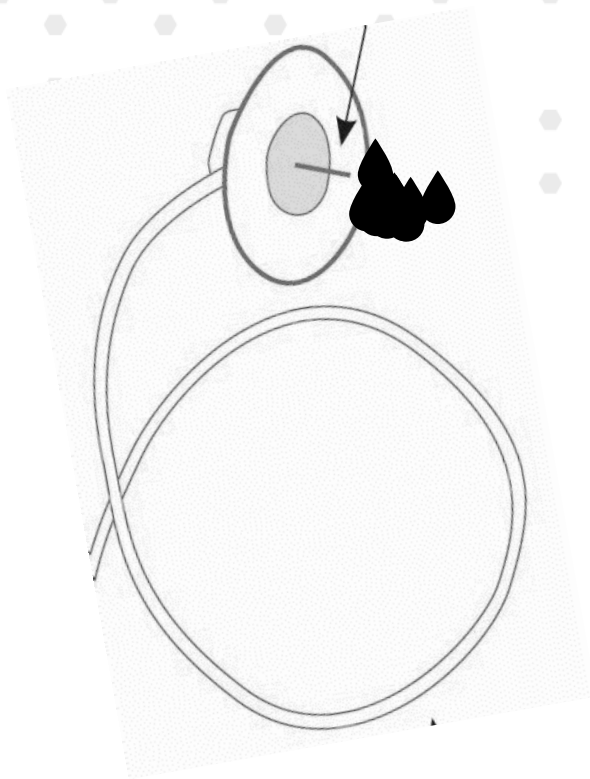
# Infusion Sets

- Small, flexible cannula that is inserted under the skin
- With tubed pumps you can detach from the infusion site and then reconnect
  - *(for showering, or other activities where you want to disconnect from your pump)*

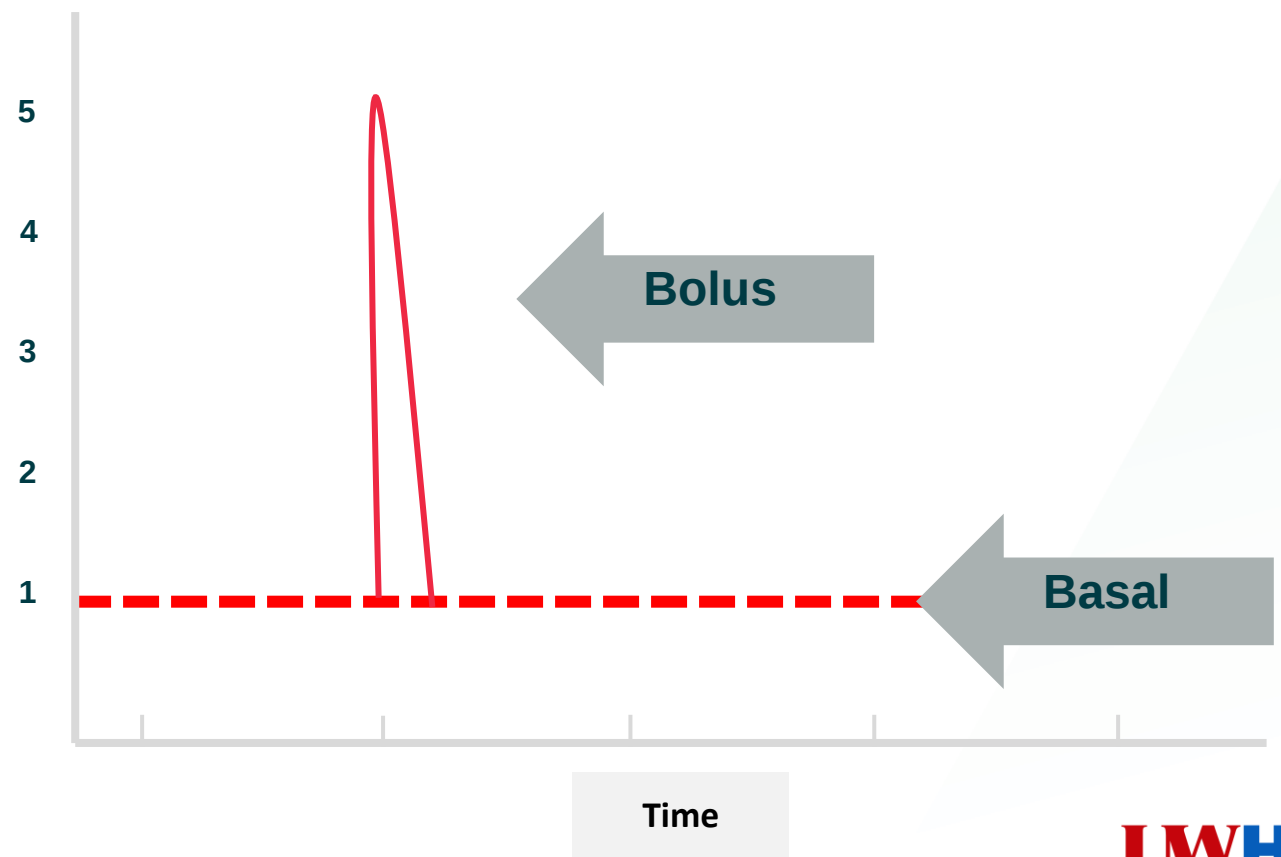


# **Pumps deliver only ONE type of insulin – Rapid- Acting!**

- Fill pump with rapid-acting insulin every 2-3 days
- Administers basal and bolus insulin
- Allows improved dosing flexibility
- Typically, no injected long-acting (basal) insulin is used



Rapid-Acting Insulin (Units)



# Risk with a Pump

- Because there is no injected long-acting insulin working in the body, a child can develop diabetic ketoacidosis (DKA), a life-threatening complication of diabetes, more quickly
- We prevent this with close blood sugar monitoring and taking fast action if something doesn't seem right

# How to prevent DKA?

Have a pump failure plan in place BEFORE the failure

Pumpers should have a way to inject insulin in case of pump failure

Be Suspicious! Stay on the alert for pump failure.

Monitor blood sugars closely

If blood sugars stay high and are not coming down with a pump bolus examine the pump for obvious disconnections or malfunction

Consider checking for ketones

Consider contacting the child's parent/guardian ASAP if you suspect issues

# What are some problems I might need to troubleshoot with a pump?



Cannula (straw) has come out of the skin or is kinked



Tubing is broken or kinked



The pump itself is having a mechanical problem



Problem with insulin absorption – is the site red or inflamed?



Low or no power (batteries running low or pump needs to be charged)



The pump is out of insulin

# What are the symptoms of a pump failure?

- Most commonly a persistent high blood sugar OR an abnormally high spike after a meal
  - Is the insulin getting in??
- Error Screen on Pump
  - Usually only if pump is malfunctioning – very rare to get an occlusion message
- May see or smell insulin
  - But most commonly, you see nothing at all!
- Presence of Ketones
- Symptoms of related to ketone production – not feeling well, upset stomach, vomiting

# How do I handle a pump failure?

- Don't dismiss repeated high glucoses
- Keep pump failure on your radar
- Check for ketones
- In the case of pump failure, parent or guardian must be contacted to help troubleshoot. Steps needed may include:
  - Replace infusion set
  - Give insulin by injection (esp. if ketones are >small)
    - Ensures there is insulin in the body
  - Contact pump company if failure is mechanical

# How urgent is this?

## Less Urgent

- Timing of failure known (infusion set was pulled out) **and** bolus had been recently administered
- Blood glucose high, but ketones **negative to trace**
- Child **able to tolerate PO intake**

May be appropriate to attempt bolus through pump x1, monitor for reduction in glucose

## More Urgent

- Ketones **moderate to large**
- Child with **symptoms of DKA**
- Suspect that pump has not been working for long-period of time
- **Child unable to tolerate PO intake**

**True diabetes emergency.** Insulin should be given by injection and then pump site replaced.

# Health Facts for You



## Problem Solving High Blood Sugars When Using an Insulin Pump

When using an insulin pump, it is important to understand that when insulin flow stops, the blood glucose (sugar) will rise quickly. A sudden high blood glucose could be related to an insulin pump problem.

When the body does not have enough insulin, blood glucose rises quickly. This can lead to diabetic ketoacidosis (DKA). Fat is burned for energy. The breakdown of fat produces ketones which are an acid. When ketones build up in the blood, this is called DKA.

DKA can occur quickly and can be life threatening. For this reason, an **unexpected blood glucose over 250 should never be ignored.**

### Symptoms of DKA

- Nausea, vomiting
- Thirst
- Frequent urination
- Feeling drowsy and having difficulty staying awake
- Weakness
- Stomach pain or cramps
- Shortness of breath
- Fruity taste or odor on the breath
- Dehydration

### Common Causes of High Blood Glucose

- Problem with the infusion set or site. The site may or may not appear red, swollen or be painful.
- Insulin pump reservoir or pod is empty.
- Leaking where tubing or pod connects to the reservoir or the body.
- Infusion set or pod is dislodged or kinked.

### Other Causes

- Illness
- Changes in eating plan or exercise
- Physical stress: injury, pain, infection
- Emotional stress
- Steroid pills or injection
- Missed bolus or under-counting carbohydrates at a meal

If high blood glucose is due to illness, make sure your pump is working correctly and then follow sick day guidelines. Contact your pump company if concerned about pump malfunction or the need for a possible replacement.

### If blood glucose is more than 250 mg/dL two times in a row:

- Determine cause of the high blood glucose.
- Check urine ketones.
- Troubleshoot the pump, check your infusion set and site.
- Follow action plan on the next page.

## What to Do Based on Ketones and Blood Glucose Levels

| If ketones are negative:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | If ketones are positive:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"><li>1. Take a correction bolus using your pump.</li><li>2. Increase fluid intake (8 ounces every hour).<ul style="list-style-type: none"><li>• <b>Children:</b> 1 ounce per year of life up to 7-8 ounces every hour. (example: 4 ounces every hour for a 4-year-old)</li><li>• <b>Adults:</b> 8 ounces every hour</li></ul>Drink plenty of water or non-carbohydrate fluids to prevent dehydration.</li><li>3. Recheck blood glucose in 1-2 hours.</li></ol> <p>If next blood glucose is lower:</p> <ul style="list-style-type: none"><li>• No further action is needed. Continue to monitor blood glucose more closely the rest of the day.</li></ul> <p>If next blood glucose is NOT lower:</p> <ul style="list-style-type: none"><li>• Take a correction bolus of your rapid acting insulin (Humalog®, Novolog® or Apidra®) using a syringe or insulin pen.</li><li>• Change insulin pump infusion set (pod) and site.</li><li>• Test urine ketones again. If urine ketones are moderate to large and/or you have symptoms of DKA, call your doctor or go to urgent care or the emergency room.</li></ul> | <ol style="list-style-type: none"><li>1. Take correction bolus by syringe or insulin pen.</li><li>2. Change pump infusion set (pod) and site.</li><li>3. Increase fluid intake.<ul style="list-style-type: none"><li>• <b>Children:</b> 1 ounce per year of life up to 7-8 ounces every hour. (example: 4 ounces every hour for a 4-year-old)</li><li>• <b>Adults:</b> 8 ounces every hour</li></ul>Drink plenty of water or non-carbohydrate fluids to prevent dehydration.</li><li>4. Recheck blood glucose in 2 hours.</li></ol> <p>If next blood glucose is lower:</p> <ul style="list-style-type: none"><li>• Check blood glucose again in 2 hours to be sure the new set (pod) is working.</li><li>• Continue to check urine ketones every 2 hours until negative.</li><li>• Resume giving correction bolus with the pump.</li><li>• Continue to monitor blood glucose more closely the rest of the day.</li></ul> <p>If next blood glucose is NOT lower:</p> <ul style="list-style-type: none"><li>• Continue to take insulin using your correction scale using a syringe or pen every 2 hours (or your sick day plan as directed). Do this until blood glucose levels start coming down.</li><li>• Test urine ketones every 2 hours until negative.</li><li>• If urine ketones are moderate to large and/or you have symptoms of DKA, call your doctor or go to urgent care or the emergency room.</li></ul> |

Your health care team may have given you this information as part of your care. If so, please use it and call if you have any questions. If this information was not given to you as part of your care, please check with your doctor. This is not medical advice. This is not to be used for diagnosis or treatment of any medical condition. Because each person's health needs are different, you should talk with your doctor or others on your health care team when using this information. If you have an emergency, please call 911. Copyright © 2/2021 University of Wisconsin Hospitals and Clinics Authority. All rights reserved. Produced by the Department of Nursing. HF# 6979

# **What is a continuous glucose monitor (CGM)?**

- A CGM is a system that uses a small, flexible wire inserted under the skin to measure sugar values in the fluid between the cells (interstitial space)
- Interstitial sugar is close to blood sugar most of the time

# Continuous Glucose Monitor Basics

- CGM systems consist of 3 components:
  - Sensor
  - Transmitter
  - Receiver

Dexcom G6



Libre 2



Medtronic Guardian



# What are some problems I might need to troubleshoot with a CGM?



CGM is dislodged or pulled out of skin



No data available on receiver (receiver failure, poor connectivity, WIFI failure)



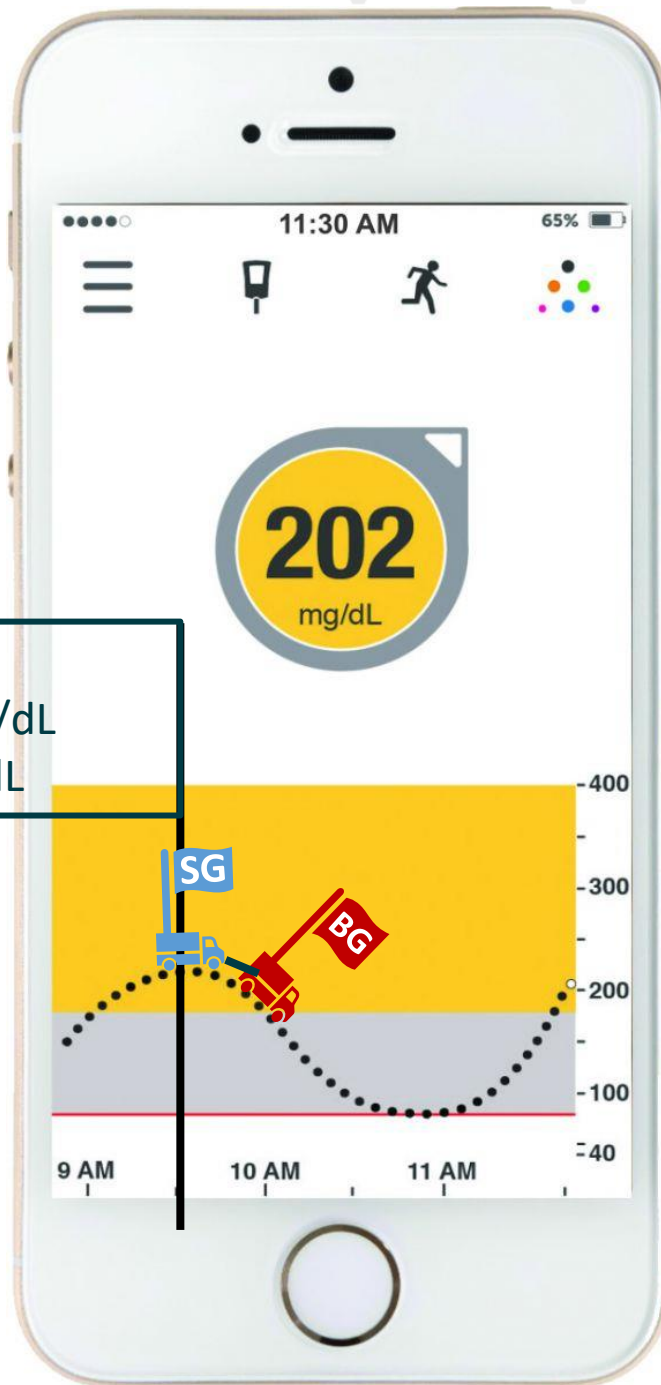
CGM value different than expected/anticipated



Lag time



Adhesion to skin



iPhone Image: Diatribe.com

# What to do if the CGM Fails or is not working?

- Troubleshoot?
  - Ensure that receiver is within 20 feet of sensor/transmitter
  - Is there an issue with phone or receiver (not charged, not connecting to sensor, etc?)
- Monitor blood glucose
  - All kids on CGM should always have a backup glucometer available – plan ahead 😊
  - May need to monitor more often if concerned for low blood sugar with activity
- Other
  - Do parents want to be notified?
  - If just a loss of “shared” data, can child connect to “secure” wifi to prevent gaps in wifi access? Part of 504 Plan?

# When do I need to check a blood sugar?

- CGM not being worn or not working
- CGM reading doesn't seem right based on what has happened or how the child feels
- No arrow displayed with CGM reading
- You think blood sugar might be low or high blood sugar
- Checking after treating a low blood sugar

# Can I trust the CGM?

| G6 - | Meter Value mg/dL | G6 + |
|------|-------------------|------|
| low  | 40                | 60   |
| low  | 50                | 70   |
| 40   | 60                | 80   |
| 50   | 70                | 90   |
| 64   | 80                | 96   |
| 72   | 90                | 108  |
| 80   | 100               | 120  |
| 88   | 110               | 132  |
| 96   | 120               | 144  |
| 104  | 130               | 156  |
| 112  | 140               | 168  |
| 120  | 150               | 180  |
| 128  | 160               | 192  |

| G6 - | Meter Value mg/dL | G6 + |
|------|-------------------|------|
| 232  | 290               | 348  |
| 240  | 300               | 360  |
| 248  | 310               | 372  |
| 256  | 320               | 384  |
| 264  | 330               | 396  |
| 272  | 340               | high |
| 280  | 350               | high |
| 288  | 360               | high |
| 296  | 370               | high |
| 304  | 380               | high |

[Is my Dexcom CGM sensor accurate?](#)

# What about when the pump and sensor work together? (Hybrid Closed Loop Systems)

- If sensor fails, pump will NOT adjust insulin based on CGM readings
- Pump may default to preset basal rates, instead of adjusting up and down based on glucose trends
  - May be at increased risk for hyper- or hypo-glycemia
  - Will not suspend on or before low without sensor data
- Consider Increase frequency of glucose monitoring, esp. with activity or other variables

# Resources

- [Problem Solving High Blood Sugars When Using an Insulin Pump](#)
- [Tandem Diabetes – Troubleshooting your Glucose](#)
- [Dexcom – Is my CGM Accurate?](#)
- [Dexcom – Recommended Phone Settings](#)