Spilling the Tea on Continuous Glucose Monitoring

Elizabeth Bender Roe, DNP, APNP

Pediatric Diabetes

UWHealthKids

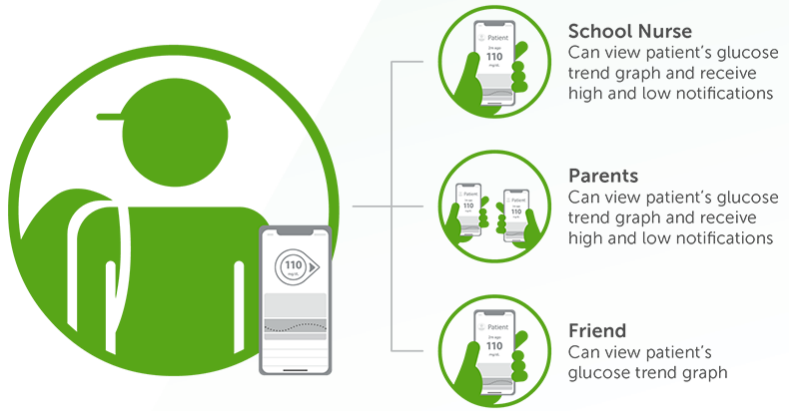
Learning Objectives

1. Define what continuous glucose monitoring is and how it is different from blood sugar monitoring.
2. Explain how to utilize CGM for children in the school setting.
3. Identify how care can be adapted in the school setting.
4. Explain how CGM is used in automated insulin delivery systems.

UWHealthKids

Following at School

- Our team does not routinely recommend school staff “follow” a student who is using a CGM
  - If you are planning to follow a child (with your personal or school issued device) we recommend consulting with your administrators.
- Recommendations for CGM monitoring at School
  - If a CGM alarms during class an adult can assist the child to the office for treatment if needed.
  - Create a plan for times during the day when you will check the cgm (such as before lunch or boarding the bus).



UWHealthKids

Dexcom

10-day wear

G6

G7 – coming soon!

https://provider.dexcom.com/products/dexcom-g6-personal-cgm-system

Libre

14-day wear

Libre 2

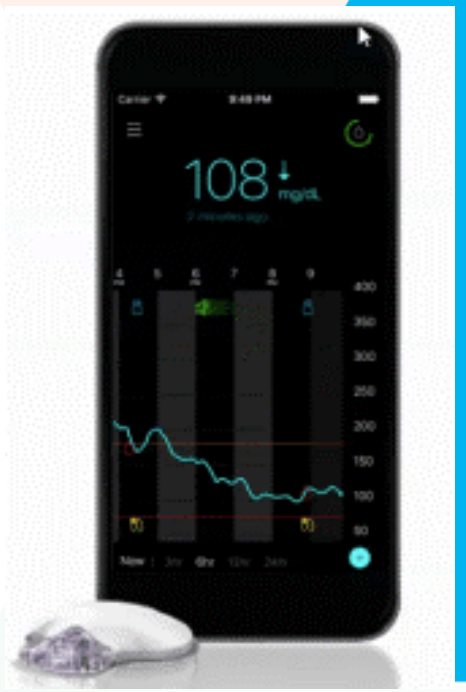
Libre 3

New

https://abbott.mediaroom.com

Medtronic Guardian

7-day wear



https://www.medtronicdiabetes.com

UW Health Kids

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 your cells (interstitial space)

- Interstitial sugar is close to blood sugar most of the time

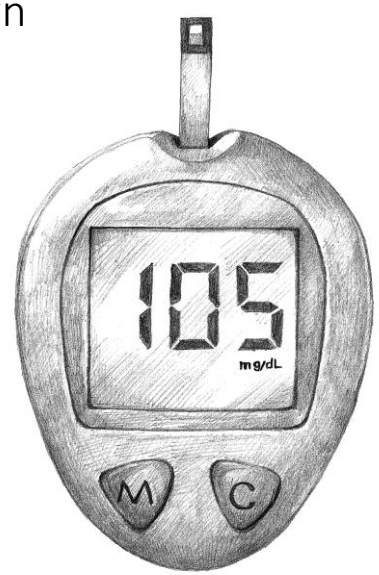
https://www.niddk.nih.gov/health-information/diabetes/overview/managing-diabetes/continuous-glucose-monitoring

Blood Glucose vs. CGM Data

Blood Glucose

One blood glucose number

No information about how fast the blood sugar is going up or down



CGM

Gives glucose value, how fast glucose is changing and in what direction, and where glucose trends have been for the last several hours

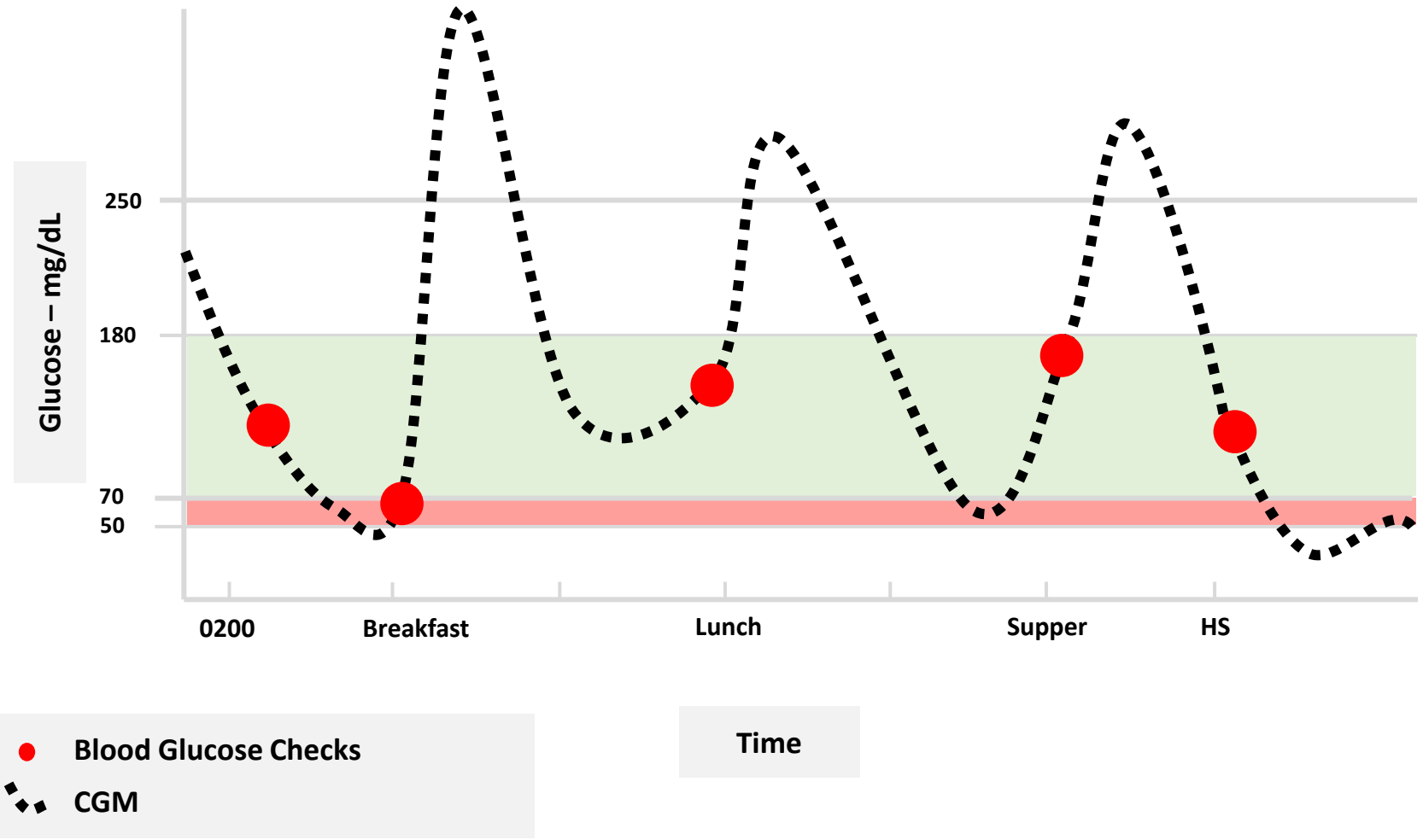
Alarms that alert you if blood sugar is high or low

May be able to tell you when blood sugar is trending low so that you can prevent a low blood sugar

OR if CGM links with your pump, the pump may be able to stop giving basal insulin to try to prevent a low blood sugar

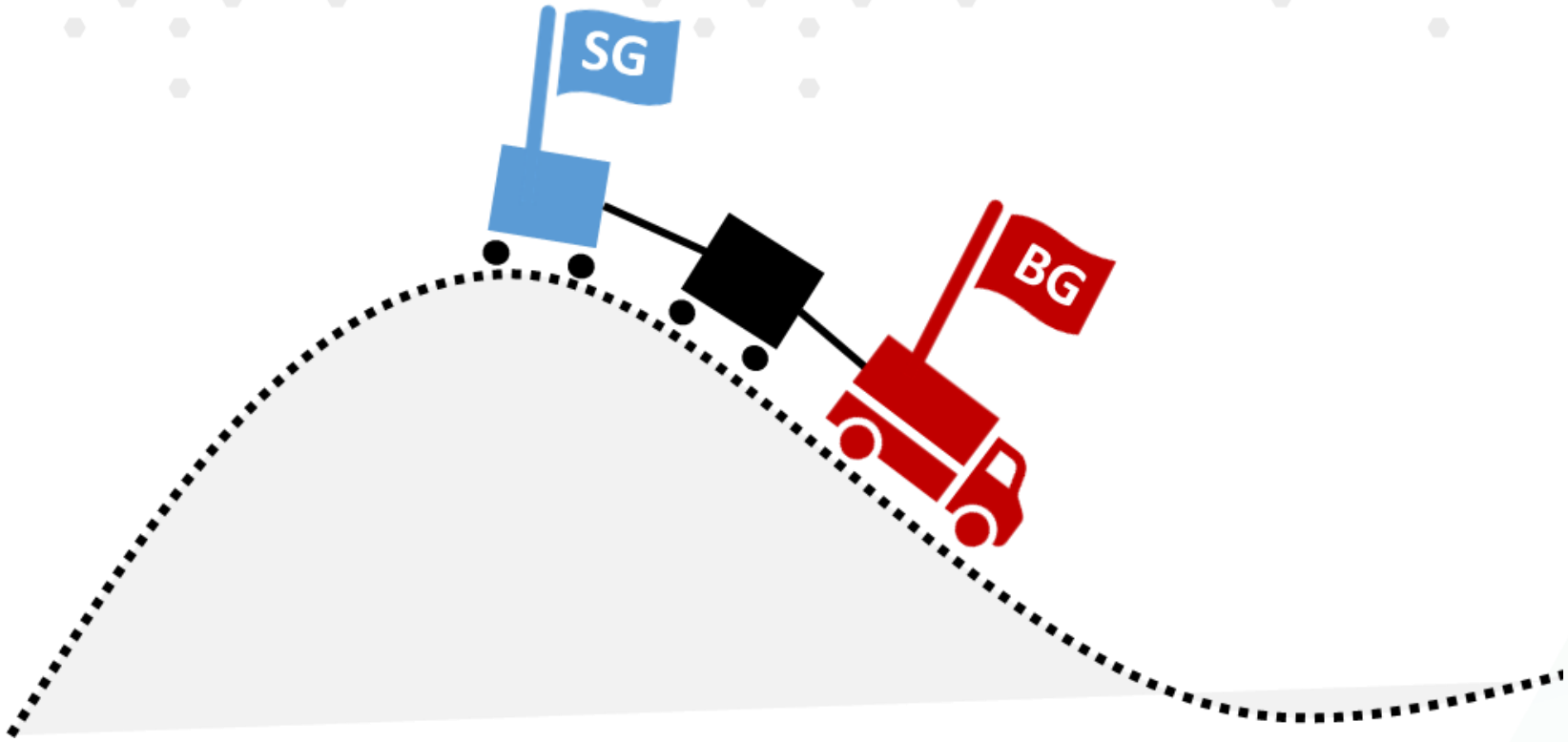
UWHealthKids

CGM vs. Blood Glucose



UWHealthKids

Lag Time



Helpful Resource from Dexcom about Sensor Accuracy

UWHealthKids

Considerations for Children Using CGM

- The child and family will see more spikes and dips, **most of which do not need immediate intervention**
- A high blood sugar is expected after eating and more insulin is not needed.
  - If there is a pattern of high blood sugars 3-5 hours after eating an adjustment to insulin timing or amount may be needed.
- Consider only keeping alarms for LOWS during the school day to avoid disruptions to learning/class time

UWHealthKids

Considerations for Children Using CGM

- Each family will have different goals for CGM use a school
  - Ideal: optimal learning environment that limits unnecessary interruptions while supporting glucose management
- Are alarm limits reasonable? Could they be optimized?
- Do most alerts require an intervention?
- If you will respond to trend arrows, how will you do this? What guidelines will you use?

UWHealthKids

Example 1

- This 8 year old child was sent to the office for this alarm.
- Snack was given with insulin about 30 minutes ago.
- The child will go to recess in 15 minutes.

What action would you take?

If this is a recurrent issue, what change might be needed?

UWHealthKids

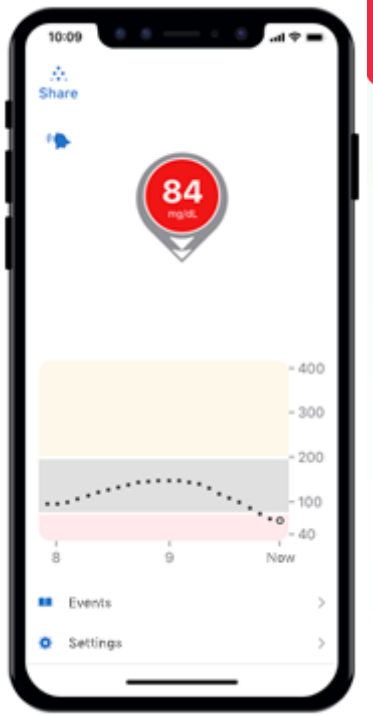
Adapting care in the school setting

- CGM shows TREND of glucose and RATE
  - This information is useful when considering upcoming events such as standardized tests, recess, gym class or going on the bus
- When working to prevent a low fewer carbs are needed. Giving 15+ grams to prevent a low will likely cause hyperglycemia

Example 2

- 12-year-old
- Left gym class to come to office
- CGM alarming, but no s/s of hypoglycemia
- Lunch is in 1 hour

What would you do next?



UWHealthKids

When is a glucometer needed?

- CGM not being worn or not working
- Warm Up period
- CGM reading doesn’t seem right based on what has happened or how you feel
- No arrow displayed with CGM reading
- You think blood sugar might be low or high
- Checking after treating a low blood sugar

UWHealthKids

Rate of Change

Dexcom G5/G6*		Guardian Connect		FreeStyle Libre	
Arrow	Meaning	Arrow	Meaning	Arrow	Meaning
⇈	**Glucose rapidly rising** >3 mg/dL/min >0.2 mmol/L/min	⇈	**Glucose rapidly rising** >3 mg/dL/min >0.2 mmol/L/min	—	—
↑	**Glucose rising** 2–3 mg/dL/min 0.1-0.2 mmol/L/min	↑	**Glucose is rising** 2–3 mg/dL/min 0.1-0.2 mmol/L/min	↑	**Glucose rapidly rising** >2 mg/dL/min >0.1 mmol/L/min
↗	**Glucose slowly rising** 1–2 mg/dL/min 0.06-0.1 mmol/L/min	↑	**Glucose slowly rising** 1–2 mg/dL/min 0.06-0.1 mmol/L/min	↗	**Glucose rising** 1–2 mg/dL/min 0.06-0.1 mmol/L/min
→	**Glucose steady** *Increasing/decreasing* <1 mg/dL/min <0.06 mmol/L/min	—	**Glucose steady** Increasing/decreasing <1 mg/dL/min <0.06 mmol/L/min	→	**Glucose steady** *Increasing/decreasing* <1 mg/dL/min <0.06 mmol/L/min
↘	**Glucose slowly falling** 1–2 mg/dL/min 0.06-0.1 mmol/L/min	↓	**Glucose slowly falling** 1–2 mg/dL/min 0.06-0.1 mmol/L/min	↘	**Glucose slowly falling** 1–2 mg/dL/min 0.06-0.1 mmol/L/min
↓	**Glucose falling** 2–3 mg/dL/min 0.1-0.2 mmol/L/min	↓	**Glucose is falling** 2–3 mg/dL/min 0.1-0.2 mmol/L/min	↓	**Glucose rapidly falling** >2 mg/dL/min >0.1 mmol/L/min
⇊	**Glucose rapidly falling** >3 mg/dL/min >0.2 mmol/L/min	⇊	**Glucose rapidly falling** >3 mg/dL/min >0.2 mmol/L/min	—	—

*Arrows appear differently in G5/G6 touchscreen receiver and smartphone displays.

https://journals.sagepub.com/doi/10.1177/0145721718818066

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

UWHealthKids

Hybrid Closed-Loop Systems

Image: Medtronic.com

Image: Tandemdiabetes.com

Image: MyOmnipod

UWHealthKids

	Omnipod 5 System	MiniMed 670G	Tandem Control-IQ
Calculation	HCL system • Automated basal doses will be based on an estimated TDD = (programmed total daily basal insulin) × 2 • After first pod change, automated basal will be based on the actual TDD • HCL set point can be programmed to 110, 120, 130, 140 and 150 mg/dl	HCL system • Uses TDD calculated from last 2–6 days • Automated basal calculated by system every 5 min • HCL set point = 120 mg/dl • No automated correction doses. Manual correction doses based on HCL algorithm and not on programmed correction factors	HCL system • Increases or decreases programmed basal rates based on CGM tracings and predicted glucose levels • Automated correction dose once/h of 60% calculated correction dose • Target range of 112.5 to 160 mg/dl • Correction bolus target of 110 mg/dl
Adjustment	User can modify in HCL: • I:C ratios (for meal boluses) • Correction factor (for high glucose correction boluses) • Active insulin time (for user-given correction boluses only, not for system delivered insulin) • Target glucose (for algorithm set point and correction boluses) • HypoProtect mode (for exercise) Users cannot modify in HCL:	Users can modify in HCL: • I:C ratios • Active insulin time • Temp target of 150 mg/dl Users cannot modify in HCL: • Basal rates • Correction factor • HCL set point of 120 mg/dl (except when using temp target)	User can modify in HCL: • I:C ratios • Basal rates • Correction factor • Exercise and sleep activities User cannot modify in HCL: • Active insulin time (set at 5 h) • Correction bolus target of 110 mg/dl

Cobry EC, Berget C, Messer LH, Forlenza GP. Review of the Omnipod® 5 Automated Glucose Control System Powered by Horizon™ for the treatment of Type 1 diabetes. *Ther Deliv. 2020 Aug;11(8)*:507-519. doi: 10.4155/tde-2020-0055. Epub 2020 Jul 28. PMID: 32723002; PMCID: PMC8097502.

UWHealthKids

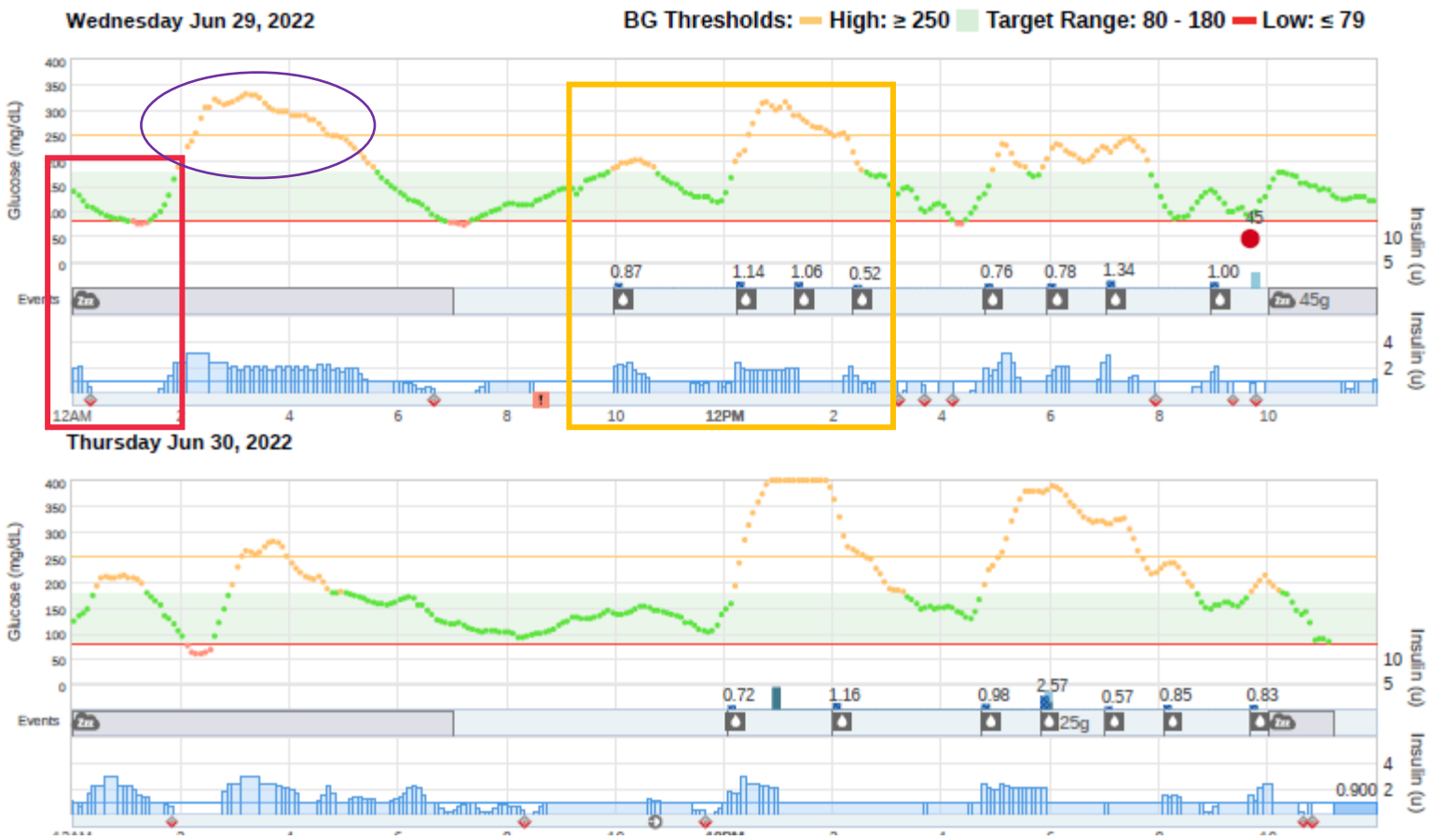
What you need to know

- The system anticipates and tries to prevent prolonged high or low blood sugar but it is not perfect and is not an “artificial pancreas”
- When treating a low with this system **fewer carbs are needed (5-10) as system has already decreased or stopped insulin**
- Giving uncovered carbs too far before activity to try and prevent lows often backfires as it triggers the pump to give more insulin shortly before or during activity
  - Systems have settings (Activity Mode/Exercise Mode/Temporary Target) to help prevent lows with activity by decreasing insulin and anticipating glucose levels will drop faster. These settings work best when turned on 30-60 minutes before activity to decrease the amount of insulin on board

UWHealthKids

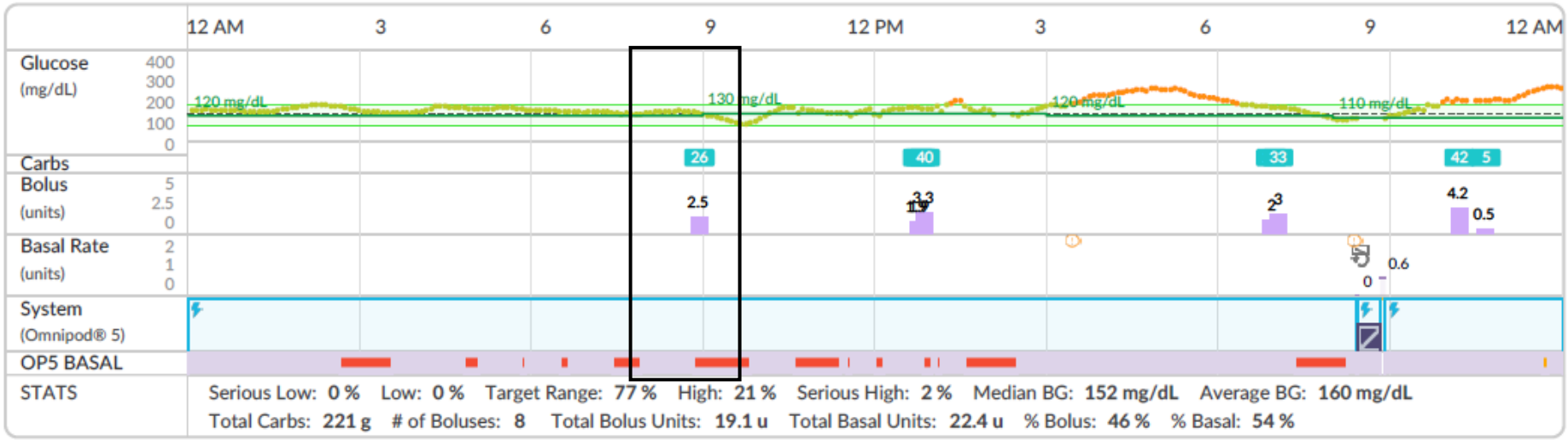
TANDEM
Diabetes Care

Therapy Timeline | Wednesday Jun 29, 2022 - Tuesday Jul 12, 2022 CGM Data by Dexcom

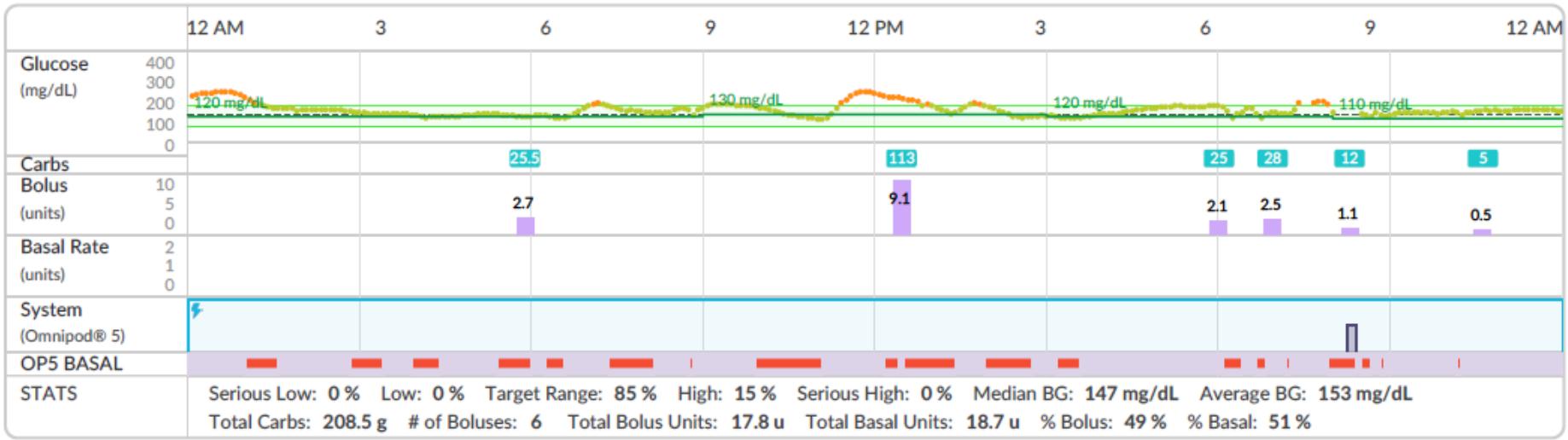


UWHealthKids

September 23, 2022



September 22, 2022



UWHealthKids

Slaninova N, Fiedorova K, Selamat A, Danisova K, Kubicek J, Tkacz E, Augustynek M. Analysis and Testing of a Suitable Compatible Electrode's Material for Continuous Measurement of Glucose Concentration. Sensor. 2020 Jun 30;20(13):3666. doi: 10.3390/s20133666. PMID: 32629993; PMCID: PMC7374362.

https://www.niddk.nih.gov/health-information/diabetes/overview/managing-diabetes/continuous-glucose-monitoring

Klonoff DC, Kerr D. A Simplified Approach Using Rate of Change Arrows to Adjust Insulin With Real-Time Continuous Glucose Monitoring. *J Diabetes Sci Technol. 2017 Nov;11(6)*:1063-1069. doi: 10.1177/1932296817723260. Epub 2017 Sep 8. PMID: 28884599; PMCID: PMC5951054.

Saunders A, Messer LH, Forlenza GP. MiniMed 670G hybrid closed loop artificial pancreas system for the treatment of type 1 diabetes mellitus: overview of its safety and efficacy. *Expert Rev Med Devices. 2019* Oct;16(10):845-853. doi: 10.1080/17434440.2019.1670639. Epub 2019 Sep 30. PMID: 31540557; PMCID: PMC6816287.