

Diabetes Technology: Embracing Your Inner Diabetes Nerd



Kids deserve the best.

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Objectives

- Overview of Blueloop/Mycareconnect
- CGM the basics
- CGM updates
- CGM use in the school setting
- Insulin pump the basics
- Pump use in the school setting
- Technology – where it is going

Medical Profile

Insulin Calculator: On Off

Target Blood Glucose: 120

Target Blood Glucose Range: 70 - 180

Insulin Sensitivity Factor (Correction Factor): 1 unit of insulin lowers blood glucose 40 milligrams.

Direct Blood Glucose Above: 150.0

Insulin on Board (Insulin Action Time): 3 hours

Carb Factors / Ratios: [Use Default Ratio](#)

Breakfast: 6:00 AM to 9:30 AM 1 unit per 10 carbs

AM Snack: 9:30 AM to 11:00 AM 1 unit per 10 carbs

Lunch: 11:00 AM to 1:30 PM 1 unit per 10 carbs

PM Snack: 1:30 PM to 5:00 PM 1 unit per 10 carbs

Dinner: 5:00 PM to 9:00 PM 1 unit per 20 carbs

Bedtime/Overnight: 9:00 PM to 6:00 AM 1 unit per 20 carbs

Bedtime/Overnight Target Blood Glucose: 150

Bedtime/Overnight Target BG must be equal to or greater than Target BG

Insulin Calculator

Insulin Calculator

BG: 256 mg/dL

Carbs: 56 g

Target BG: 120 mg/dL

Correction: 40 mg/dL

Carb Factor: 10 g

Carbs / Carb Factor + (BG - Target BG) / Correction Factor

9

Lunch

Go

Select a reason for Overriding the Insulin Calculator

- Unsure of Carbs
- Sick
- Adrenaline
- Before Exercise
- After Exercise
- Insulin On-Board
- Gut Instinct
- Tired
- Bed Time
- Other Reason

Reports

Self Monitoring Blood Glucose Report

Avg Glucose mg/dL 146	Estimated HbA1c 6.7%	Severe Low Below 54 mg/dL 0.0%	Low Below 70 mg/dL 2.8%	In Range 70 - 180 mg/dL 72.2%	High Above 180 mg/dL 22.2%	Severe High Above 250 mg/dL 13.9%	Coeff. of Variation 51%	SD mg/dL 74	Avg Checks / Day 5.1
Avg Carbs / Day 316.7g	Avg Bolus / Day 18.6U <small>Avg # bolus doses / day = 3.4</small>	+		Avg Basal / Day 6.0U	=	Avg Total All Insulin 24.6U			

Insulin Adherence Report (2 calculator values overridden out of 36)

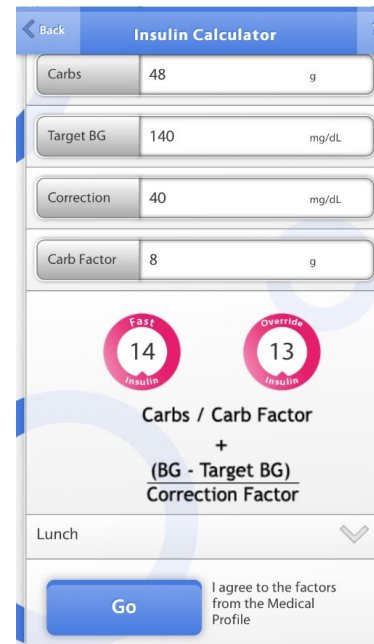
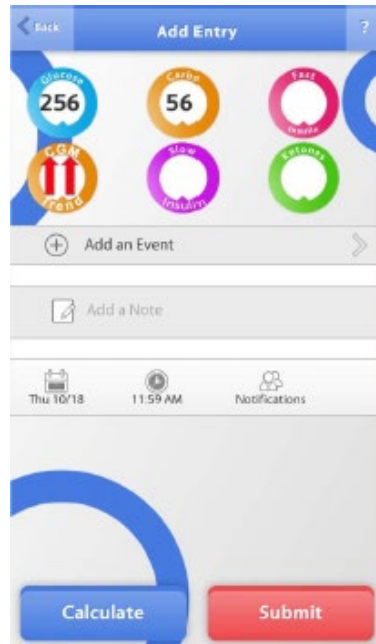
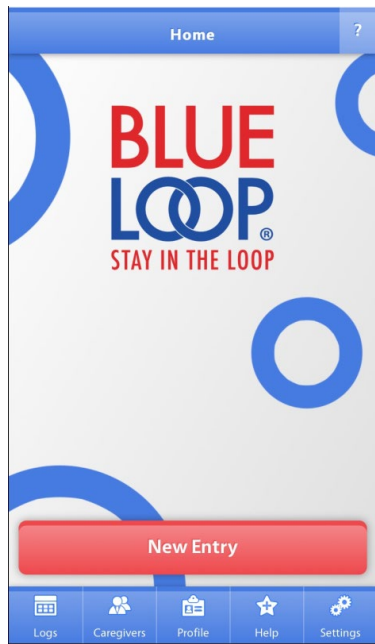
Date	Time	Units Calculated	Units Delivered	Override Reason(s)	Pre BG	Post BG	Time Between BG Tests
4/10/18	12:01 PM	2.5	2	Before Exercise,	80	89	1 hrs 37 mins
4/12/18	12:01 PM	2.5	2	Before Exercise,	126	105	1 hrs 39 mins

- Single app to calculate, log and communicate diabetes information.
- Decrease time, enhance accuracy and improve compliance when calculating insulin dose.
- Improve communication among caregivers and providers.
- Gain insights from patient data and improve outcomes.

BlueLoop

- Medical profile programmed with doses and used to calculate doses.
- School staff can be confident in the insulin dose they are administering, blueLoop is more accurate than dose charts and less room for error than doing calculations.
- Use of BlueLoop at home and school has provided a bridge for the families that struggle with communication.
- If the app cannot be used in the school setting a website is available for use,
<https://blueLoop.mycareconnect.com>

Blueloop Screen Shots



Blueloop Features

- Family can initiate account or schools can do so by contacting the Blueloop team.
- School can have an account with multiple students.
- A district RN can have an account with multiple schools
- Medical profile has the doses programmed and these doses will be viewed with each calculation allowing staff to ensure consistency with IHP.
- Family can set up the account to receive a text when an entry is made which provides immediate communication with a family.
- The app can be used to log BGs even if the child does not need insulin and a calculation (a low BG).
- Logbooks are available for review by anyone using the account giving insight into management at home which is sometimes missed in the school setting.

Logbook

9/18/2018	12a	1a	2a	3a	4a	5a	6a	7a	8a	9a	10a	11a	12p	1p	2p	3p	4p	5p	6p	7p	8p	9p	10p	11p
BG								246			130													
Carbs								46			17													
Bolus																								
Insulin On Board																								
Fast/Slow								6			1													

9/17/2018	12a	1a	2a	3a	4a	5a	6a	7a	8a	9a	10a	11a	12p	1p	2p	3p	4p	5p	6p	7p	8p	9p	10p	11p
BG								146			185	167		77			91		140					
Carbs								63			18						23		72	63				
Bolus																								
Insulin On Board																								
Fast/Slow								6.5			2						1		4.5	3.5				

9/16/2018	12a	1a	2a	3a	4a	5a	6a	7a	8a	9a	10a	11a	12p	1p	2p	3p	4p	5p	6p	7p	8p	9p	10p	11p
BG											136			62					100			185		
Carbs											71			57		30			122					
Bolus																								
Insulin On Board																								
Fast/Slow											7			2.5		1.5			7.5			11		

9/15/2018	12a	1a	2a	3a	4a	5a	6a	7a	8a	9a	10a	11a	12p	1p	2p	3p	4p	5p	6p	7p	8p	9p	10p	11p
BG									170		79	89		158				151				66	76	
Carbs									76		15			60				17		70		15		
Bolus																								
Insulin On Board																								
Fast/Slow									8					4				1		4	11			

Notes/Comments

9/17/2018																								
	12a	1a	2a	3a	4a	5a	6a	7a	8a	9a	10a	11a	12p	1p	2p	3p	4p	5p	6p	7p	8p	9p	10p	11p
BG								146			185	167		77			91		140					
Carbs								63			18						23		72	63				
Insulin On Board																								
Fast/Slow								6.5			2						1		4.5	3.5				
Notes	<p>9/17/2018 1:11 PM Lincoln School Lunch 143 65 3.5 4 Reason Notes: per dad go down .5</p>																							
	<p>9/17/2018 12:51 PM Lincoln School 60 Notes: Skittles;will retest at 1:10</p>																							

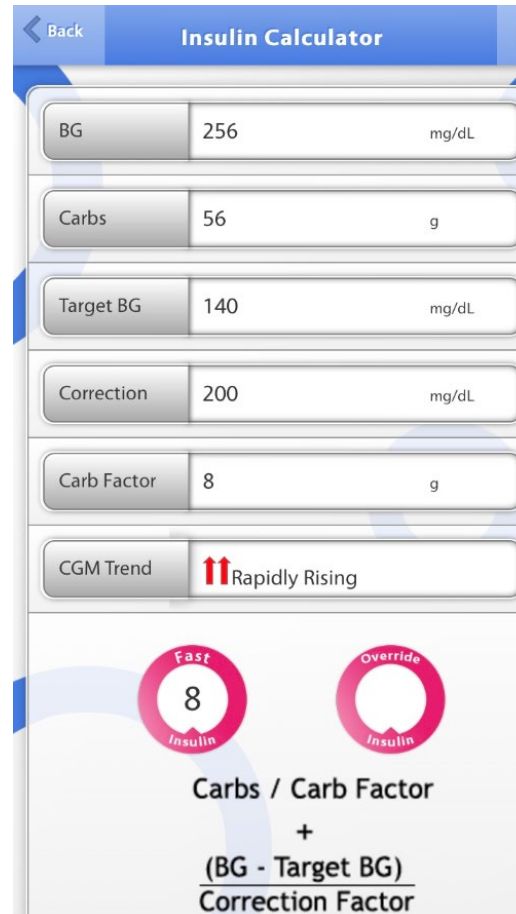
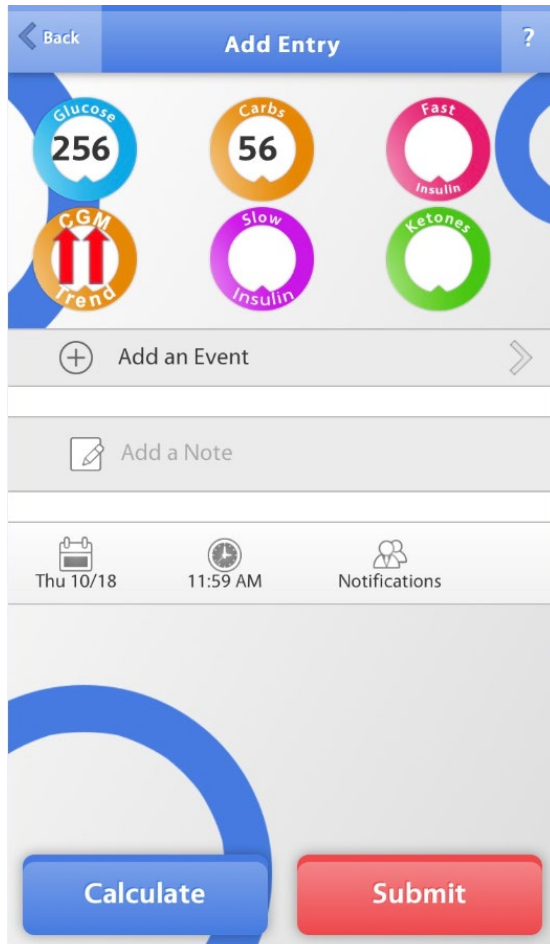
Benefits to Blueloop

- Increased accuracy of dosing.
- Easy to use by all staff and the student.
- Increased independence for the student.
- Improved communication between school and family.
- Improved communication between school and clinic.
- Provides a better overall picture of student's diabetes management.
- Clinic has access to school numbers since often families forget to bring data to appointments.

CGM Enhancement to Blueloop

- Family can now add CGM information to the medical profile.
- This allows you to enter the arrows of the CGM.
- The dose will be modified based on the Endocrine Society pediatric guidelines for dose adjusting based on the CGM trend.
- Families may or may not want this used in the school setting.
- CHW can provide guidelines if this is requested.

Screenshots with CGM



Dose increased by 0.5 due to arrows

Blueloop Questions



Continuous Glucose Monitors



What is CGM?

- Continuous Glucose Monitoring systems use a tiny sensor inserted under the skin to check glucose levels in tissue fluid.
- This information includes both a sensor glucose value and an arrow to show if the glucose level is rising or falling.

<https://www.youtube.com/watch?v=u3LH6eRquEw&feature=youtu.be>

Parts of CGM

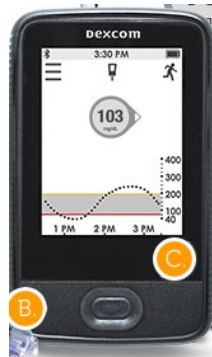
1. Sensor



2. Transmitter



3. Receiver



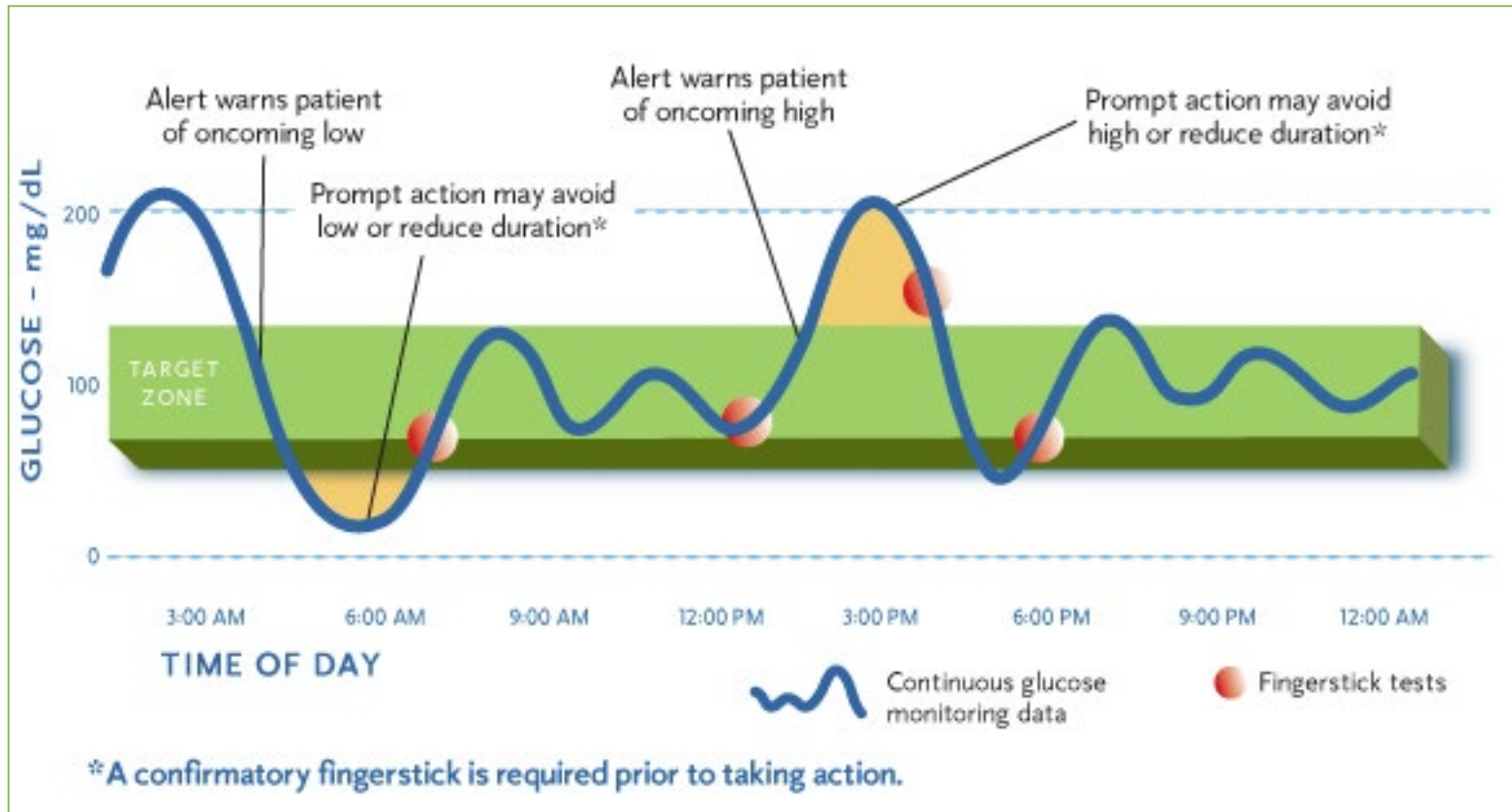
How CGM works

- A tiny electrode (sensor) is inserted just under the skin
- Sensor continually measures glucose levels in the interstitial fluid (IF)
- Transmitter sends information to the receiver
- Receiver shows both a number and trend arrow

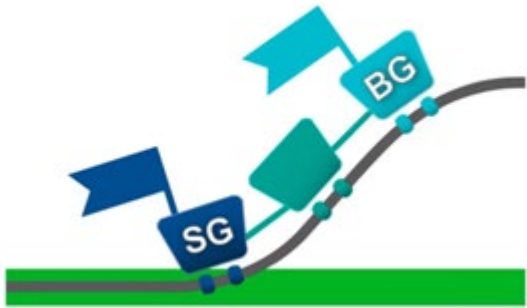
Advantages

- Can provide real time glucose information every 5 minutes
- Shows where glucose is
 - Current number on machine
- Shows where glucose was
 - Trend graph
- Predicts where glucose is going
 - Rate of change arrows
- Certain devices are FDA approved to use for dosing
- Remote monitoring
- Multiple alarm settings
- Reduced or eliminates finger-sticks

Blood Glucose Data Vs. CGM Data



Understanding Lag Time



The SG value may be lower than the BG meter value



The SG value may be higher than the BG meter value



The SG value should be close to the BG meter value



Readings can be different and still be considered accurate



CGM Accuracy

MARD: Mean Absolute Relative Difference between the blood glucose monitoring system value and the lab reference value. (The lower the better)

- The glucometer and CGM can have different values and still fall within a range that is considered accurate
- Most blood glucose meters have approximately 15% variance
- What that means? CGM could be more accurate than the blood sugar test!
- Blood sugar testing can have user error – dirty finger, wet finger

Medtronic	8.7%
Dexcom	9%
Libre	9.4%

“I Don’t Trust the CGM!”

- Most CGM systems are FDA approved to dose from – this is a practice change but one that should be adopted in all settings.
- You need to know what CGM your student uses to determine if the CGM data can replace blood sugar testing.
- There will be a discrepancy in the data but that does not mean that the CGM is off – the accuracy of the CGM is better than most meters.
- There needs to be a number and an arrow to use the number for dosing on approved systems.
- If physical symptoms do not match the number you should verify with a finger poke.
- The medical management plan should include whether the parent wants CGM values used for treatment decisions and dosing or if they prefer finger pokes – this should be the family’s discretion.

Dexcom



Available Models: G5, G6

Similarities:

- Remote Monitoring-If the student has a blue-tooth enabled device near them, the results can be remotely monitored
- Set high and low alarms
- Shows glucose trending arrows
- Updates glucose reading every five minutes

Dexcom Comparison

Dexcom G5	Dexcom G6
<ul style="list-style-type: none">• CAN be used to determine insulin dose see CHW protocols on website• Requires calibrations• Can NOT be used with acetaminophen• Larger size• 7-day wear	<ul style="list-style-type: none">• CAN be used to determine insulin dose• Does not require calibrations• CAN be used with acetaminophen• Smaller size• 10-day wear

SCHOOL NURSE GUIDE



dexcomG6[®]

CONTINUOUS GLUCOSE MONITORING

<https://provider.dexcom.com/education-research/clinic-resources/webinars-and-presentations/dexcom-g6-cgm-system-school-nurse>



Kids deserve the best.

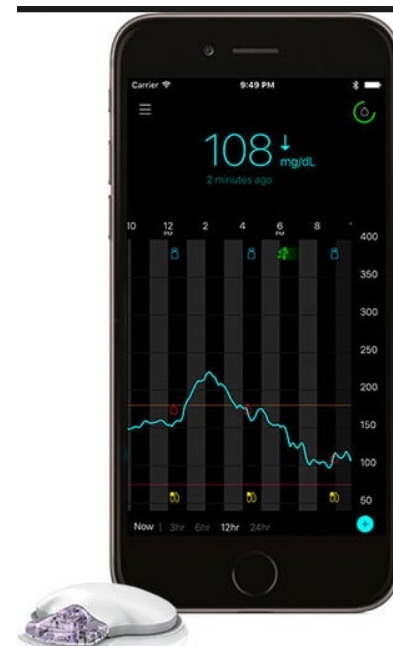
Libre Flash

- Flash glucose monitor – not continuous, does not have alerts and alarms for high/low values
- Quarter-sized sensor that will give glucose value only when the reader or app is swiped over the top.
- Shows trending arrows
- CAN be used to determine dosing



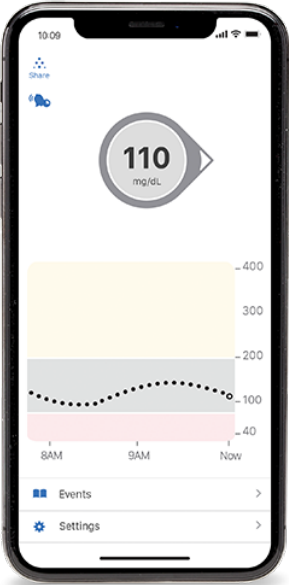
Medtronic CGM

- Guardian 3 Sensors used with Medtronic pump or phone app
- NOT used for dosing
- Requires calibration
- Shows trending arrows
- Set high and low alarms

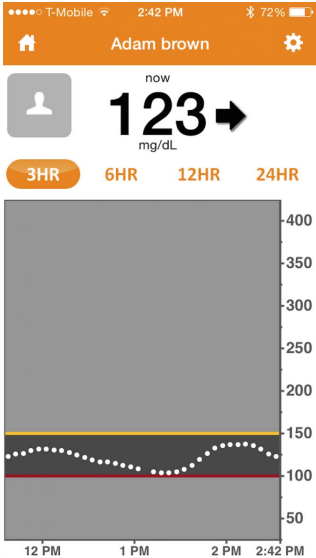


CGM App Screen Shots

Dexcom G6



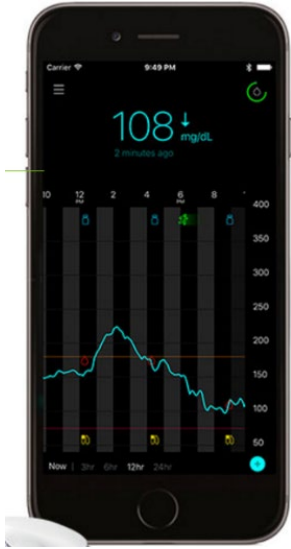
Dexcom Follow



Libre View



Guardian



Trend Arrows

Trend Arrows show the direction and speed of glucose change and can only be seen with CGM. Catch highs and lows before they happen.



Constant

0-30 mg/dL up or
down in ½ hour



Slowly Rising

30-60 mg/dL
up in ½ hour



Rising

60-90 mg/dL
up in ½ hour



Rapidly Rising

90 or more mg/dL
up in ½ hour



Slowly Falling

30-60 mg/dL down
in ½ hour



Falling

60-90 mg/dL
down in ½ hour



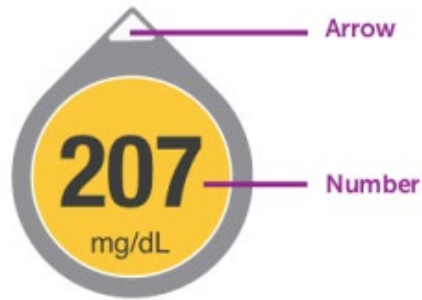
Rapidly Falling

90 or more mg/dL
down in ½ hour

Dosing Based on Trend Arrow

- Families are taught to modify the calculated insulin dose based on the trend arrow.
- If a family requests this in the school setting guidelines have been endorsed by the Endocrine Society.
- Blueloop app has incorporated the Endocrine Society guidelines to modify the calculated dose if the family has turned the feature on.
- Using the information from the trend improves the accuracy of the dose and will result in more time in the target range.

Example of Using Trend Information



ICR 1:15 grams

Target glucose: 120

ISF/Correction Factor 1:40

Target range 70-150

Food dose = 60 grams / 15 = 4 units

$207 - 120 / 40 = 2.175$

Insulin dose = 6.175

CGM trend = 2 units

Total dose = 8 units

- You need both a number and arrow to use the CGM for dosing.
- Using the arrow the Endocrine society guideline is to increase by 2 units for people with a correction factor of 40
- This student would receive 8 units of insulin because the arrow indicates that the glucose will be 60 points higher in 30 minutes so the dosing is being proactive.
- Thinking about lag time and the arrow pointing up the actual BG check would be higher than the CGM which makes this adjustment safe and appropriate.



CHW Recommendations for Use in School Setting

- The student may need to have cell phone with them or use school Wi-Fi to transmit data during the school day.
- Parents may be monitoring numbers from their phone so this may increase parent contact.
- Family is trained to be proactive and treat based on arrows so it is OK to request a snack even if not under the low threshold to prevent hypoglycemia.
- Very experienced families may request doses be adjusted depending on arrows – this will be indicated on IHP if the family does adjust insulin doses.
- High alerts may occur after eating and will not always need to be treated. There must be two hours between insulin doses.

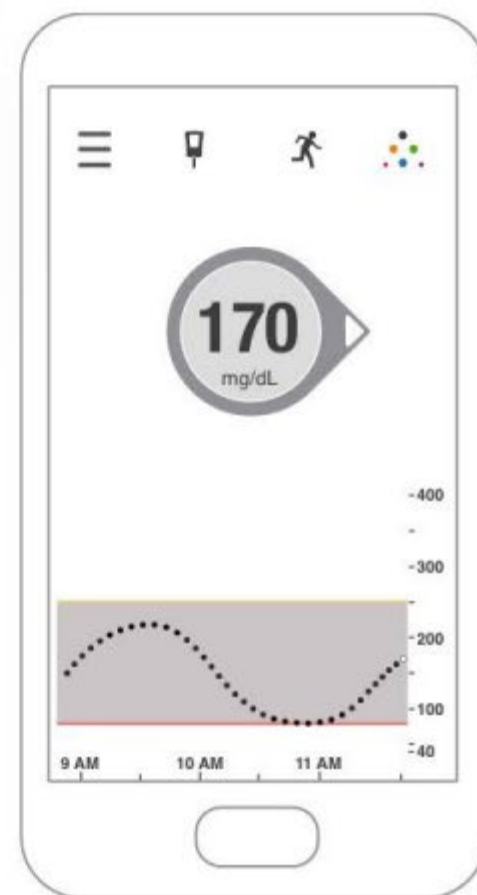
CHW Recommendations for Use in School Setting

- Constant monitoring by school personnel is not expected, priority should be given to low and high alerts.
- Schools should not be asked to reinsert a sensor.
- Back up supplies for blood glucose testing should be at the school.
- Blood glucose should be checked with finger poke if symptoms don't match the sensor glucose.
- Blood glucose should be checked if there is not a number and arrow on the receiver.
- Currently only Dexcom G5, G6 and Libre CGM should replace finger pokes when dosing insulin.

Soccer Practice

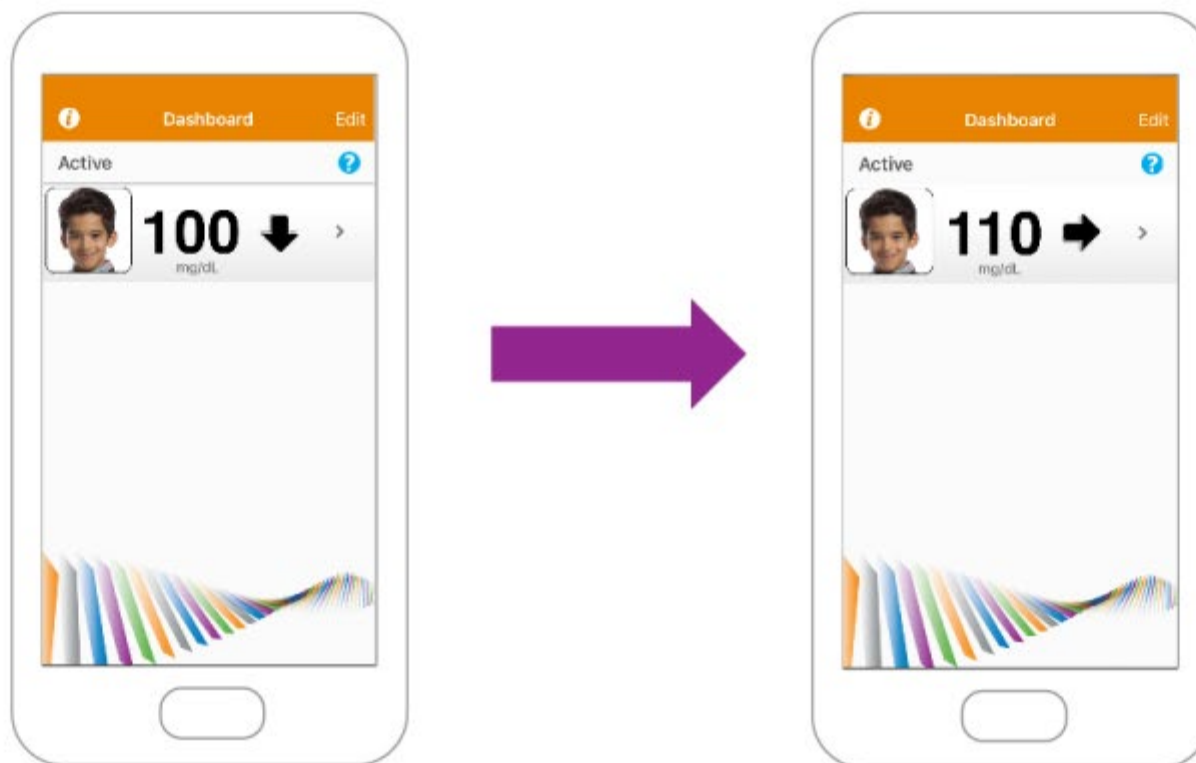


When Max and Grandma get to soccer practice, they look at Max's Dexcom G5 Mobile. They see Max's glucose is 170 and steady. Max puts his phone on the sidelines. Max is within 20 feet so he will still get his readings. Grandma watches the practice, taking pictures.



Soccer Practice (cont.)

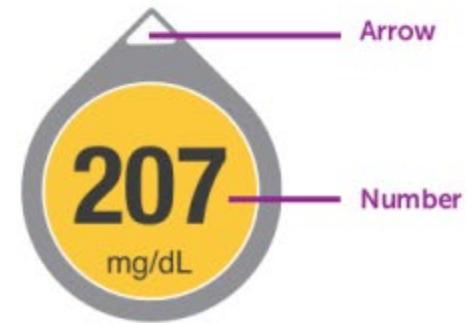
Near the end of practice Grandma gets an alert on her Dexcom Follow App. She sees that Max's glucose is 100 and going down. Grandma calls Max over and looks at his app to make sure it has the same information. After verifying, she gives him a juicebox. Fifteen minutes later she sees that Max's glucose started to go back up.



Birthday Cake

A little over two hours later it is time for cake and Max calls Grandma again. Grandma asks the same questions:

- Do you have both number and arrow on your Dexcom CGM?
 - **Yes. This means Max can use his Dexcom for treatment.**
- What does the number say? Is the arrow going up or down?
 - **207 with a single arrow going up. This means Max needs a little more insulin to get back in target range.**
- What kind of cake are you going to eat and does it have frosting?
 - **Chocolate and yes**
- When Max is going to eat the cake?
 - **Right now**



The dose should NOT be adjusted to consider the arrow because it has not been 3 hours since the last insulin dose.

Grandma tells Max to take insulin to correct for his high glucose* and cover for the cake. Grandma calculates the amount of insulin based on his diabetes management plan.

* It is important not to take insulin doses too close together, or "stack" insulin. Wait at least two hours.

Insulin Pumps



What is an Insulin Pump

An insulin pump is a medical device used to administer insulin in the treatment of diabetes, also known as continuous subcutaneous insulin infusion (CSII). The device may vary depending on design and may include tubing or a pod system.

Advantages to Insulin Pumps

- Convenience – fewer or no insulin injections
- More flexibility and freedom – easier to dose extra snacks or sleep in later
- More precise dosing – the pump can deliver very small increments eliminating the need for rounding
- Improved blood sugar control with the ability to use advanced features a pump may offer
- Less room for error in dose calculations since the pump calculates the dose for the user



Disadvantages to Insulin Pumps

Skin problems

- Irritation- possible itching, rashes, inflammation
- Infections
- Limited site rotation will cause lipohypertrophy

Cost

- Initial pump cost & ongoing pump supplies
- Warranty can last up to 4 years

DKA

- Increased risk with pump malfunction
- Absorption problems if inserted into a overused site

Technical difficulties

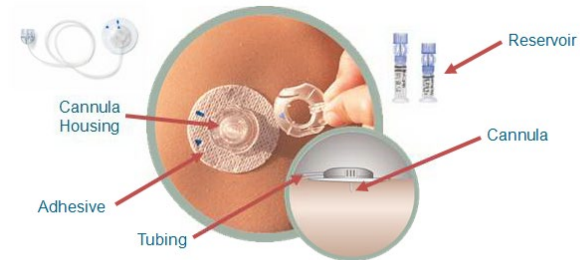
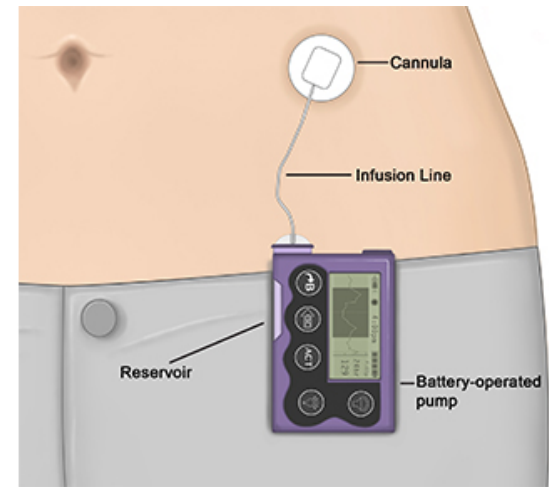
- Computer problems
- Sets clogging, bending

Always there

- Attached to pump 24hrs a day
 - Sleeping, in bathroom, figuring out where to put it on your body
- People see it & ask questions

Parts of an Insulin Pump

- Computerized device
 - Programmed with specific insulin doses
 - Calculates the insulin dose when a blood sugar or carbs are entered
 - Dose is delivered when buttons are manually pushed
- A pump reservoir
 - Similar to a regular syringe, holds 2 to 3 days worth of insulin
- A thin plastic tube called a cannula
 - Changed at home every 2-3 days
 - Similar to an IV
 - Attached to the body 24/7
- Insulin passes from the pump reservoir through the tubing into the subcutaneous (skin) tissue replacing insulin injections



Center for Disease Control (CDC) Recommends
Changing Infusion Sets Every 2-to-3 days

Insulin Delivery Similar to the Pancreas

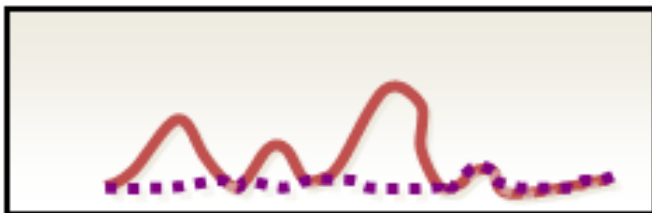
Bolus Insulin

- The insulin given to eat a meal, snack or to correct a high blood sugar level
- The pump calculates the dose based on the settings programmed in the pump
- The user has the ability to alter the calculated dose prior to administering the insulin

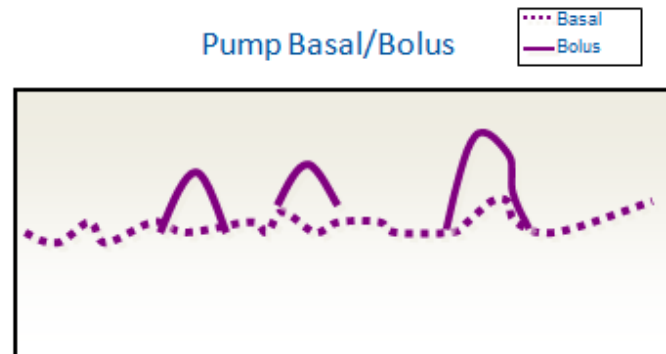
Basal Insulin

- The small amount of insulin continually delivered through a 24 hour period of time
- Helps stabilize blood sugar levels in between meals and while sleeping
- Replaces long acting insulin

Normal Pancreas



Pump Basal/Bolus



Using an Insulin Pump for a Bolus

- Manually push buttons on the pump to deliver the bolus dose.
- Either enter the glucose value into the pump or the pump may have a linked meter.
- Always need to enter grams of carbohydrates into your pump.
- The pump will do the calculations but you can override the recommended dose.

Special Pump Features

- The pump can be programmed for temporary increases or decreases in the basal insulin for exercise or illness.
- Insulin can be suspended if the student is having a low blood sugar that is not quickly responding to fast acting sugar.
- A tubed pump can be disconnected for sports or activity.

CHW Recommendations for Use in the School Setting

- Staff should be aware of what pump the student is wearing.
- Staff should be familiar with basic button pushing for the pump.
- The medical management plan should include the level of independence a child has with the pump.
- Despite the independence with button pushing it is advised that school aged children be supervised when dosing.
- If there is a severe low, seizure or loss of consciousness the pump should be removed.

CHW Recommendations for Use in the School Setting – Pump Failure

- School staff are not expected to change a pump site.
- A back up plan needs to be in place for dosing if pump fails.
- Insulin pen or vial needs to be available at school for dosing.
- Pump settings or doses need to be provided by the parent for a pump failure.
- Blood sugars need to be checked and insulin needs to be given every 2 hours if a pump is off the body (there is no basal insulin).

Check Your Knowledge

- <https://create.kahoot.it/login>

Omnipod

Current Omnipod



2019 Omnipod Dash



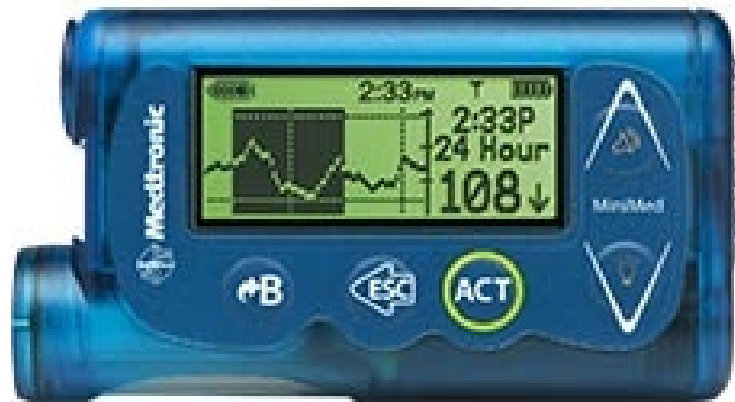
Omnipod Current PDM

- An insulin pump without tubing attached
- Able to dose and test with the current PDM (Personal Diabetes Manager/remote)
- Built in bolus calculator that has doses programmed and calculates the insulin required for correction or at a meal.
- PDM must be within 5 feet of the student for dosing
- Automatic cannula insertion through the remote on the PDM
- Gets changed every 2-3 days and is not disconnected for sports, activity
- Waterproof

Omnipod Dash (2019)

- PDM will be replaced by a “locked down” Android phone to have easy to use touchscreen features.
- Phone will act as the remote to the pod and will need to be within 5 feet of the student.
- Calorie King food database to look up carb information.
- There will be a separate meter that will automatically enter the blood glucose into the app if the patient checks their blood glucose by meter.
- Student may have an additional app on their phone to view pump data or to “find my PDM”.
- Up to 12 people can follow the pump data remotely.
- Training app should be available soon.

Medtronic



Medtronic 500 Series

- An insulin pump with tubing attached.
- Pump may be disconnected for physical activity if necessary but not recommended.
- Pump is not waterproof so is disconnected for swimming or showers.
- Linked meter that automatically enters blood glucose data in the pump
- Built in bolus calculator that has doses programmed and calculates the insulin required for correction or at a meal.
- Dose by pushing buttons on the pump, if BG is checked with meter it will be in the pump, add carbs and dose.
- Patients may or may not use a Medtronic CGM with this system but it cannot be dosed off so they still must do BG checks.

Medtronic 630

- An insulin pump with tubing attached.
- Pump may be disconnected for physical activity if necessary but not recommended.
- Pump is waterproof.
- Linked meter that automatically enters blood glucose data in the pump.
- Built in bolus calculator that has doses programmed and calculates the insulin required for correction or at a meal.
- Dose by pushing buttons on the pump, if BG is checked with meter it will be in the pump, add carbs and dose.
- Works with the Guardian CGM but still requires a BG test for dosing.
- Smartguard technology– the 630 insulin pump will suspend insulin if the student has a low blood sugar and does not respond to the CGM alarm.
- The insulin will resume after 2 hours unless started again manually.

Medtronic 670

- An insulin pump with tubing attached.
- Pump may be disconnected for physical activity if necessary but not recommended.
- Pump is waterproof.
- Linked meter that automatically enters BG data in the pump.
- Built in bolus calculator that has doses programmed and calculates the insulin required for correction or at a meal.
- Dose by pushing buttons on the pump, if BG is checked with meter it will be in the pump, add carbs and dose.
- Works with the Guardian CGM but still requires a BG test for dosing.
- This CGM does require calibration and the pump indicates when it is required, at least every 12 hours but 3-4 calibrations per day recommended.
- Smartguard Auto Mode – the 670 insulin pump will increase and decrease the basal insulin to attempt to achieve a target of 120.
- Training app available – MiniMed 670 Scenario Simulator

Tandem/TX2



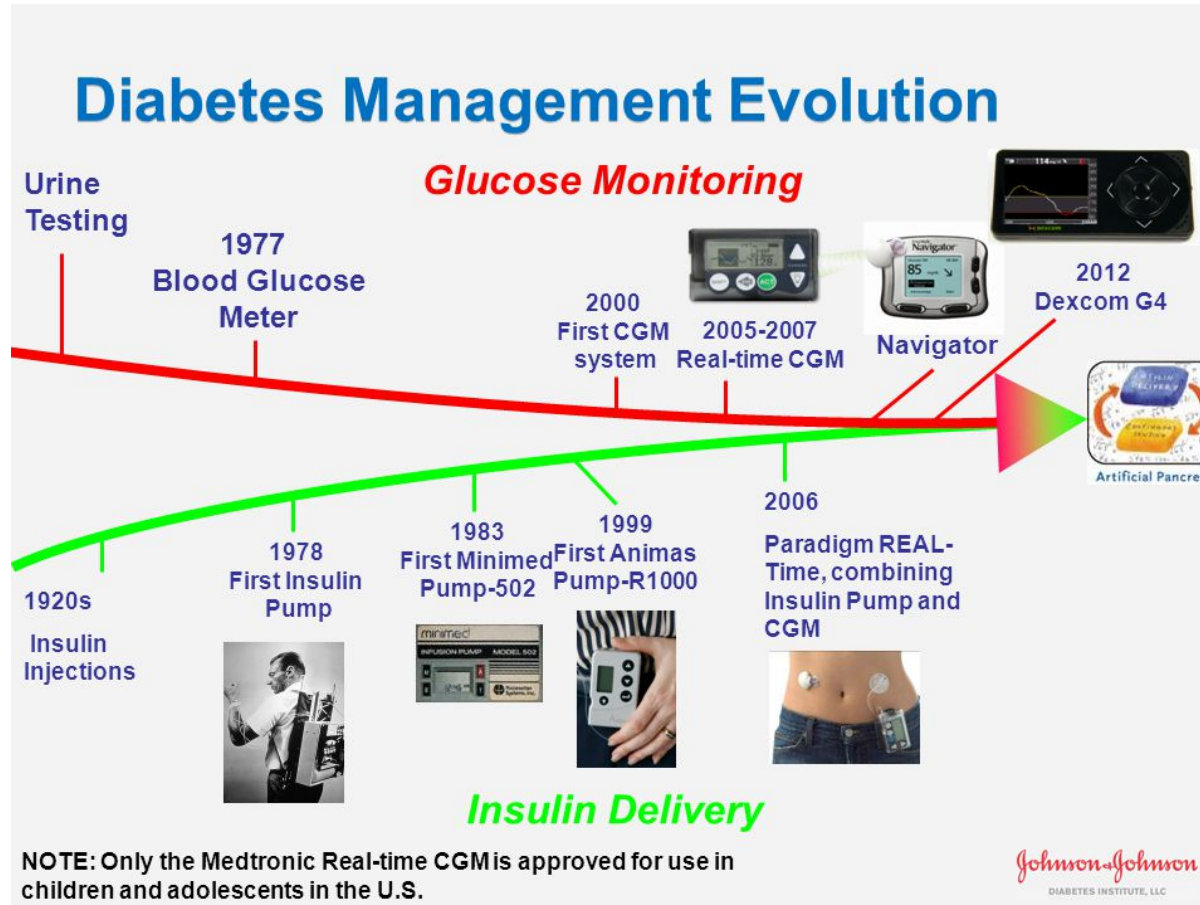
Tandem/TX2

- An insulin pump with tubing attached.
- Pump may be disconnected for physical activity if necessary but not recommended.
- Pump is not waterproof so is disconnected for swimming or showers.
- No linked meter so BG is entered in the pump.
- Built in bolus calculator that has doses programmed and calculates the insulin required for correction or at a meal.
- Dose by pushing buttons on the touch screen of the pump, either BG or CGM data entered and carbs entered prior to dose.
- Patients may or may not use a CGM with this system. CGM data may show on the insulin pump face.
- Training app available – T:simulator App

Tandem/TX2 Basal IQ

- Newest version of the TX2 pump has CGM integration.
- Dexcom G6 data is shown on the pump face.
- If the CGM trend is expected to fall below 80 in the next 30 minutes insulin is suspended and resumes once the CGM trend changes.
- This insulin pump does not increase the insulin dose based on CGM values at this time.

What's Next?



Technology Coming Soon

- Medtronic is working on an improved system that will include a new CGM that can be dosed off and will require fewer calibrations.
- TX2 is expected to launch a “Control IQ” in 2019 that will adjust insulin doses based on the Dexcom data – current system only works to prevent lows. The new system will also correct high blood sugars automatically. This pump will still require a meal dose be entered.
- Omnipod Horizon is expected to launch in 2020 which will adjust insulin doses based on CGM data. This pump will require a meal dose be entered.

Future Technology - Goal

- Current technology and near future technology is offering Hybrid Closed Loop systems where there is some automation in insulin delivery but the user still needs to interact with the pump at times for bolusing.
- Goal of technology is to develop a full Closed Loop / Artificial Pancreas Systems – timeline on this is unclear
- A closed-loop insulin delivery system is an artificial pancreas. ... At present CGM-insulin pump systems are not closed-loop because the person has to make decisions about how much insulin to give.
- A fully closed-loop system would auto adjust all insulin delivery even after a meal.

Resources

- CHW resources can be found on the website, www.chw.org/diabetes