

Diabetes Technology in School-Aged Children

August 6, 2024

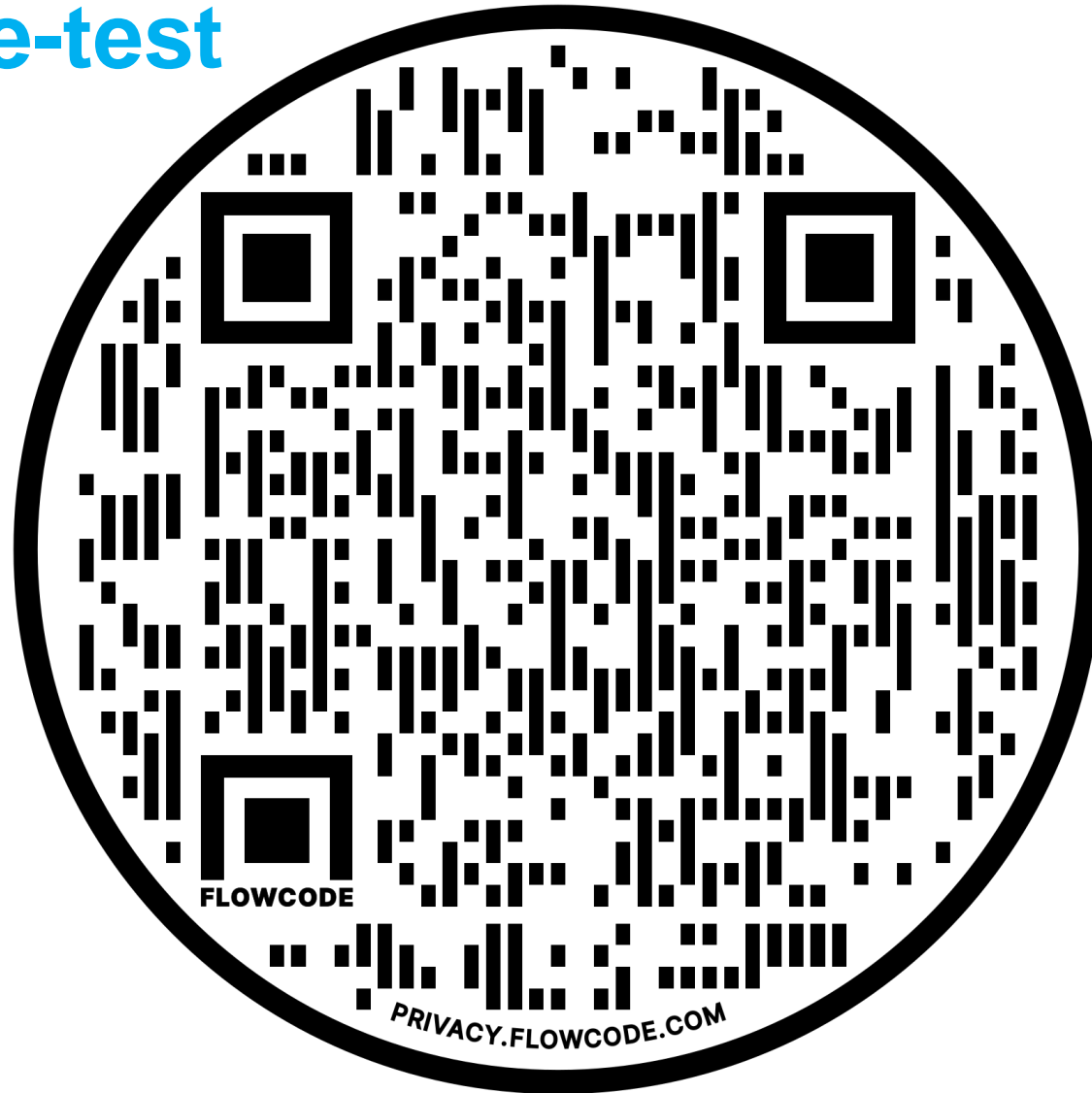
Amberly J. Evasic, RD, LDN, CDCES
Quality Coordinator
LVPG Diabetes and Metabolism Center



Agenda

- Continuous Glucose Monitors (CGMs)
- Smart Pens
- Insulin Pumps- Basics
- Insulin Pumps- Automated Insulin Delivery Systems (AIDs)
- Special Circumstances
- Pump Simulator Apps and Links
- Additional Resources

Quick Pre-test



Continuous Glucose Monitors (CGMs)

- Interpreting Glucose Data

How to read your glucose measurements

CGM readings may be different from fingerstick readings. Fingersticks measure your glucose level from your bloodstream. A CGM measures your glucose from interstitial (IN-ter-STIH-shul) fluid. This is the fluid between your body's cells (see Figure 2).

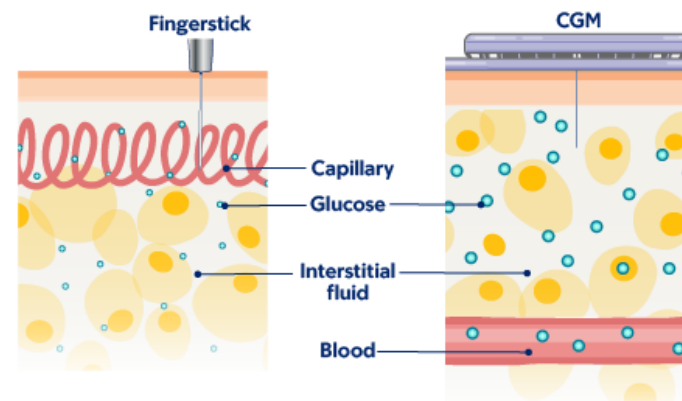


Figure 2. Fingerstick (left) and CGM (right)

Continuous Glucose Monitors (CGMs)

- Interpreting Glucose Data
 - [BG vs SG discussion.pdf](#)

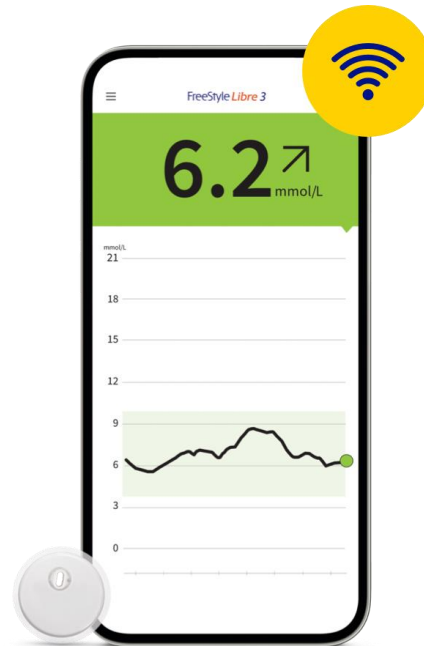
Continuous Glucose Monitors (CGMs)

- Dexcom G6 and Dexcom G7
- Option for phone or receiver to view glucose data
- 10-day wear



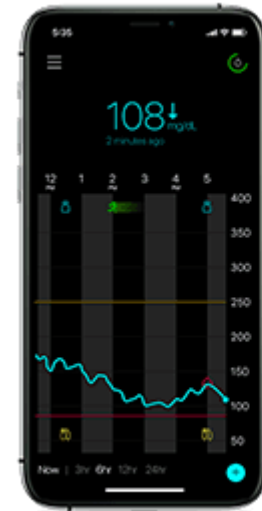
Continuous Glucose Monitors (CGMs)

- Libre 2 and Libre 3
- Option for phone or receiver to view glucose data
- 14-day wear



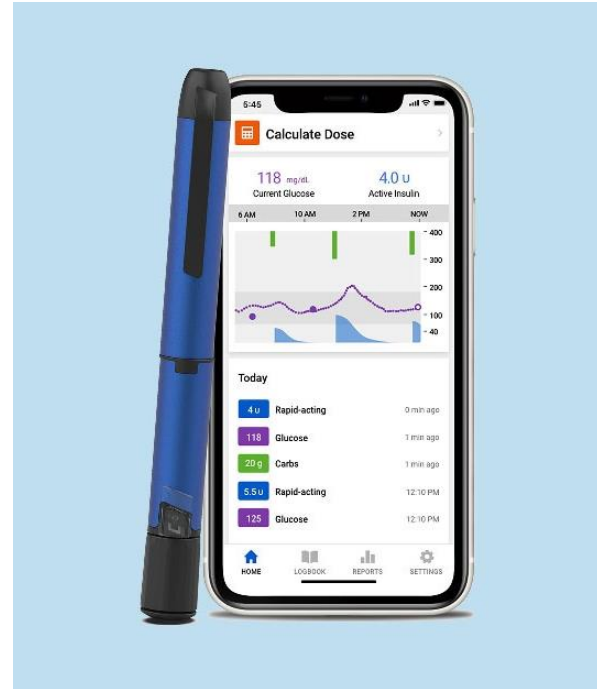
Continuous Glucose Monitors (CGMs)

- Medtronic Guardian Connect
- Phone only to view glucose data, no receiver available
- 7-day wear



Smart Pens

- InPen
 - Replaceable insulin cartridge
 - Mealtime insulin only
- Lilly Tempo Pen
 - Bluetooth cap placed on Tempo pen
 - Can be used for long-acting or mealtime insulin



[InPen™ Smart Insulin Pen | Medtronic \(medtronicdiabetes.com\)](#)

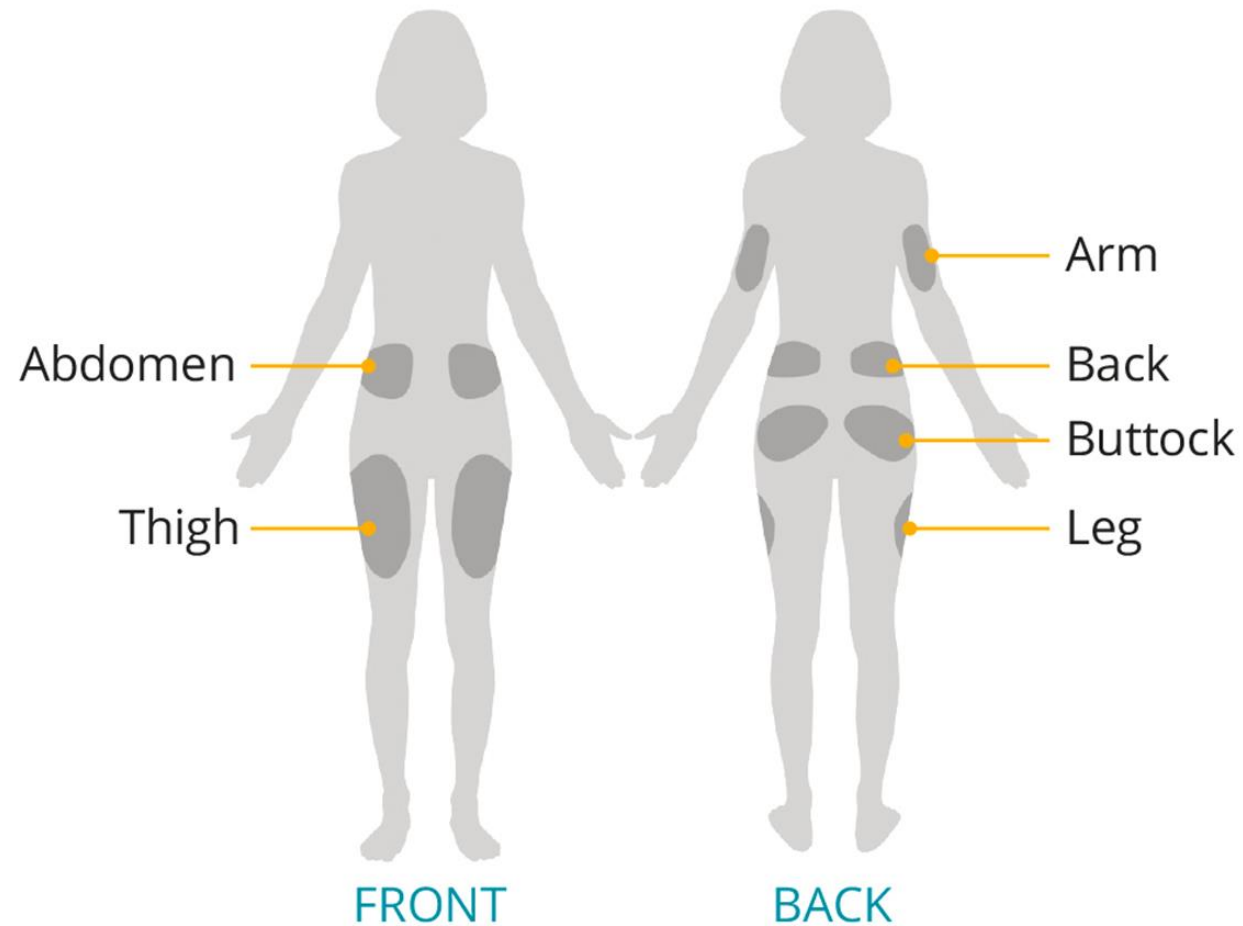
[Tempo™ Personalized Diabetes Management Platform | Pen, Smart Button, App \(lillytempo.com\)](#)

Smart Pens

- Apps include calculator tool to help determine mealtime insulin doses
- All doses are logged in app, whether or not patient uses the calculator tool

Insulin Pumps- Basics

- Where to wear pumps and sensors and/or inject insulin



Insulin Pumps- Basics

- Only rapid-acting insulin is used in pumps
 - Novo Nordisk ([Diabetes Treatments | Novo Nordisk U.S. \(novonordisk-us.com\)](#))
 - Novolog/Aspart
 - Fiasp
 - Lilly ([Current Medicines | Medicines | Eli Lilly and Company](#))
 - Humalog/Lispro
 - Lyumjev
 - Sanofi ([Exploring Our Prescription Product Information | Sanofi USA](#))
 - Admelog
 - Apidra

Insulin Pumps- Basics

- Rapid-Acting Insulin Action Time
 - Onset
 - 5-15 minutes
 - Peak
 - 30-90 minutes
 - Effective Duration
 - <5 hours

Insulin Pumps- Basics

- Basal vs. Bolus Insulin
 - Basal Delivery
 - Slow and steady drip of insulin every five minutes throughout the day and night
 - Helps manage blood sugars between meals and overnight
 - For manual mode pumps, basal rates are preset and deliver automatically
 - Bolus Delivery
 - Larger burst of insulin delivered before eating carbohydrates and to correct hyperglycemia
 - For manual mode pumps, all bolus delivery is done by the patient

Insulin Pumps- Basics

- Bolus calculator built into all pumps to help user determine right dose for the scenario
 - User enters:
 - Number of grams of carbs they're about to eat
 - Blood glucose value
 - Healthcare provider determines ratios for calculations:
 - Insulin to Carb Ratio (ICR)
 - Example: 1 unit for every 15 grams of carbs eaten
 - Insulin Sensitivity Factor (ISF)
 - How much glucose is expected to decrease by if one
 - Target Glucose

Insulin Pumps- Basics



- DKA Prevention- Potential Causes of DKA
 - Bent/kinked cannula
 - Flexible, plastic tube under the skin
 - Can occur when an infusion set is inserted or simply while wearing
 - Dislodged cannula
 - Look for wetness at insertion site
 - Assess for aroma of insulin
 - Blood at infusion set site interrupting insulin delivery
 - Skin irritation or infection at infusion set site interrupting insulin delivery
 - Pump malfunction
 - Insulin exposed to extreme heat or cold

Insulin Pumps- Basics

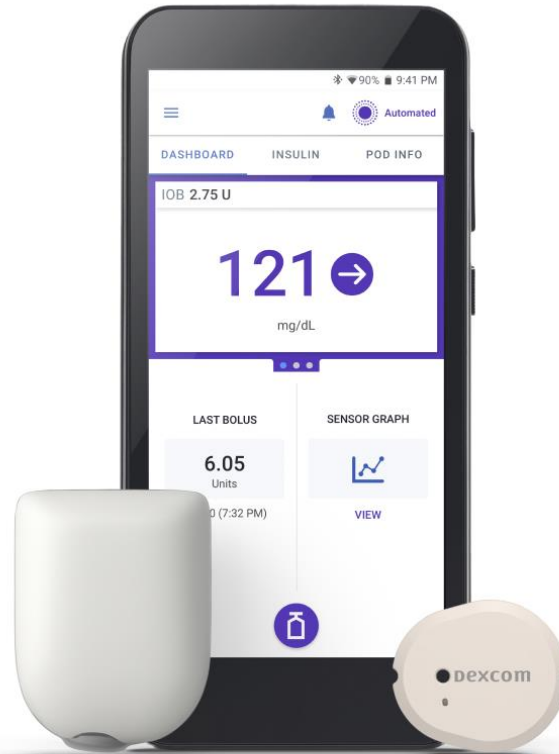
- DKA Prevention
 - Rapid-acting insulin only lasts for 3-4 hours
 - Avoid being disconnected from pump for more than one hour at a time
 - If pump is off for extended period of time, must:
 - Either deliver long-acting insulin dose one time plus rapid-acting for meals
 - Must wait to resume pump until 23-24 hours after last dose of long-acting insulin
 - OR deliver rapid-acting insulin every 3-4 hours until pump can be resumed
 - Ultimately, follow instructions from student's healthcare providers and guardians

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Omnipod 5
- Tandem
 - T:slim X2
 - Mobi
- Medtronic 780G
- Beta Bionics iLet

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Omnipod 5

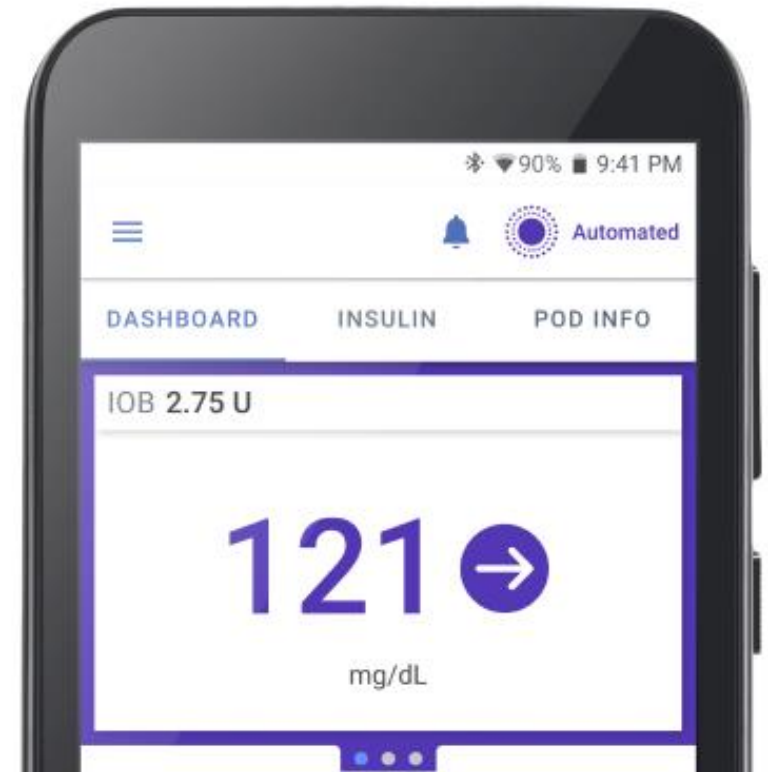


Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Omnipod 5
 - Works with Dexcom G6 or Dexcom G7 sensors
 - Automatically adjusts basal delivery
 - Called “Automated Mode”
 - Still requires user to bolus for carbohydrates before eating
 - Can bolus from smart phone if phone is compatible
 - Change site every three days
 - Glucose data is viewed on either phone app or Omnipod 5 controller (if using)
 - Can't use separate Dexcom receiver to view glucose
 - Can't use Omnipod 5 controller and Omnipod 5 app on smart phone at the same time

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Omnipod 5
 - How do you know if the pump is in Automated Mode?
 - Look for the purple circle and “Automated” in the upper righthand corner of the screen
 - If the circle is blue and it says “Manual,” then it’s in Manual Mode
 - Basal insulin delivering based on preset rates
 - If the circle is dark gray and it says, “Limited,” it’s in Automated Mode but is missing a signal from the sensor to be able to automatically adjust basal delivery
 - Pump delivers basal conservatively based on recent basal insulin needs

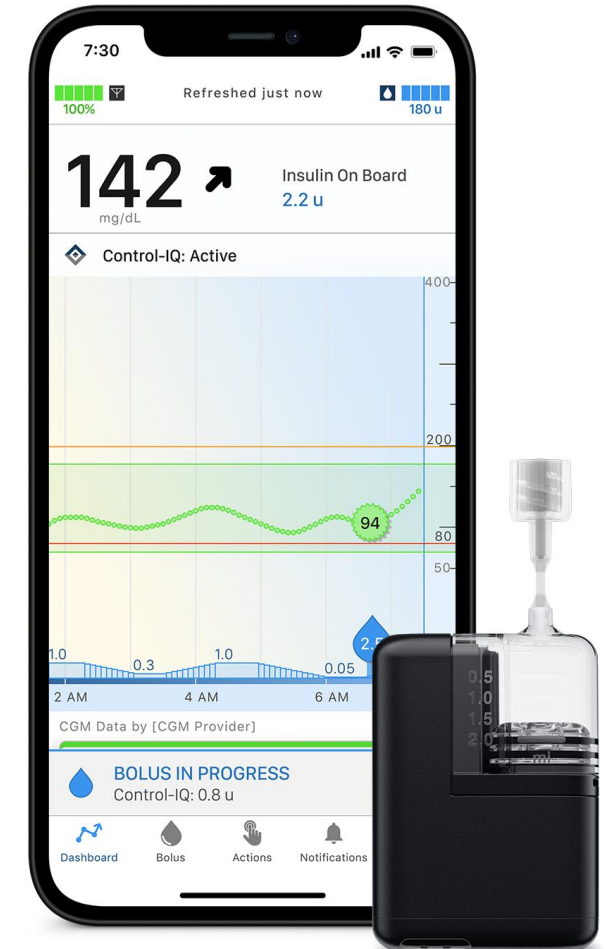
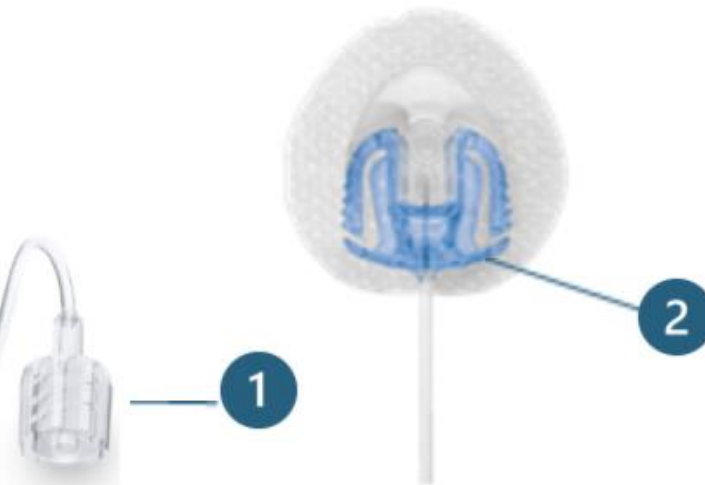
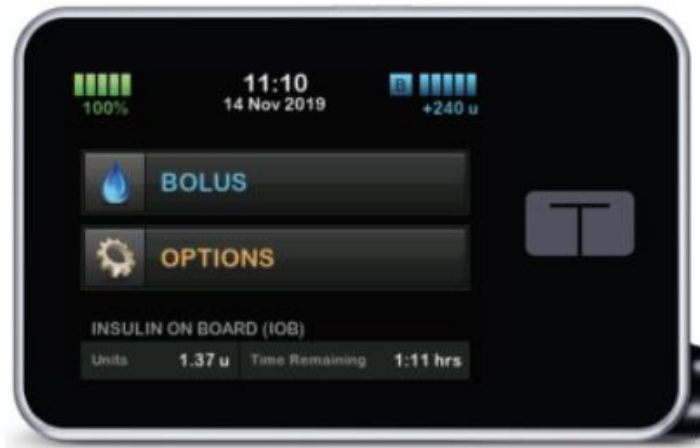


Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Omnipod 5
 - What happens if no sensor is on?
 - Basal delivery continues using Manual Mode settings
 - Will not automatically adjust
 - User is responsible for all bolus insulin delivery as usual

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Tandem
 - T:slim X2
 - Mobi



[t:slim X2 Insulin Pump | Type 1 Diabetes Insulin Pump | Tandem Diabetes Care](#)

[Tandem Mobi | Tandem Diabetes Care](#)

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- T:slim X2
 - Works with Dexcom G6, Dexcom G7, and Libre 2 Plus sensors
 - In addition to automatic basal insulin adjustment, can deliver correction bolus up to once every 60 minutes as needed to treat hyperglycemia
 - Called “Control-IQ”
 - Still requires user to bolus for carbohydrates before eating
 - Can bolus from smart phone if phone is compatible
 - Change site every three days
 - Glucose data is viewed on pump screen and phone app
 - Can't use separate Dexcom receiver to view glucose

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Tandem T:slim X2
 - How do you know if Control-IQ is turned on?
 - Look for the diamond in the upper lefthand corner of the graph on the home screen



Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Tandem T:slim X2
 - What happens if sensor is not on?
 - Basal delivery continues using Manual Mode settings
 - Will not automatically adjust
 - User is responsible for all bolus insulin delivery
 - No automatic correction boluses will be delivered

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Tandem Mobi
 - Works with Dexcom G7 sensor
 - In addition to automatic basal insulin adjustment, can deliver correction bolus up to once every 60 minutes as needed to treat hyperglycemia
 - Called “Control IQ”
 - Still requires user to bolus for carbohydrates before eating
 - All bolusing occurs from the smartphone app (no screen exists on pump)
 - Change site every three days
 - Glucose data is viewed on phone app only
 - Can't use separate Dexcom receiver to view glucose

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Tandem Mobi
 - How do you know if Control-IQ is turned on?
 - Look for the diamond in the upper lefthand corner of the graph
 - Also says, “Control-IQ: Active”



Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Tandem Mobi
 - What happens if sensor is not on?
 - Basal delivery continues using Manual Mode settings
 - Will not automatically adjust
 - User is responsible for all bolus insulin delivery
 - No automatic correction boluses will be delivered

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Medtronic 780G



Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Medtronic 780G
 - Only works with Medtronic Guardian Sensor
 - In addition to automatic basal insulin adjustment, can deliver correction bolus up to once every five minutes as needed to treat hyperglycemia
 - Called “SmartGuard”
 - Still requires user to bolus for carbohydrates before eating
 - Must bolus from pump (no smart phone bolusing option yet)
 - Change site every three days
 - Has option for seven-day infusion set ([Extended™ Infusion Set and Reservoir | Medtronic \(medtronicdiabetes.com\)](#))
 - Glucose data is viewed on pump screen and paired phone app

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Medtronic 780G
 - How do you know if you're in SmartGuard?
 - Look for the blue shield around the sensor glucose number
 - If the pump home screen just shows a graph, then the pump is out of the automated mode



Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Medtronic 780G
 - What happens if sensor is not on?
 - Basal delivery continues using Manual Mode settings
 - Will not automatically adjust
 - User is responsible for all bolus insulin delivery
 - No automatic correction boluses will be delivered

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Beta Bionics iLet



Makers of the first and only, fully automated bionic pancreas (betabionics.com)

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Beta Bionics iLet
 - Works with Dexcom G6 or Dexcom G7 sensors
 - In addition to automatic basal insulin adjustment, can deliver correction bolus up to once every five minutes as needed to treat hyperglycemia
 - Called “Going Bionic”
 - Still requires user to bolus, however not for grams of carbs
 - Boluses are called “meal announcements”
 - Usual amount of carbs, less than usual, or more than usual
 - Must bolus from pump (no smart phone bolusing option yet)
 - Glucose data is viewed on pump screen and paired phone app

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Beta Bionics iLet
 - How do you know if the pump is “bionic” (automatically adjusting insulin delivery)?
 - Look for the circle with arrows around the sensor glucose number/trend arrow



Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Beta Bionics iLet
 - “When your CGM is offline, your iLet Device will enter BG-run mode, which is limited to a maximum of 48 hours in the first 7 days after initializing the iLet, and a maximum of 72 hours thereafter. This mode requires frequent entry of BG values to continue insulin dosing. You will be alerted when BG values need to be entered. After the maximum allowable period (48 or 72 hours), BG-run mode will expire and CGM values are required to resume dosing. When BG-run mode expires and CGM values are not available, ALL insulin dosing will stop. You must switch to alternative therapy as advised by your healthcare provider.”

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Adaptivity
 - Some pump systems learn over time
 - Omnipod 5
 - Medtronic 780G
 - Beta Bionics iLet
 - A new pump or phone app wipes all adaptivity and device must learn about the user's insulin needs again
 - Tandem does not have a learning algorithm, therefore a new pump with the same settings as the previous pump will function the same way.

Insulin Pumps- Automated Insulin Delivery Systems (AIDs)

- Settings Changes
 - Each pump system differs in what settings affect how the AID system adjusts insulin delivery
 - Omnipod 5
 - Manual mode basal changes do not affect Automated Mode delivery
 - Bolus settings changes, including Target BG, do affect delivery
 - Tandem
 - Basal & bolus settings changes directly affect insulin delivery with algorithm
 - Medtronic 780G
 - Manual mode basal and ISF changes do not affect Automated Mode delivery
 - Bolus settings changes to Target BG and Carbohydrate Ratio do affect delivery
 - Beta Bionics iLet
 - Has no basal or bolus settings entered and therefore can't be changed at all
 - Can only change glucose targets and weight

Special Circumstances- Treating Hypoglycemia for Students Using AID systems

- Students will likely need less glucose to treat lows
 - Systems are automatically reducing or stopping basal insulin delivery when predicting that hypoglycemia may occur
- May only need 7-8 grams of carbohydrates to treat hypoglycemia, compared to usual recommendation of 15 grams of carbs

Special Circumstances- Physical Activity

- Aerobic activities that can cause hypoglycemia
 - Recess, Sports Practices
- Plan ahead to decrease risk for low blood sugars
 - If on MDI, may have a plan to have a snack without insulin coverage prior to activity
 - General guideline is 10-20 grams of carbs for every 30 minutes of moderate activity
 - If on insulin pump in manual mode, may start a Temporary Basal
 - User tells pump to decrease preset basal delivery by a percentage for a set period of time.
 - Example: 50% temp basal for two hours
 - Ideally, set 60-90 minutes before activity if possible

Special Circumstances- Physical Activity

- Plan ahead to decrease risk for low blood sugars
 - If on insulin pump in automated mode (AID system), may turn on activity feature to increase glucose target to 150 mg/dL
 - Tandem: Exercise Activity
 - Omnipod: Activity Mode
 - Medtronic: Temp Target
 - iLet: no option for adjusted glucose target
 - Ideally, set 60-90 minutes before activity
 - Avoid carb-loading while connected to pump with automated system running
 - Pump will respond to the rise in blood sugar by delivering more insulin

Special Circumstances- Physical Activity

- Plan ahead to decrease risk for low blood sugars
 - For MDI and pumps, can also reduce a mealtime insulin dose/bolus that is occurring within three hours of starting physical activity

Special Circumstances- Physical Activity

- Adrenaline-producing events
 - Games, matches, meets, performances, competitions, field day
- Expect blood sugars to rise during and after high-intensity exercise
 - Adrenaline rush prompts liver to release extra glucose into the blood

Adces. *Diabetes Care and Education Curriculum*. Adces; 2021.

Cornell, S. (2023). *The Art and Science of Diabetes Care and Education*. Page 416

Special Circumstances- Physical Activity

- Late lows after activity
 - “Hypoglycemia may follow within 1 to 16 hours of completion of exercise due to glucose transport into skeletal muscle tissue and hepatic glycogen depletion.”
 - If sporting events/exercise occur in the late afternoon or evening, late lows tend to occur overnight or could be early AM for students starting school early.

Special Circumstances- Illness/Physical Stress

- Illness, especially infection, raises blood sugars
- Menstrual cycles affect blood sugars
 - Hormone shifts, appetite changes, pain/discomfort
 - Can see high and low blood sugars
- Continue wearing insulin pump, especially if in automated mode
 - May have to deliver additional correction boluses to treat high BGs
- Check for ketones and monitor glucose every 2-4 hours

Special Circumstances- Emotional Stress

- Stress of all kinds raises blood sugars
- Continue wearing insulin pump, especially if in automated mode
 - May have to deliver additional correction boluses to treat high BGs

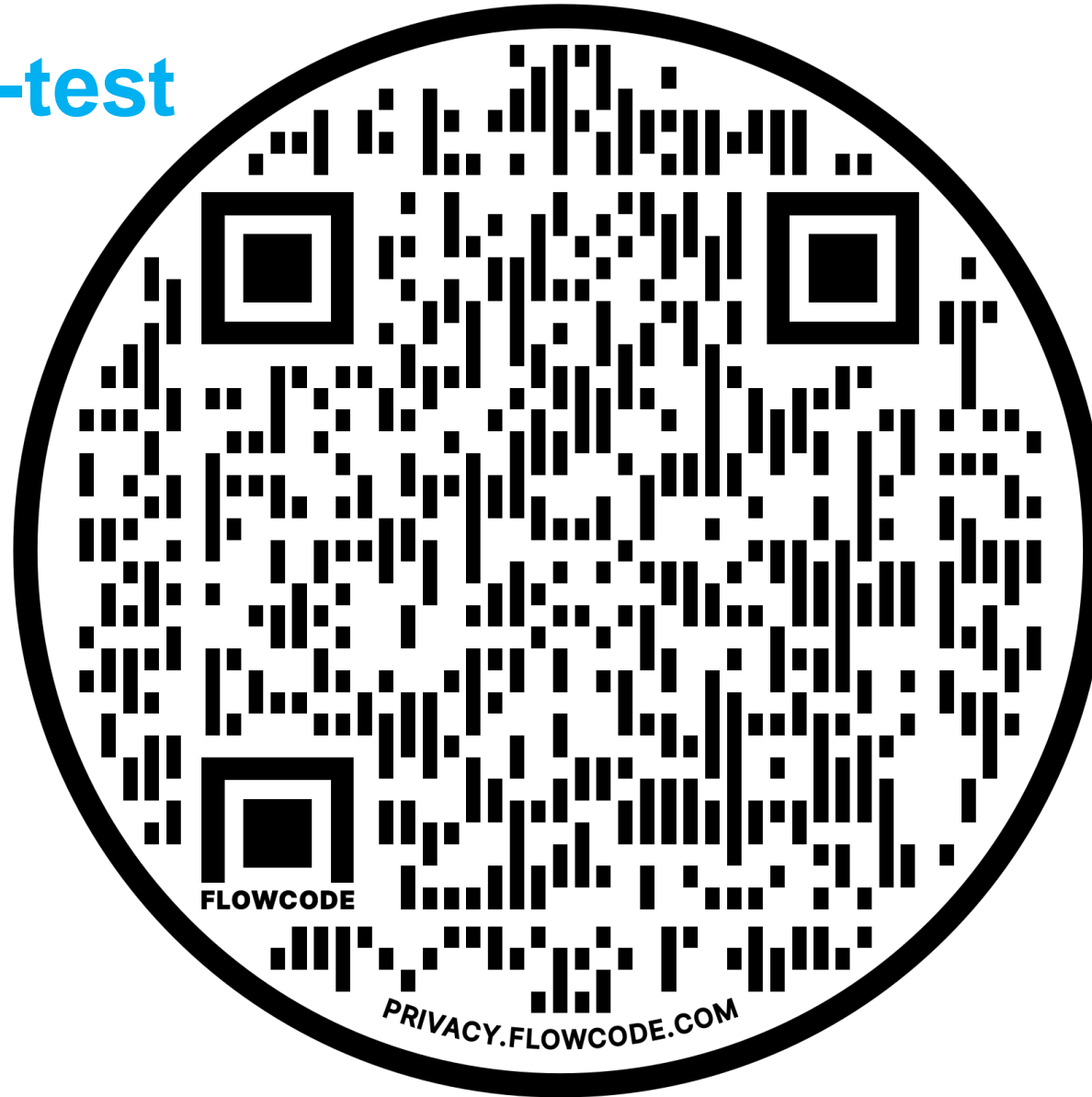
Pump Simulator Apps and Links

- Medtronic
 - [Virtual Pump Demo | Medtronic \(medtronicdiabetes.com\)](https://www.medtronicdiabetes.com)
- Tandem
 - [Virtual Pump Demos | Tandem Diabetes Care](https://www.tandemdiabetes.com)
- Omnipod
 - [Back to school with Omnipod® 5 | Omnipod](https://www.omnipod.com)
- Beta Bionics iLet
 - No virtual pump available

Additional Resources

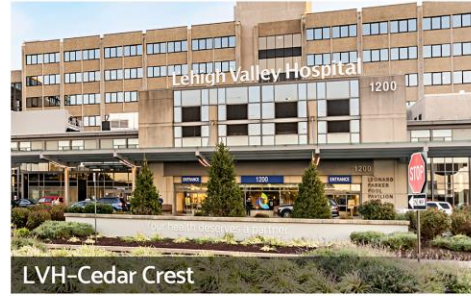
- Medtronic
 - [School-Nurse-Guide-MiniMed-780G-System.pdf](#)
([medtronicdiabetes.com](#))
- Tandem
 - [Diabetes Care Plan & Resources for School | Tandem Diabetes Care](#)
- Omnipod
 - [Back to school with Omnipod® 5 | Omnipod](#)
- Beta Bionics iLet
 - [LA000061_B-Educational-Resource-Guide-v5.6-1-1.pdf](#)
([betabionics.com](#))

Quick Post-test



Questions?

A COMPLETE HEALTH NETWORK



LVH-Cedar Crest



LVH-Muhlenberg



LVH-17th Street



LVH-Hazleton



LVH-Pocono



Lehigh Valley Reilly Children's Hospital



LVH-Schuylkill E. Norwegian Street



LVH-Schuylkill S. Jackson Street



LVHN-Tilghman



LVHN-Highland Avenue



LVH-Carbon



LVH-Dickson City



LVH-Hecktown Oaks



LVHN ExpressCARE



Health Centers



Lehigh Valley Physician Group



WHO WE ARE

LEHIGH VALLEY HEALTH NETWORK

14 HOSPITAL CAMPUSES

5 INSTITUTES

1 CHILDREN'S HOSPITAL

300+ PRACTICE LOCATIONS

9 COMMUNITY CLINICS

29 HEALTH CENTERS

19 EXPRESSCARE LOCATIONS

2 CHILDREN'S EXPRESSCARE LOCATIONS

60+ REHABILITATION LOCATIONS

80+ TESTING AND IMAGING LOCATIONS

22,000+ EMPLOYEES

1,900+ PHYSICIANS

1,200+ ADVANCED PRACTICE CLINICIANS

4,100+ REGISTERED NURSES

75,400 ACUTE ADMISSIONS

327,600 ED VISITS

1,700+ LICENSED BEDS

5-TIME MAGNET® HOSPITAL

LEHIGH VALLEY HEALTH NETWORK ACHIEVEMENTS

2021

BEST WORKPLACE IN HEALTH CARE & BIOPHARMA™

Fortune

GREAT PLACE TO WORK-CERTIFIED™

Second consecutive designation by Great Place to Work®

PATIENT SAFETY EXCELLENCE AWARD™

Healthgrades (Coordinated Health-Allentown)

BEST AMBULATORY SURGICAL CENTER

Newsweek (Eastern Pennsylvania Endoscopy Center)

NO. 1 HOSPITAL IN THE REGION

Eighth consecutive designation from U.S. News & World Report (LVH-Cedar Crest)

BEST-IN-STATE EMPLOYER

Forbes

STROKE GOLD PLUS QUALITY ACHIEVEMENT AWARD

Get With the Guidelines® (LVH-Cedar Crest, LVH-Pocono, LVH-Schuylkill and LVH-Hazleton)

LEVEL 10 MOST WIRED ACUTE CARE

College of Healthcare Information Management Executives

LEVEL 10 MOST WIRED AMBULATORY CARE

College of Healthcare Information Management Executives

DESIGNATED AS A LEVEL II TRAUMA CENTER

(LVH-Muhlenberg)

2022

TOP PLACES TO WORK IN THE LEHIGH VALLEY

The Morning Call

150 TOP PLACES TO WORK IN HEALTHCARE

Becker's Healthcare

LEAPFROG 'A' GRADE FOR QUALITY AND PATIENT SAFETY

The Leapfrog Group (LVH-Pocono, LVH-Hazleton)

PATIENT SAFETY EXCELLENCE AWARD™

Healthgrades (Coordinated Health-Allentown)

LGBTQ+ HEALTHCARE EQUALITY INDEX, THE HUMAN RIGHTS CAMPAIGN

(LVH-Cedar Crest, LVH-Muhlenberg, LVH-17th Street, LVH-Pocono and LVHN-Tilghman)

HAP COVID RESPONSE INNOVATION AWARD, TOP COVID-19 INITIATIVE RECOGNITION

The Hospital and Healthsystem Association of Pennsylvania

U.S. NEWS & WORLD REPORT BEST HOSPITALS

Ninth consecutive designation No. 1 Hospital in the Region, No. 7 Hospital in Pa. (LVH-Cedar Crest)

GREAT PLACE TO WORK CERTIFIED™

Third consecutive designation by Great Place to Work®

LEVEL 10 MOST WIRED ACUTE CARE

College of Healthcare Information Management Executives

LEVEL 10 MOST WIRED AMBULATORY CARE

College of Healthcare Information Management Executives

COMPREHENSIVE STROKE CENTER RECERTIFICATION

The Joint Commission (LVH-Cedar Crest)

AMERICA'S BEST PHYSICAL REHABILITATION CENTERS

Newsweek (LVH-Cedar Crest)

AMERICA'S BEST MATERNITY CARE HOSPITALS

Newsweek (LVH-Cedar Crest)

BEST MATERNITY HOSPITALS

Money/Leapfrog (LVH-Cedar Crest, LVH-Pocono)

GET WITH THE GUIDELINES

Stroke Gold Plus with Target (LVH-Cedar Crest, LVH-Schuylkill, LVH-Hazleton, LVH-Pocono)

GET WITH THE GUIDELINES

Stroke Gold Silver with Target (LVH-Muhlenberg)

EXCELLENCE IN PATIENT EXPERIENCE AWARD

Ranked first in the medium health systems by NRC

2023/24

U.S. NEWS & WORLD REPORT BEST HOSPITALS LIST

Ranked 27th nationally for orthopedic care, No. 6 hospital in Pa., top hospital in the region for the 10th consecutive year (LVH-Cedar Crest)

U.S. NEWS & WORLD REPORT

High Performing Maternity Care (LVH-Cedar Crest, LVH-Muhlenberg, LVH-Pocono, LVH-Hazleton)

AMERICA'S BEST MATERNITY HOSPITALS

Newsweek (LVH-Cedar Crest, LVH-Pocono)

GREAT PLACE TO WORK CERTIFIED™

Fourth consecutive designation by Great Place to Work

BEST HOSPITALS TO WORK FOR BY STATE

Becker's Healthcare

BEST-IN-STATE EMPLOYER

Forbes

TOP TEACHING HOSPITAL

The Leapfrog Group (LVH-Cedar Crest)

HOSPITALS AND HEALTH SYSTEMS WITH GREAT ORTHOPEDIC PROGRAMS

Becker's Healthcare (Lehigh Valley Orthopedic Institute)

HOSPITALS AND HEALTH SYSTEMS WITH GREAT ONCOLOGY PROGRAMS

Becker's Healthcare (Lehigh Valley Topper Cancer Institute)

HOSPITALS AND HEALTH SYSTEMS WITH GREAT HEART PROGRAMS

Becker's Healthcare (Lehigh Valley Heart and Vascular Institute)

HOSPITALS AND HEALTH SYSTEMS WITH GREAT SPINE AND NEUROLOGY PROGRAMS

Becker's Healthcare (Lehigh Valley Fleming Neuroscience Institute)

LEVEL 9 MOST WIRED

Ambulatory Care College of Healthcare Information Management Executives

LEVEL 9 MOST WIRED

Acute Care College of Healthcare Information Management Executives

LEAPFROG SAFETY GRADES

Spring 2023, "A" for Safety (LVH-Cedar Crest, LVH-Muhlenberg, LVH-Hazleton) Fall 2023, "A" for Safety (LVH-Cedar Crest and LVH-Hecktown Oaks)

GET WITH THE GUIDELINES

Stroke Gold Plus with Target The Joint Commission, American Stroke Association (LVH-Cedar Crest, LVH-Muhlenberg, LVH-Hecktown Oaks, LVH-Pocono, LVH-Schuylkill, LVH-Hazleton)

BEST IN-STATE HOSPITALS

Top 10 hospital in Pennsylvania Newsweek (LVH-Cedar Crest)

PATIENT CHOICE AWARD FOR HEALTH CARE

WebMD (Lehigh Valley Heart and Vascular Institute)

EMPOWERING WOMEN AWARD

Lehigh Valley Business

