# The Evolution of Diabetes Technology

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# AGENDA

- Quick Review of Type 1 and Type 2 Diabetes
- Review of Insulin Delivery
- Glucose Monitoring
- Insulin pumps - AID (Automated Insulin Delivery) Systems
- CGM therapy

# Type1 and Type 2 Diabetes

## Type 1 Diabetes

- Once known as juvenile diabetes or insulin dependent diabetes
- Auto immune disease attacks the beta cells in pancreas
- Pancreas makes little to no insulin
- Life long dependency on insulin
- Estimated 5-10 % of population

## Type 2 Diabetes

- Pancreas does not make enough insulin
- Cells don't respond normally to insulin known as insulin resistance
- Treatment is lifestyle changes, oral medications and/or insulin therapy
- Estimated 90-95% of population

# Insulin Delivery

- 1922 discovery of insulin
- Insulin vials and syringes
- 1981 insulin pens were introduced
- Easy to use injection devices used as MDI (multiple daily injection)
- Insulin pump therapy was introduced almost 40 years ago Introduced in 1970's
- CSII –continuous subcutaneous insulin infusion-only using short acting insulin

# Glucose Monitoring

- SMBG- self monitoring blood glucose
- Frequent monitoring from capillary blood
- Smaller and easier to use glucometers developed in 1980's
- CGM- continuous glucose monitoring started in 1999
- Disposable sensors testing sugar in interstitial fluid at intervals of 1-5 minutes

# Evolution of Diabetes Technology

- 1920's: Discovery of insulin, BD launched first specialized insulin syringe, commercial production of artificial insulin and Novo syringe launched
- 1950's: First disposable glass syringe
- 1960's: Invention of first insulin pump
- 1970's: Introduction of first commercial insulin pump
- 1980's: First insulin pen Novo pen
- 1990's: First generation of insulin pens launched and introduction of smart insulin pumps

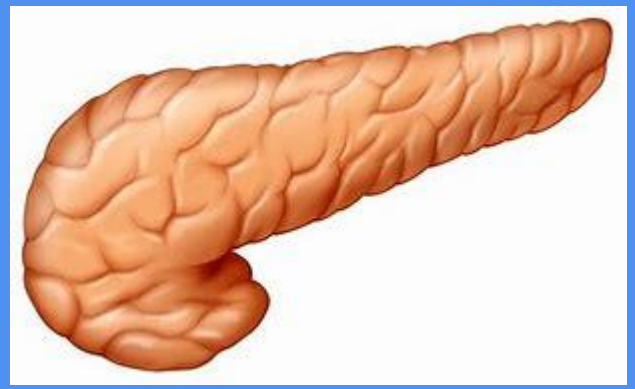
# Evolution of Diabetes Technology

- 2000's: Introduction of second generation of insulin pens and sensor augmented pumps emerged, first Omipod system FDA approved
- 2010: Introduction of artificial pancreas, Medtronic first hybrid closed loop system, first DIY artificial pancreas systems (closed looping) and FDA approved Medtronic AP 670 G inulin pump with Guardian 3 sensor
- 2017-2019: First Bionic Pancreas-iLet, Tandem Tslim X2 pump approved
- 2020's: Omnipod 5 system FDA approved, Tandem Tslim with control IQ, Tandem Mobi pump, Medtronic 780 G pump with Guardian 4 sensor and Beta Bionics i-Let pump FDA approved

Technology can be a wonderful thing…very useful tools to make living with diabetes more “normal”. However, technology is only as good as the effort put into its use.

# Insulin Pumps

Think of an insulin pump as an external pancreas



# Insulin Pump Basics

- Insulin pump
  - Battery operated device
  - Chargeable devices (like a cell phone)
  - Controlled by a computer chip
  - Reservoir/cartridge/pod filled with insulin
- Insulin Pumps are worn 24 hours per day

# Insulin Pump Basics

- Pumps are little computerized machines that use rapid acting insulin.
- They can calculate the exact dose of insulin needed when they are told blood sugar and carbohydrates or by using sensor data.
- Are also programmed to be very individualized. Insulin delivered through a tiny catheter that looks and feels sort of like fishing line. "Sites" can be put anywhere an insulin injection can be given and must also be rotated every 2-3 days.
- Hold 180-300 units of insulin. Most are partially waterproof.
- Has safety features to prevent from accidentally giving extra insulin.

**https://www.endocrineweb.com/guides/insulin/insulin-pump-overview**

# Insulin Pump Basics

- Only rapid acting insulin is used in insulin pumps (Novolog/Humalog/Fiasp/Admelog)
- Basal insulin/Bolus insulin
- **Basal Insulin** (takes the place of Lantus/Basaglar/Semglee/Tresiba/insulin glargine-yfgn)
  - Delivered in small doses every few minutes around the clock
  - Basal rates can be flexible
    - Can be adjusted based on lifestyle
- **Bolus Insulin**
  - Administered at meals and snacks
  - Correction of high blood sugars
  - ICR and CF can be adjusted based on lifestyle

# Insulin Delivery

- Insulin is stored in a reservoir/cartridge within the pump
- Insulin is delivered through a tube to an infusion set or through a pod
- Infusion sets are placed anywhere on the body that an injection can be delivered
- Inserted at a 45- or 90-degree angle
- 6-8 mm deep
- Placed manually or with insertion device

**Pod pump**

- Attached directly to the body
- No tubing

# Commitment Required for Successful Pumping

- Testing blood sugar AT LEAST 4 times a day if not wearing sensor.
- Changing site as instructed (minimum of every 3 days if not sooner)
- Be comfortable being “connected”.
- Have realistic expectations of insulin pump use.
- Attend follow-up appointments with physician
- Have a back-up plan for site/pump failure.

# UNRealistic Expectations of Pumping

- It is the CURE for diabetes.
- I can eat ANYTHING and ANY AMOUNT of anything I want whenever I want.
- I don’t have to check my blood sugar as often.
- My blood sugars will be perfect.

# Realistic Expectations of Pumping

- More flexibility with what to eat and when to eat.
- Tighter control of sugars while on pump.
- Expect to still have highs and lows.
- Usually takes 3-6 months to adjust to being “connected”.
- Will help alleviate some of the burden of diabetes.

# Pros and Cons of an Insulin Pump

- **Advantages of Pumping to Consider**
- Eliminates daily injections.
- Match insulin requirements to lifestyle
- More accurate insulin delivery, which can improve glucose control (aka HgbA1c)
- More flexibility
- Less blood sugar fluctuations

- **Disadvantages of Pumping to Consider:**
- Expense
- Potential for weight gain on a pump
- Some people don't like being attached
- Potential for DKA if bad site not caught quickly due to bent cannula or not inserted correctly

# Insulin Pump Companies

Omnipod

Tandem

Beta Bionics

Medtronic

# Omnipod

- Pod holds 200 units of insulin. Minimum amount is 85 units
- No tubing
- Wear pod for up to 72 hours
- POD is waterproof for up to 25 ft. for 1hr.
- Omnipod 5 is a hybrid closed-loop system and uses Dexcom G6

Omnipod Dash

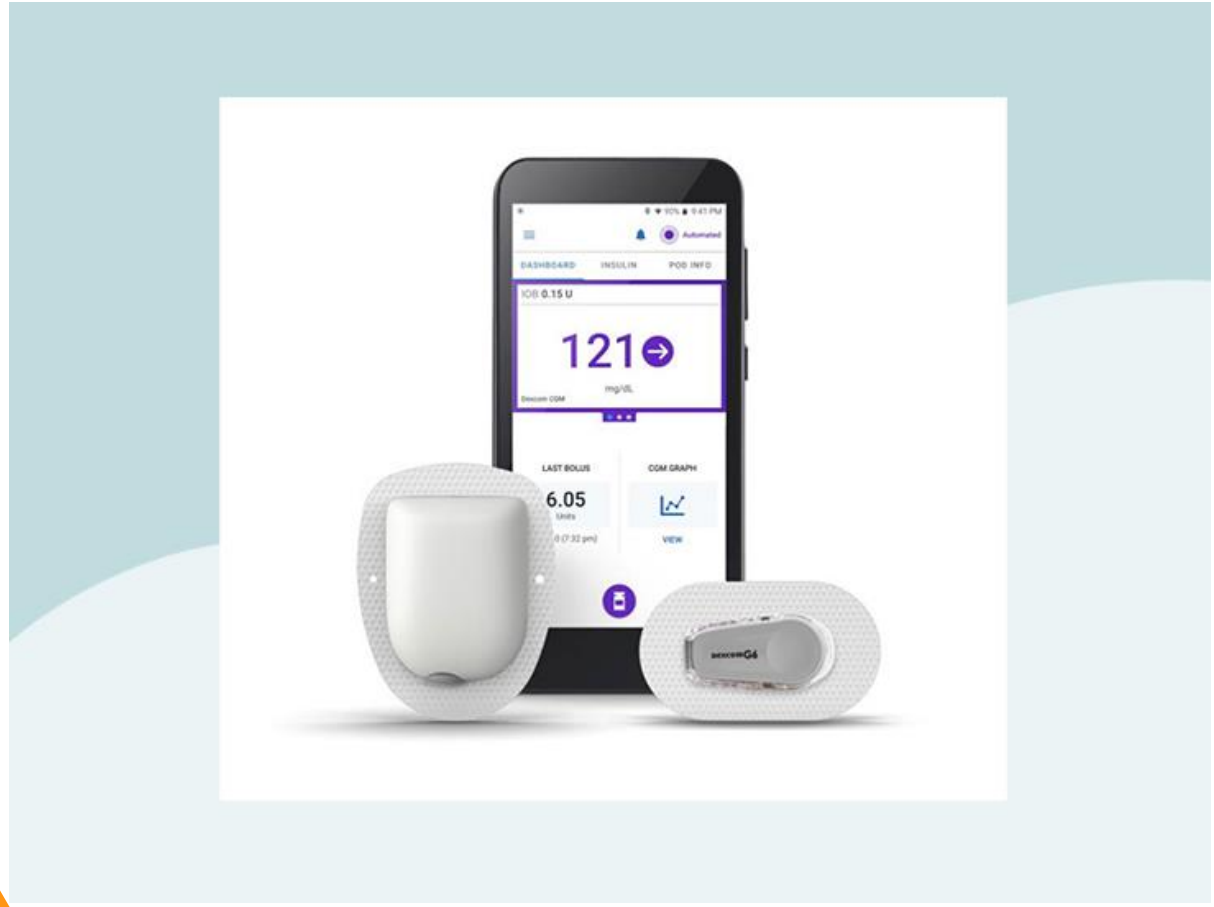

Omnipod 5


https://diabeteseducatorscalgary.ca/devices/insulin-pumps/omnipod
www.diatribe.org
www.omnipod.com/healthcareproviders/dash

# OmniPod Dash


- Tubeless pump
- Pod
- PDM (Personal Diabetes Manager) or Controller
  - Settings
  - Meter
  - Communicates remotely with pump
- Easy to use
- Touch Screen

# Omnipod 5

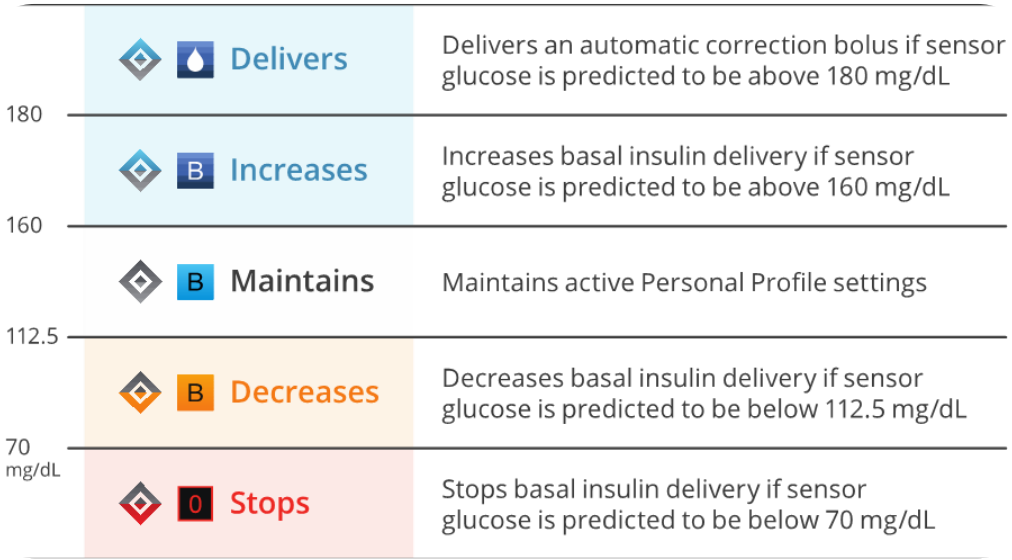



- Works with Dexcom G6
- Smart Adjust technology adjust insulin delivery based on Dexcom values every 5 minutes and predicts glucose 1 hour ahead
- Customizable target range between 110-150

# Tandem T Slim

- Holds 300 units of insulin in a cartridge. Minimum amount is 75 units
- Links with Dexcom G6 & G7/ Libre 2Plus
- Rechargeable battery. Can use with phone app.
- NOT compatible with Apidra.
- Watertight up to 3 feet for 30 minutes
- Control IQ
- Tslim x 2
- Touch screen

# Control IQ




- Control-IQ™ advanced hybrid closed-loop technology is designed to help increase time in range (70–180 mg/dL)*
- Uses Dexcom G6/ G7 CGM values to predict glucose levels 30 minutes in the future and adjust insulin delivery
- Also delivers an automatic correction bolus (up to one per hour) as needed for CGM readings >180 mg/dl

# Tandem Mobi
# Worlds smallest Pump

- I phone controlled
- 200 unit insulin cartridge
- Wireless charging
- Remote software updates
- Water resistant
- Notifications for alerts and alarms
- Ability to do a quick bolus from button on pump without using I phone
- Compatible with Dexcom G6 CGM sensor (Dexcom G7 expected Quarter 2, 2024)*
- Control IQ technology


# iLet Bionic Pancreas


# iLet Bionic Pancreas

- For patients with Type 1 Diabetes 6 years or older
- 180 unit cartridge for insulin (Humalog,Novolog/Fiasp)
- Option to choose a target of "usual 120", "less than usual 110" or "more than usual 130".
- **Must** wear Dexcom G6 or G7 for system to work
- The iLet makes 100% of the insulin dosing decisions based on CGM readings
- Uses infusion sets for insulin delivery

# iLet Bionic Pancreas

- Basal algorithm determines basal insulin requirements
- Adapts continuously to changing insulin needs
- No basal rates are programmed into system
- Develops and continuously updates basal rate profile for insulin delivery every 5 minutes

# iLet Bionic Pancreas

- Correction algorithm automatically adds insulin beyond basal insulin requirements
- Reduces insulin when needed to help protect against hypoglycemia
- Eliminates need for user to determine timing or size of correction dose
- Adapts continuously to changing needs
- Eliminates user error regarding “stacking insulin”

# iLet Bionic Pancreas

- Meal announcement algorithm eliminates the need to set or know insulin to carb ratios
- No Carb Counting. The iLet only needs an estimate of the carbs at a meal. 3 options: "Usual for me" "more than usual" or "less than usual".
- Gives meal doss customized to individual.
- Automatically adjusts amount of insulin given based on dosing history or similar, previous meal announcements

# Medtronic 780 G

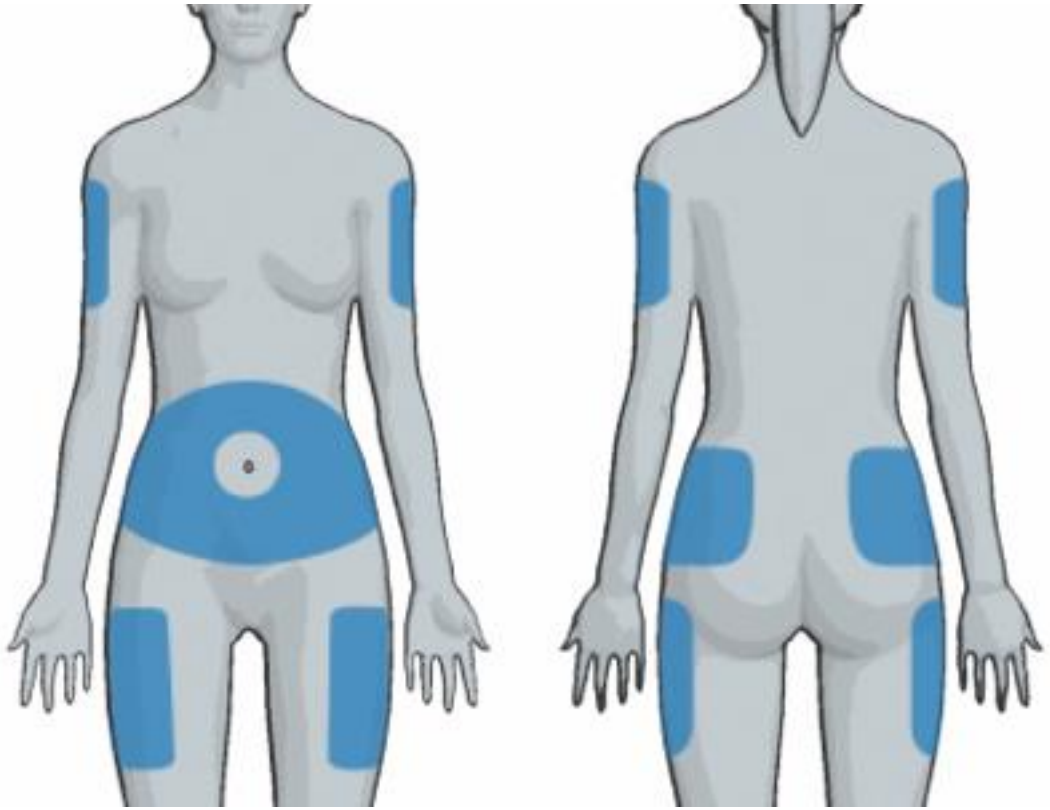
# Medtronic 780 G Smart Guard Technology

- 780 G pump receives information from Guardian 4 sensor to calculate insulin adjustments
- Only the MiniMed™ 780G system with **Meal Detection™ technology*** can automatically deliver correction† boluses of insulin **without any work needed from you,** as quickly as every 5 minutes.§
- Uses Guardian 4 sensor with transmitter
- Extended infusion set for 7day wear

# Medtronic 780 G Smart Guard Technology

- Customized targets of 100,110 or 120
- Temporary target of 150 for exercise
- Auto corrections every 5 minutes when sensor reads >120 mg/dl
- Holds 300 units of insulin in reservoir
- Multiple, different infusion sets can be used
- Phone apps for patient and caregivers displays glucose, insulin and alerts

# Potential Infusion Site Spots



# Pump Sites

-Tiny cannula inserted under skin
-Changed every 2-3 days
-Connected to insulin source-cartridge, reservoir or pod
-Can be inserted anywhere you can give an insulin injection


# Today's CGM Options

**Dexcom**

**Libre**

**Medtronic**

# How do CGMs work?

- Sensor is inserted under skin and measures interstitial glucose level (glucose between the fluid between cells)
- Transmitter wirelessly sends information to a monitor
- Blood draw is most accurate, then a fingerstick. However, all have a margin of error
- SG & BG should be similar
- Larger difference can be seen after meals or after a bolus, during exercise

Always use a FSBS for treatment decisions if your sensor doesn't match how you feel

# Advantages of CGM Use

1. Less fingersticks.
2. Easy access to blood glucose 24/7.
3. Helps prevent severe hypoglycemic events.
4. Easy to use.

# "Do I really not need to do fingersticks?"

- Although a lot of marketing suggests you never have to do finger sticks again, there are certain times you will need to fingerstick, such as:
- if CGM fails/falls off
- for calibration, if required
- to confirm a reading in question before making dosing decision

Thank you

Questions ????