

Introduction to Insulin Pumping - The role of Insulin Pumping in Diabetes Care

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Objectives

- A) IDENTIFY WHO IS APPROPRIATE FOR INSULIN PUMP THERAPY
- B) IDENTIFY KEY FUNCTIONS OF AN INSULIN PUMP.
- C) IDENTIFY RESOURCES AVAILABLE IN WYOMING.

ADDITIONALLY
IDENTIFY NON-INSULIN PUMP
INSULIN DELIVERY DEVICE
OPTIONS

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Disclosures

Product Trainer for

Medtronic

Omnipod

Tandem



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Terminology

- ▶ A1C (HbA1c) Test - A 2-3 month average of blood glucose values expressed in percent. The normal range varies based on a number of factors.
- ▶ Advanced Hybrid Closed Loop system (AHCL) - AHCL systems are differentiated from a standard Hybrid Closed Loop system (HCL) by the ability to deliver automatic correction boluses.
- ▶ AID Automated Insulin Delivery (AID) - Any system where an insulin pump is able to adjust insulin delivery based solely on input from a CGM or other data source, without user intervention.
- ▶ Artificial Pancreas - An investigational device designed to mimic a human pancreas by combining an insulin pump with a continuous glucose sensor.
- ▶ Aseptic Technique - A process for maintaining sterilization and avoiding contamination.
- ▶ Audio Bolus - The pump can be programmed so the user hears a beep when they select a bolus insulin amount.
- ▶ Basal-IQ Technology - A predictive low glucose suspend system (PLGS) from Tandem Diabetes Care that uses the Dexcom G6 CGM.
- ▶ BG (Blood Glucose / Blood Sugar) - The level of glucose in the blood, measured in mg/dL.
- ▶ Bolus - A dose of insulin given to cover food consumed or elevated blood glucose

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Terminology - continued

- ▶ Cannula - The tiny, flexible section of the infusion set that is inserted under the skin through which insulin is delivered.
- ▶ Carb Ratio (Insulin-to-Carbohydrate Ratio) - The number of grams of carbohydrate that one unit of insulin will cover.
- ▶ Cartridge - A disposable insulin holding component found in certain pumps.
- ▶ CGM (Continuous Glucose Monitor) - A continuous glucose monitor (CGM) is a handheld personal monitoring device that uses wireless technology to collect glucose readings from a small sensor inserted under the skin.
- ▶ Closed Loop - A system that regulates blood glucose automatically without a person with diabetes needing to enter data such as glucose or carbohydrate values.
- ▶ Closed Loop Control (CLC) - A measure of how much time an automated insulin delivery (AID) system is actively adjusting insulin delivery. Typically communicated as a percentage.
- ▶ Control IQ - Definition and description coming soon.
- ▶ Correction Bolus - A dose of insulin given to correct an elevated blood glucose level.
- ▶ Correction Factor (Insulin Sensitivity Factor) - The amount of blood glucose (mg/dL) that is lowered by one unit of insulin.
- ▶ Discard Pod - The DISCARD POD option (on certain pumps only) is offered if the PDM is unable to reestablish communication with the Pod after a communication error. This option allows the PDM to abandon that Pod and activate a new Pod.

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Terminology - continued

- ▶ Fingerstick - A method used to test blood glucose by using a puncturing device (like a lancet) to take a small sample of blood from the finger.
- ▶ Infusion Set (Insertion Set) - A complete tubing system that is attached to the end of the cartridge of the pump and connects to the body at the infusion site, through which insulin is delivered.
- ▶ Infusion Site (Insertion Site) - The area on the body into which the cannula or needle are inserted.
- ▶ Injection / Infusion Site Rotation - Changing the places on the body where insulin is injected. This applies to either syringe injections or insulin pump infusion sets. Rotation prevents the formation of lipodystrophies (defects in the breaking down or building up of fat below the surface of the skin), which can result in lumps or small dents in the skin surface.
- ▶ Insertion Device - A device used to insert the cannula under the skin.
- ▶ Insulin Duration - The amount of time that insulin is active and available in the body after a bolus has been delivered. It is also used in the calculation for insulin on board (IOB).
- ▶ Insulin on Board (IOB or BOB) - Reflects how much insulin is remaining in the body from a previous bolus (or boluses) that will continue to lower glucose. It is also referred to as active insulin or bolus on board.
- ▶ Insulin Pump - A small medical device that delivers precise amounts of short- or rapid-acting insulin into the body in the treatment of diabetes. The two modes of delivery are basal and bolus.
- ▶ Insulin Stacking - Occurs when multiple boluses of insulin accumulate in the blood and may lead to hypoglycemia.
- ▶ Introducer Needle - A small needle used to insert the cannula under the skin and that is removed after insertion.

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Terminology - continued

- ▶ LGS Low Glucose Suspend - A term for early automated insulin delivery (AID) systems that shut off insulin delivery when CGM values dropped below a given level. Also called Threshold Suspend systems.
- ▶ Occlusion - A blockage or interruption in insulin delivery.
- ▶ PDM - Personal Diabetes Manager (typically a pump).
- ▶ PLGS Predictive Low Glucose Suspend system - Similar to LGS, except insulin delivery is shut off based on predicted glucose values, not current values.
- ▶ Pod Therapy - A PDM that's similar to traditional insulin pumps in some ways but are wearable, insulin-filled Pods that include a small cannula (like a tube) that inserts automatically. Often still referred to as a pump.
- ▶ Quick Bolus - A secondary way to deliver a bolus by following vibration and beep commands without navigating through or viewing the insulin pump screen.
- ▶ Rapid-Acting Insulin - A type of insulin with the most rapid onset (10 minutes), that works more quickly at lowering your blood glucose.
- ▶ Reverse Correction (negative correction) - For blood glucose levels below the Target BG, the Bolus Calculator (feature on some pumps) uses a Correction Factor to reduce a portion of a meal bolus dose.

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Terminology - continued

- ▶ Short-Acting Insulin - A type of insulin that starts to lower blood glucose within 30 minutes after injection and has its strongest effect 2 to 5 hours after injection.
- ▶ Site Reminder - A programmable setting to remind the pump user when it is time for an infusion set to be changed.
- ▶ Syncing - Pairing two devices so that they can communicate wirelessly with each other.
- ▶ Target Glucose - A specific glucose goal typically used to calculate a Correction Bolus.
- ▶ Target Range - An ideal glucose range for people with diabetes, and is defined as between 70mg/dL and 180 mg/dL.
- ▶ Temporary Rate - An insulin pump feature that allows a short-term adjustment to the basal rate.
- ▶ Time in Range (TIR) - The amount of time spent in a person with diabetes ideal blood sugar range. TIR is typically 70 and 180 mg/dL in a 24-hour period but can be modified for a variety of reasons. It is often expressed as a percentage.
- ▶ Time Segments - Specific time periods within a Personal Profile where basal rates, correction factors, carb ratios, and target glucose values are set.
- ▶ Treatment Value - Predicted CGM values that trigger predictive technology to act in order to help increase time in range.
- ▶ Treshold Suspend - Early automated insulin delivery (AID) systems that shut off insulin delivery when CGM values dropped below a specific level. Also known as Low Threshold Suspend or Low Glucose Suspend systems.
- ▶ Tubing - A flexible tube that allows insulin to flow from the pump to the infusion site.

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Terminology

Direct from DANATECH – Association of Diabetes Care and Education Specialists Technology Platform

<https://www.adces.org/danatech/insulin-pumps/insulin-pumps-101/insulin-pump-glossary>



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Considerations of insulin pump therapy

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CLINICAL INDICATIONS FOR INSULIN PUMP USE

- ▶ Persons with Type 1 diabetes or Type 2 diabetes requiring frequent multiple daily injections
- ▶ Inadequate glycemic management despite optimized multiple daily injection therapy
- ▶ High glucose variability
- ▶ Elevated A1C
- ▶ Recurrent, severe or unpredictable hypoglycemia
- ▶ Nocturnal hypoglycemia
- ▶ Hypoglycemia unawareness
- ▶ Recurrent hyperglycemia
- ▶ Dawn phenomenon
- ▶ Preconception planning
- ▶ Pregnancy
- ▶ Extreme insulin sensitivity
- ▶ Gastroparesis
- ▶ Early neuropathy or nephropathy
- ▶ Renal transplantation
- ▶ Potentially persons with needle phobia
- ▶ Lifestyle Indications
- ▶ Erratic schedule
- ▶ Varied work shifts
- ▶ Frequent travel
- ▶ Desire for flexibility
- ▶ Inconvenience of multiple daily injections

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DESIRED ATTRIBUTES OF A PUMP CANDIDATE (AND/OR PARENT(S) OF PUMP CANDIDATE)

- ▶ Motivation to succeed, as pump therapy requires readiness, preparedness and time investment before and during initiation
- ▶ Realistic expectations of the capabilities of pump therapy
- ▶ Demonstration of independent diabetes management and knowledge of the basics of diabetes education, including all topics listed in the National Standards for Diabetes Self-Management



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CONSIDERATIONS FOR DISCONTINUING AN INSULIN PUMP

- ▶ Lack of insurance or means to pay for an insulin pump and pump supplies
- ▶ Change in physical or mental capacity to manage an insulin pump
- ▶ Any suicidal ideation

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Choosing the “RIGHT” Pump

Cost and Coverage



Tube and Tubeless

Alarms/Alerts and Customization

Glucose Monitoring | Insulin Pumps & A

[Home](#) / [Insulin Pumps](#) / [Find & Compare Insulin Pumps and AIDs](#)

NARROW YOUR SEARCH

- No Tubing Required
- Activity Settings
- Automatic Correction Boluses

FIND & COMPARE INSULIN PUMPS

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Insulin Pump Therapy

Continuous Subcutaneous Insulin Infusion



Suspend Features



Automated Insulin Delivery (AID) Systems



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Continuous Subcutaneous Therapy (CSII)

Must have an infusion set placed into the skin

- May be visible tube

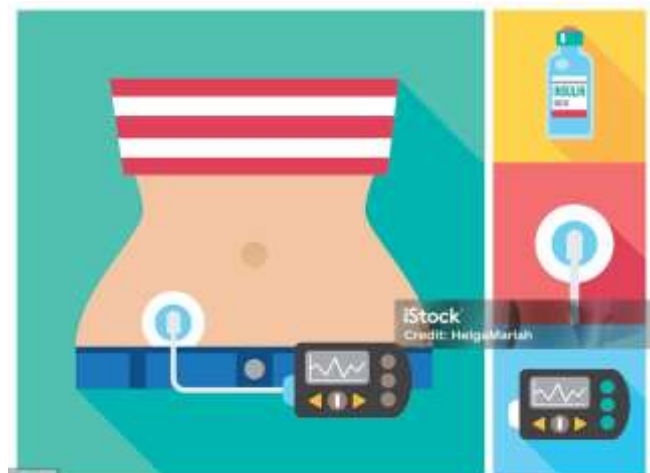
- May be "tubeless"

- May be steel

Rapid Acting Insulin

- Fiasp @ not recommended for some devices

Insulin dose based on basal rate; as well as user delivered boluses based on prescribed Insulin Correction Factor (ICF or Insulin Sensitivity Factor/ISF) and Insulin Carb Ratio (ICR)



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Traditionally CSII Pumps



Features

Currently Available?

Auto Correct Bolus

Closed Loop Functionality

Calibration Required

Medicare Covered

Remote Software Update Cap.

Multiple Languages

Food Database

Waterproof

Other Sig. Features

Accu-Chek Solo Micropump

AWAITING USA Release

No

No

No

No

No

Yes

No

IP22: Protected from water spray less than 15 degrees from vertical

200 unit hold / 4 day wear / 2 cannula length options

Omnipod DASH

Yes

No

No

No

Yes

Yes

Yes

IP28: As deep as 25 feet of water for up to 60 minutes

200 unit hold / 3 day wear / connect with glucometer

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Automated Insulin Delivery Devices

Must contain

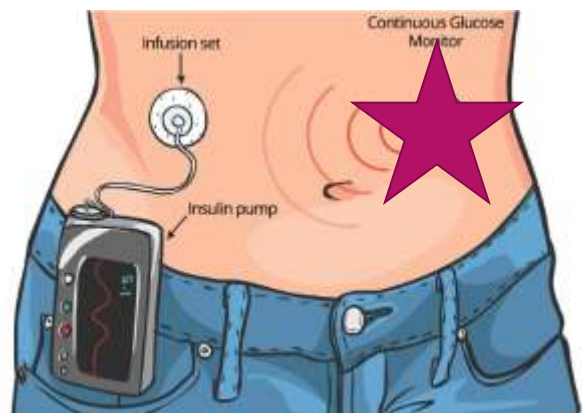
Insulin Pump

Connected CGM

Algorithm

Settings still include all of the settings from CSII pumps.

Automation comes from the algorithm making either basal insulin adjustments and or basal insulin adjustments along with correction boluses.



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AID Systems



Features

Activity Feature

Auto Correct Bolus

Closed Loop Functionality

Calibration Required

Medicare Covered

Remote Software Update Cap.

Multiple Languages

Food Database

Waterproof

Other Sig. Features

Medtronic 770G

Yes – Temp Target 150 for 0.5-12 hrs

No

Yes – Guardian 3 sensor & transmitter

Yes – Every 12 hours

Yes

Yes – to 780G as available

Yes

No

Yes – Sensor 8 feet for 30 minutes, pump is waterproof 12 feet x 24 hr

300 unit hold / treatment target of 120 mg/dL when automated

t:slim x2 with Basal IQ

No

No

No – does pause delivery to prevent lows

No – Dexcom G6

Yes

Yes

No

No

IXP 7: As deep as 3 feet of water for up to 30 minutes

300 unit hold / temp basal rate feature

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AID Systems



Features

Activity Feature

Auto Correct Bolus

Automatic Insulin Adjustments

Closed Loop Functionality

Calibration Required

Medicare Covered

Remote Software Update Cap.

Multiple Languages

Waterproof

Other Sig. Features

Medtronic 780G

Yes

Yes

Yes

Yes

No – Guardian 3 & 4 sensor / transmitter

Yes – confirm with Medtronic

Yes

Yes

IXP 8: 12 feet (3.6 meters) for up to 24 hours

300 unit hold / Phone Apps for data following

t:slim x2 with Control IQ

Yes – also sleep feature

Yes

Yes

Yes

No – Dexcom G6 / G7 & Libre 2+

Yes

Yes

No

IXP 7: As deep as 3 feet of water for up to 30 minutes

300 unit hold / phone app for bolusing

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AID Systems



Features

Activity Feature
Auto Correct Bolus
Closed Loop Functionality
Calibration Required
Medicare Covered
Remote Software Update Cap.
Multiple Languages
Food Database
Waterproof

Other Sig. Features

Omnipod 5

Yes
 No
 Yes – Dexcom G6 / G7
 No
 Yes
 Yes
 Yes
 No
 IP28: As deep as 25 feet of water for up to 60 minutes
 200 unit hold / has an android phone app or controller option

Tandem Mobi

Yes
 Yes
 Yes – Dexcom G6
 No
 Yes
 Yes
 Yes
 No. Water Resistant - Tested at 8 feet for 2 hours (IP28 rating)
 200 unit hold / 3 day wear / iPhone app only

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AID Systems



Features

Activity Feature
Auto Correct Bolus
Closed Loop Functionality
Calibration Required
Medicare Covered
Remote Software Update Cap.
Multiple Languages
Food Database
Waterproof

Other Sig. Features

iLet Bionic Pancreas

No
 Yes
 Yes
 No – Dexcom G6
 Not Yet
 Yes
 No
 No
 Yes. Up to 12 feet for up to 30 minutes.
 300 units / variable target treatment glucose levels

Medtronic 630G

No
 No
 No – stops insulin for low glucose
 Yes
 Yes
 No
 No
 12 feet for 24 hours after manufacturing w/ reservoir
 300 unit hold / 3 day wear / connect with glucometer

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Alternative Pumping

- ▶ Tidepool Loop gains FDA clearance
 - ▶ Tidepool Loop is the first fully interoperable automated insulin dosing app, cleared by the FDA, that originated as a patient-led initiative



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Non Pump Delivery Considerations

- ▶ Uses multiple daily injections (MDI) and has access to a compatible smart phone and app
- ▶ Struggles to calculate doses accurately and may benefit from the bolus calculator feature available with smart pen technology
- ▶ Misses doses and/or forgets when the last dose was given
- ▶ Is challenged by the need for frequent blood glucose logging and may benefit from the integrated meter features that automatically transmit the reading to the app
- ▶ Does not want to use an insulin pump, but desires access to more comprehensive data regarding their insulin dose and glucose trends

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Non Pump Delivery Systems – tip sheet



NovoPen 6

Medicine Type:

Levemir, Tresiba, Novolog or Fiasp (long or short acting insulins)

Dose Delivery:

1-60 units in 1 unit increments



NovoPen Echo

Medicine Type:

Levemir, Tresiba, Novolog or Fiasp (long or short acting insulins)

Dose Delivery:

0.5 to 30 units in 0.5-unit increments

InPen by Medtronic

Medicine Type:

Lilly Humalog® U-300 mL and Novo Nordisk Novolog® and Fiasp® U-100 3.0 mL pre-filled insulin cartridges.

Dose Delivery:

0.5 Units

Largest Dose Possible

30 units

Phone App with

Fixed dose/meals size/carb ratio



CeQur Simplicity

Medicine Type:

Novolog or Humalog

Dose Delivery:

2 units

Largest Dose Possible:

2 units

Total Capacity:

200 units



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Panther Program

▶ Pantherprogram.org

The screenshot shows the Panther Program website homepage. At the top, there is a navigation bar with the Panther logo (a stylized 'P' in a circle) and the text "PANTHER® Diabetes Technology. Deciphered." To the right of the logo are links for "HOME" and "RESOURCE". Below the navigation bar is a large heading: "Get to the gist of what you need to know." Underneath this heading is a sub-heading: "Essential resources and guidance for health care professionals working with diabetes technology." Below the sub-heading are four prominent buttons with arrows pointing right: "Device Comparison Chart", "Point-of-Care Clinic Tools", "NEW Insulin Pump Settings Tool", and "Skin Solutions". To the right of these buttons is a small thumbnail image of a document or chart.

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Panther Program Clinic Tools



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Panther Program Settings Tool

INSULIN PUMP SETTINGS GUIDANCE

INPUT THE FOLLOWING TO GET STARTED:

Age:*	Total Daily Basal: Long acting insulin dose	Do you know their current Insulin-to-Carb (I:C) Ratio(s)? *
<input type="text"/>	<input type="text"/>	<input type="radio"/> Yes <input type="radio"/> No
Weight (kg):*	Injection Total Daily Dose (TDD): The total amount of insulin from long acting and rapid acting insulin received each day, on average.	Do you know their current Correction Factor/Sensitivity? *
<input type="text"/> <input type="radio"/> Weight entered is in kilograms*	<input type="text"/>	<input type="radio"/> Yes <input type="radio"/> No
Duration of type 1 diabetes: *	Most recent A1c (if known): <input type="text"/> %	
<input type="radio"/> ≤ 1 year <input type="radio"/> > 1 year		
	Current Time In Range (TIR) (if known): <input type="text"/> % % time with glucose levels: 70-180 mg/dL	

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Panther Program Settings Tool

The screenshot shows the 'BASAL PROGRAM' tab of the Panther Program Settings Tool. It contains three steps for calculating pump settings:

- STEP 1:** Reduce injection basal insulin (35 units) by 20-30% to get pump total daily basal dose (range of 24.5 - 28.0 units). The calculated **Total Daily Basal Dose (pump)** is 28 units/day.
- STEP 2:** Divide by 24 hours to get **Hourly Basal Rate**. The calculated **Hourly Basal Rate** is 1.20 units/hour.
- STEP 3:** Use this basal rate as a starting point. You can program the same rate for the full 24 hour day, or you can increase or decrease the basal rate for different times of day. You use the time segments we suggest to

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Case Study 1

87 yo female

PMHx: Type 1 diabetes

CKDIII

Mild Retinopathy

Current pump warranty expires end of May

Insurance – Medicare / BCBS

- ▶ Current pump: Medtronic 630G
- ▶ Current CGM: Dexcom G6
- ▶ Current Settings: uses Exchange Ratios in pump settings instead of Carb Ratios
- ▶ A1C 7.3%
- ▶ CGM Summary
 - ▶ High – 31%
 - ▶ TIR – 65%
 - ▶ Low – 3%
 - ▶ Very Low - <1%

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Case Study 2

24 yo male

PMHx: Type 1 diabetes

Unknown eye issues, but reports blurred vision at times.

Insurance – Blue Cross Blue Shield; Parents Insurance

- ▶ Current pump: Tandem t:slim x2 (previous pump, Medtronic 670G)
- ▶ Current CGM: Dexcom G6 (variable use) / Dexcom G7 (2 months) / Libre 3 (this week)
 - ▶ Mostly using BGs and glucometer
- ▶ Current Settings: "manual" control IQ turned off
- ▶ A1C 11%(2024); 8.2%; 9.6% (2023); 10.4% (2018) 11.8%(2018)
- ▶ Current desires: a new pump that is not connected to CGM

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Case Study 3

24 yo male

PMHx: Type 1 diabetes

Unknown eye issues, but reports blurred vision at times.

Insurance – Blue Cross Blue Shield; Parents Insurance

- ▶ Current pump: Tandem t:slim x2 (previous pump, Medtronic 670G)
- ▶ Current CGM: Dexcom G6 (variable use) / Dexcom G7 (2 months) / Libre 3 (this week)
 - ▶ Mostly using BGs and glucometer
- ▶ Current Settings: "manual" control IQ turned off
- ▶ A1C 11%(2024); 8.2%; 9.6% (2023); 10.4% (2018) 11.8%(2018)
- ▶ Current desires: a new pump that is not connected to CGM

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References

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- ▶ <https://www.adces.org/danatech/insulin-pumps/pumps-in-professional-practice/pump-therapy-assessment>
- ▶ <https://www.adces.org/danatech/insulin-pumps/insulin-pumps-101/choosing-the-right-pump>

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- ▶ chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.adces.org/docs/default-source/practice/educator-tools/insulin/role_insulin_smart_pens_tip-sheet.pdf?sfvrsn=ffc49f58_4
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- ▶ <https://www.adces.org/danatech/insulin-medicine-delivery/find-compare-delivery-devices/product-detail/inpen>
- ▶ <https://www.adces.org/danatech/insulin-medicine-delivery/find-compare-delivery-devices/product-detail/cequr>

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- ▶ <https://www.adces.org/danatech/insulin-pumps/find-and-compare-insulin-pumps/product-detail/accu-chek-solo-micropump>
- ▶ <https://www.adces.org/danatech/insulin-pumps/find-and-compare-insulin-pumps/product-detail/omnipod-dash>
- ▶ <https://www.adces.org/danatech/insulin-pumps/find-and-compare-insulin-pumps/product-detail/minimed-770g-system---integrated-cgm>
- ▶ <https://www.adces.org/danatech/insulin-pumps/find-and-compare-insulin-pumps/product-detail/t-slim-x2-with-basal-iq-technology>

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- ▶ <https://www.adces.org/danatech/insulin-pumps/find-and-compare-insulin-pumps/product-detail/minimed-780g-system>
- ▶ <https://www.pantherprogram.org/>
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- ▶ <https://diatribe.org/tidepool-loop-cleared-fda>
- ▶ <https://www.tidepool.org/>

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