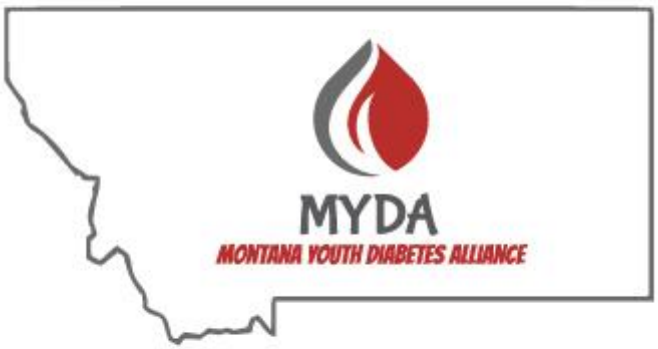

Section 6:
Insulin Pumps

Insulin Pump Therapy

What is a Pump?

An insulin pump is a small microcomputer that constantly provides insulin using a motorized drive device. Rapid-acting insulin is loaded into a reservoir or cartridge, which is then inserted into the pump's case. This is then connected to an insulin infusion set, a plastic tube that runs to a pump "site" where a small cannula, using a needle, has been inserted under the skin. After insertion, the needle is removed (similar to an IV). The insulin is then infused through the tubing and cannula under the skin. The pump site is taped and left in place for up to 2-3 days.

The pump is programmed to give a pre-set amount of insulin at regular intervals every few minutes throughout the day -- the ***basal rate***. In general, each time a person eats carbohydrates, or wants to correct a blood glucose (BG) elevation, buttons on the pump must be pushed to give a "***bolus***" of insulin. The current pumps have smart technology to help calculate recommended insulin dosage, based on the preprogrammed settings in the pump. Long-acting insulin is typically not given concurrently with a pump, but is often used as a back-up in case of pump failure.

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C.A.R.E.S. Framework for Understanding AID

Calculate: How does the system calculate automated insulin delivery?

Adjust: Which pump settings can the user adjust when using automated insulin delivery?

Revert: Can the pump operate in manual mode, without automation? Will the system revert the user out of insulin automation?

Educate: What are some key educational tips for AID in general, and for each system?

Sensor/Share: Which CGM sensor is used? Are there remote data sharing options?

BDCPantherDiabetes.org/device-comparison

CALCULATE

	Minimed 670G/770G 	T:Slim X2 Control IQ 	Omnipod 5 
What is automated insulin delivery (AID) called?	Auto Mode	Control-IQ	Automated Mode
Basal Insulin automation?	Yes; Automated basal insulin delivery calculated based on total daily insulin from past 2-6 days	Yes; Automated basal insulin delivery that increases or decreases from the programmed basal rates	Yes; Automated basal insulin delivery calculated from total daily insulin from last pod change (~3 days)
Bolus Insulin Automation?	No	Yes; Auto correction boluses may be given a max of 1/hr. and delivers only 60% of calculated correction dose based on programmed settings	No

Algorithm target BG/range	120 mg/dL	112.5-160 mg/dL (range)	Options: 110, 120, 130, 140, 150 mg/dL (programmed by user)

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ADJUST			
	Minimed 670G/770G 	T:slim X2 Control IQ 	Omnipod 5 
Can the User adjust…			
Basal rates?	No	Yes	No
I:C ratios?	Yes	Yes	Yes
Correction factors?	No	Yes	Yes
Active insulin time?	Yes	No, fixed at 5 hours	Yes
Target BG for bolus calculator?	No, fixed at 150	No, fixed at 110 mg/d	Yes
Target BG for AID?	No, fixed at 120 mg/dL	No, fixed range 112.5-160 mg/dL	Yes, 110, 120, 130, 140 or 150 mg/dL
Can user use combo boluses?	No	Yes (extend up to 2 hours)	No
Can user use temp basal feature?	No	No	No

Can user change ("override") recommended bolus doses?	No	Yes	Yes
What are the special features in automation?	**Temp Target**: changes target glucose to 150 mg/dL for set duration (30 min- 12 hrs). Intended to temporarily reduce automated insulin delivery for exercise	**Exercise Activity**: Changes target range to 140-160 mg/dL (manual start/stop, cannot set a duration). Intended to reduce insulin delivery during exercise **Sleep Activity**: Narrows target range to 112.5-120 mg/dL & prevents auto corrections. Intended to be used during sleeping hours	**Activity Feature:** Changes target BG to 150 mg/dL and additionally reduces AID calculations for set duration (1-24 hrs.). Intended to temporarily reduce insulin delivery for exercise

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REVERT			
	Minimed 670G/770G 	t:Slim X2 Control IQ 	Omnipod 5 
Can pump be used without AID?	Yes; All 3 pumps can operate in "manual mode" and users can switch to manual mode at any time. In manual mode, pump operates like a conventional insulin pump: infuses programmed basal rates.		
Does system ever limit insulin automation?	Yes; ("Safe Basal") when loss of CGM data or other system concerns	No	Yes; ("Automated:Limited") when loss of CGM communication

Will system ever revert user from AID to manual mode?	Yes; if safe basal lasts > 90 min, sensor glucose> 250 for 3 hrs. or >300 for 1 hr.	Yes; if loss of CGM communication for 20 min.	Yes; if at min/max delivery for 'long' time. No specified time but is rare
EDUCATE			
	Minimed 670G/770G 	T:Slim X2 Control IQ 	Omnipod 5 
What are unique education tips for each device?	Follow alerts to enter BG values into pump to prevent Auto mode exits, return to auto mode after an exit	Consider programming sleep schedule so sleep activity will start & end automatically each day	Wear pod & CGM on same side of body/"line of sight" to optimize communication
Exercise considerations	Set Temp target feature 1-2 hrs. before aerobic exercise begins	Set Exercise activity 1-2 hrs. before aerobic exercise begins	Set Exercise activity 1- 2 hrs. before aerobic exercise begins
General education for all AID systems	• Bolus for all meals/snacks 15 min. before eating Treat mild hypo with just 5-10g carb since insulin will likely have been suspended leading up to hypoglycemia • Follow bolus calculator recommendations when delivering bolus insulin for meals and/or correction. May be IOB from AID and bolus calculator will subtract IOB from bolus calculation		

SENSOR/SHARE			
	Minimed 670G/770G	t:Slim X2 Control IQ	Omnipod 5
Which CGM is compatible?	Guardian 3	Dexcom G6	Dexcom G6
Calibration required?	Yes; every 12 hrs. min., every 3-4 hrs. recommended (before meals, bedtime)	No	No
How long does each sensor last?	7 days maximum	10 days maximum	10 days maximum
Is there remote data sharing options?	670G: No 770G: Yes, Carelink Connect app	Yes, Dexcom G6 Share feature; Follow app for remote viewing	Yes, Dexcom G6 Share feature; Follow app for remote viewing
Does CGM glucose value auto-populate into bolus calculator?	No; enter fingerstick BG value into bolus calculator	Yes, when Control IQ active will auto populate	Yes, tap “Use CGM” in bolus calculator to populate current glucose value & glucose trend

Upon check-in: Please refer to Check In Checklist

- Double check the date and time in the pump. Be sure to record all current basal rates, carb ratio, sensitivity factors (correction ratios), and other related information.
  - Record day or date of last infusion set change.
- Basal Rates should be adjusted for increased camper activity on an individual basis; however, basal rates should usually remain unchanged until the day after check-in.
- Verify and record serial number of each campers devices

Monday morning (first full day of camp):

- Basal Rate adjustments should be made depending on *each individual camper*. **Changes can only be made by Lead Medical Personnel.**
- Initially, change only basal rates using the pump's temporary feature, not times or profiles.
- Never INCREASE basal rates on the first full day of camp.
- General Guidelines for making basal adjustments (DECREASE): (Closed loop systems to be set to activity modes)

Level of Pre-Camp Diabetes Control

Pre-Camp Activity Level	Tight or Average Control	Poor Control
Little to none	40% decrease	20-30% decrease
Moderate	20-30% decrease	10-20% decrease
High	0-20% decrease	0-10% decrease

Insulin Pump Basal Rate Adjustment

Example: Pre camp activity: little to none

Pre camp diabetes control: average control

If basal is reduced 40%, then this camper needs 60% of original basal rate. Example Pre camp Basal Rate profile:

Pre Camp 40% Reduction

12 AM – 6 AM --1.0 units / hr x 0.6 = 0.6 unit / hr

6AM – 12 noon -- 0.8 units / hr x 0.6 = 0.48 or 0.5 units / hr 12 noon – 12 AM -- 0.9 units / hr x 0.6 = 0.54 or 0.5 units / hr

Pump questions?

Check with your Medical Lead to be directed to someone with pump experience. Also, in the manual, is information for each of the pumps. These include the use of the buttons to check information, change basal rates, give boluses, access the pump wizard, etc.

1. Any insulin administered should be visually verified by a health staff member for accuracy; this applies to both younger and older campers (including teenagers). The current BG and carb count must be correctly entered into the pump.

2. Pump supplies required to be brought to camp from home:
    a. EMLA cream (if used)
    b. Insertion device (if used)
    c. Tapes, adhesives, dressings
    d. Sets, reservoirs to change at least TWICE as often as usual

3. Campers supplies can be kept with campers other personal belongings. All site changes must be documented in camper's health record, and done:
    a. In the supervision of appropriately trained staff with supervision of insertion

4. After washing hands and thoroughly cleansing the infusion site, campers will use the technique for site insertion that is normally used at home.

5. Campers will change their pump site at least **every 48-72 hours**; this is at the discretion of the team leaders, but should not exceed 72 hours maximum.

6. If the camper/staff has a BG > 300 mg/dL, first check the date of the last site change and then: See HYPERGLYCEMIA PROTOCOL

7. Campers/staff will change set and check ketones after 2 unexplained BG readings > 300 mg/dL. If there are ketones in blood, the camper/staff will take an injection of rapid- acting insulin using a syringe or pen, and present to their medical team for evaluation. Follow the Sick Day Rules and Guidelines as directed.

8. If the pump is disconnected for showering, activity, or for a site change taking longer than 30 minutes, there may be a need to replace the missed basal insulin (consult with medical team). The maximum time off the pump during exercise without replacing basal insulin is 2 hours. This decision is at the discretion of the medical team, based on the individual camper and intensity of exercise.

9. Insertion site should be checked for redness and tenderness.

10. Reservoir/cartridge should be checked to determine remaining insulin daily.

11. Pump users will follow the same night BG testing guidelines

If the pump fails during camp, the camper must follow guidelines for switching from a pump to multiple daily Injections (MDI) using Lantus insulin:

a. Check BG as directed.

b. Rapid-acting insulin is injected prior to meals as directed, based on both carb coverage and BG coverage.

c. If needed, contact pump company technical support to see if a replacement pump can be shipped directly to the camp. Performed by medical director or designee. This will also involve contacting the parents.

d. If the pump is turned off or disabled, give Lantus as the basal insulin daily at the same time each day. (The dosage is usually based on the 24 hour total of the pump's basal insulin – consult with team leader or medical director).

e. To restart a replacement pump, it must be programmed by a certified pump trainer with the camper's insulin settings, prior to resuming any insulin infusion

Pump Site Tutorials

Name: Quick-Set (Medtronic MiniMed, Generic)

Close up of Quick-set at the insertion point showing the colored arrows that indicate locked or unlocked.

Features

- Introducer needle is removed, leaving a soft, Teflon cannula in place
- Insert straight in
- Can be used by almost anyone, including people with very little body fat (6mm cannula)
- Disconnects at the insertion site
- 23" and 43" tubing
- 6mm and 9mm cannula lengths

Advantages

- Easy insertion technique (straight in)
- Can use mechanical insertion device
- Disconnect at the point of insertion
- Needle protector allows safe disposal of introducer needle in trash

Disadvantages

- Straight insertion may dislodge more easily than angled insertion
- No clear window to view the point of insertion
- Very short cannula (6mm) version increases crimp risk
- No audible click for connection confirmation

Names: Inset (Unomedical) Or Mio (made by Medtronic)

Inset opened showing the all- in-one infusion set and inserter device.

Features

- Introducer needle is removed, leaving a soft, teflon cannula in place
- Insert straight in
- Can be used by almost anyone, including people with very little body fat (6mm cannula)
- Disconnects at the insertion site
- 23" and 43" tubing
- 6mm and 9mm cannula lengths
- Audible "click" confirms connection
- All-in-one infusion set and inserter

Advantages

- Easy insertion technique (straight in)
- Includes disposable inserter making insertions very easy
- Disconnect at the point of insertion
- Self-contained sterile insertion set and inserter is small and very easy to carry

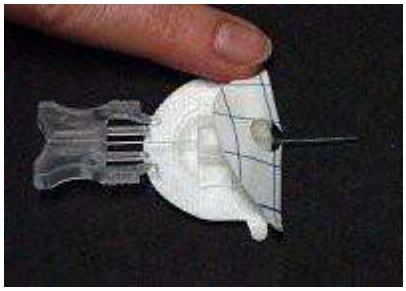
Disadvantages

- Straight insertion may dislodge more easily than angled insertion for some people
- No clear window to view the point of insertion
- Inset disconnected.

Names: Several:

- Comfort (Generic)
- Silhouette (Medtronic MiniMed)
- Tender (Disetronic)

recommended for kids



Features

- Introducer needle is removed, leaving a soft, teflon cannula in place; shorter ones now available
- Angled insertion (typically 30 degrees)
- Can be used by almost anyone, including people with very little body fat
- Disconnects at the insertion site
- Clear window lets you see the skin at the insertion site
- 23", 31", or 43" tubing
- Audible "click" confirms connection
- Silhouette variant has mechanical insertion device; other r require manual insertion

Advantages

- Angled insertion can be used by almost anyone
- Angled insertion and longer cannula makes it harder to dislodge the set, even during sports
- Clear windows allows you to see the point of insertion
- Quick disconnect at the point of insertion

Disadvantages

- Manual insertion of angled sets can be challenging to learn
- Long introducer needle can be intimidating, especially to younger kids
- Numbing cream highly

Insulin Pump
Site Change
Instructions

Tandem T:Slim	Medtronic 530G/Revel	OmniPod
1. Wash hands. From the OPTIONS screen, tap LOAD, tap CHANGE CARTRIDGE, YES to stop delivery.	1. Wash hands, disconnect from body, unscrew and remove cartridge from pump, and gather all supplies	1. Wash hands and gather all supplies; requires the personal data manager (PDM) to program
2. Disconnect the infusion set and press NEXT to continue. Remove the cartridge using the edge of a coin.	2. Go into Prime menu, select "**Rewind**"; in the 530/730 pump this is called "**Reservoir + Set**"	2. Deactivate the current Pod by going to "Settings" and choose "**Change Pod**", then confirm; *then* remove the old Pod
3. Fill the syringe with the appropriate amount of insulin, use the syringe to remove all air from the cartridge, remove resulting air from the syringe and fill the new cartridge with insulin by inserting the syringe into the port on the side of the cartridge by the tubing.	3. Fill a new 1.8mL or 3 mL reservoir with the appropriate insulin, enough for 2-3 days, being sure to remove all air	3. Press "Next" to activate a new Pod, say "Yes"
4. Insert the filled cartridge and press UNLOCK, then tap NEXT. Verify site is disconnected, tap NEXT.	4. Connect reservoir to infusion set tubing	4. Twist the needle onto the fill syringe, fill with the appropriate insulin, minimum 85u, up to 200u
5. Connect infusion set tubing to luer-lock tail of cartridge; hold pump vertically to dispel air.	5. Press and hold the "Act" button to prime the tubing, until 3-4 drops of insulin come out the needle; press "Escape" to exit this menu	5. Insert the needle straight down into the port on the back of the Pod, and completely empty the syringe; the Pod will beep, remove the syringe
6. Tap START to fill tubing. Tap STOP once 3 drops of insulin are seen. Tap DONE.	6. Prepare location with IV prep, remembering to rotate sites	6. Press "Next" which then primes the Pod, beeping when completed

7. Prepare location for infusion set with alcohol wipe, rotating sites. Insert infusion set into the skin. Connect tubing to site.	7. Insert infusion set into the skin, removing the needle	7. Prepare location with alcohol wipe, remembering to rotate sites

Tandem	Medtronic	OmniPod
8. Tap FILL CANNULA, tap NEXT. Edit Fill Amount, usually 0.3 or 0.7 units.	8. Select "**Fixed Prime**" or "**Fill Cannula**" in the Prime menu, and enter the appropriate amount of insulin for the set used	8. Remove the needle guard and paper adhesive; apply the Pod to the skin
9. Tap START to fill the cannula. The site change is complete.	No action	9. Press "Next", then "**Start**" to insert cannula and begin delivery
10. If setting Site Reminder alert, edit the settings for 2-3 days, and tap SAVE.	No action	10. The Pod automatically retracts the needle and primes the cannula
Cleo 6mm = 0.20u Cleo 9mm = 0.50u	Quick-set/Mio 6mm = 0.30u Quick-set/Mio 9mm = 0.60u Silhouette 13mm = 0.70u Silhouette 17mm = 0.90u	Works only with OmniPod system

The bolus calculators use insulin-to-carb ratio, blood glucose correction/sensitivity, duration of insulin action, and the blood glucose target to calculate a suggested bolus. If changes are made to the ratios, they must be programmed into the pump to be able to use the bolus calculator feature correctly. *Alternatively*, the dosage can be calculated and entered manually into the pump, although this does not allow use of the insulin on board feature.

The settings for insulin on board (IOB), active insulin, or bolus on board (BOB) are usually in the 2-4 hour range for most campers. Some of the older pumps do not have this feature, or may have a fixed duration of 6 hours. For the pump to suggest a dose using the insulin on board feature, it must know the current BG level.

A temporary basal rate can be used to adjust for situations when the main basal rate (continuous insulin) may be too much or too little. Situations include exercise, inactivity, sick days, low days, and night lows. Generally, adjustments of plus/minus 10-30% are used, but can vary between individuals. For some situations the pump may be removed and suspended for a short period of time. When increasing a basal rate, it is important to be sure the infusion site is working correctly.

Using the Bolus Calculators to Deliver an Insulin Bolus

Tandem	Medtronic	OmniPod
Unlock the screen	Press Bolus button	Obtain the PDM
Tap Bolus, then tap "0 grams"	Enter BG level using up/down arrows, press ACT	Choose Bolus from the Home screen
Using the onscreen keypad, enter the amount of carbs and tap DONE.	Enter amount of carbohydrates, press Act	Use the up/down controller button to enter the current BG level, press Next
Tap "ADD BG". Using the onscreen keypad, enter BG value and tap DONE. If the BG is above target, it will ask to add correction bolus	Screen will reflect the recommended dose, with adjustments for carbs, correction, and active insulin	Indicate whether or not you are going to eat, yes or no
Tap NEXT to confirm the units of insulin to be delivered	Press ACT to continue	If yes, on the next screen enter the amount of carbs, press Enter
You can override the displayed units by tapping on the units displayed.	Screen will go to bolus dose, or may need to select "Normal" bolus first	Screen will review the amount of carbs, the BG, and the insulin on board
Confirm Request, tap YES if entered data is correct, tap NO to go back and make revisions.	May adjust the bolus dose up or down, before pressing ACT to deliver	May adjust the bolus dose up or down, before pressing Enter to deliver
Tap DELIVER	If reminders are activated, the next screen will allow you to set a BG reminder, before pressing ACT to deliver the bolus	If reminders are on, you may add a reminder, set the time, and press OK
The bolus splash screen is displayed		
To cancel a bolus, tap the red X, tap YES to stop bolus. It will then show the units delivered. Tap CLOSE.	To cancel a bolus, press ACT, select Suspend, press ACT until the pump stops; will then need to resume the pump's basal rate	To cancel a bolus, be sure the PDM is turned on, press Cancel; pod should beep, screen will show how much insulin was delivered

Finding IOB or Active Insulin

Tandem T:Slim	Medtronic	OmniPod
Insulin on board is displayed on the home screen, even before you unlock the pump	In the X23 series pump, you can see the active insulin in 3 places (escape button to status screen, bolus recommendation screen, and actual bolus screen when going to give the insulin)	Look for the status screen when the Omnipod PDM is turned on; must have PDM available and in range of pod to see current information.
Alternatively, the IOB can be viewed during the bolus action from the Delivery Calculation s screen by tapping on "View Calculations", which will show you the settings and IOB.	Alternatively, when BG and carbs are entered into the pump, the IOB (called active insulin) will also be displayed in the bolus menu.	Alternatively, when BG and carbs are entered into the pump, the IOB will also be displayed in this menu.
Pump considers all boluses (meal and correction) when figuring IOB, and deducts the IOB from every subsequent bolus. It uses a linear calculation, i.e. 25% per hour for an IOB of 4 hrs. Full IOB is deducted from any bolus given between 6am and 10pm	Pump considers all boluses (meal and correction) when calculating IOB. But IOB is only deducted from correction boluses (not carb boluses). No IOB is deducted for BG below target. Uses an algorithmic equation to match the ebb and flow to insulin's activity	First generation ONLY considers correction doses when figuring IOB. You may need to override the IOB deduction. PDM 200/400 will consider all boluses (meal and correction) when calculating IOB.

Setting a Temporary Basal Rate

Tandem	Medtronic	OmniPod
Unlock pump, tap OPTIONS	Go to main menu, then to basal menu	Go to the Personal Diabetes Manager (PDM) home screen
Tap TEMP RATE	Select "Set/Edit Temp Basal"	Select "Temp basal"
Tap TEMP RATE again and select the percentage of temp basal, tap DONE	Input the number of hours for the temp basal to run, press "ACT"	Enter the desired percentage of Increase or decrease, press Enter
Tap DURATION, enter the number of hours you want, then tap DONE	Then adjust to the desired basal rate by 1% increments, press "ACT"	Enter the duration for the temp basal rate, press Enter
The pump will adjust for the minimum allowable basal rate	For example, 75% or 110%	Press Confirm to start the temp basal
Verify the pump settings and tap START.	It will then run the duration of the selected time, before resuming normal basal (100%)	Be sure PDM is within a few feet of the pod for the pod to receive the data; should hear a beep indicator
The TEMP RATE STARTED splash screen is displayed. An orange “T” is displayed if a temp basal is going.	To verify, go to the blank home screen (before the main menu) and press "Esc", then scroll down to review the temp basal status	
To cancel a temp rate, tap OPTIONS, and tap “X”; confirm message will display, tap STOP.	To cancel a temp basal, go to Main menu, then basal, then select "Cancel temp basal", press ACT	To cancel a temp basal, using the PDM, on the home screen, choose "Suspend/cancel", then choose "cancel temp basal", pressing Select, and then press confirm