

INSULIN PUMP THERAPY #1: THE BASICS

WHAT IS AN INSULIN PUMP?

An insulin pump is a small, battery-powered microcomputer. It is about the size of a deck of cards and is worn clipped to a belt or waistband, or in a pouch or pocket. The pump holds a syringe (a cartridge or a reservoir) filled with rapid-acting insulin (Humalog®, NovoRapid® or Apidra®). The pump is programmed to give small amounts of insulin through an infusion set. This is a thin plastic tubing attached to the syringe. At the end of the tubing is a small needle. The infusion set is inserted into the fatty tissue just below the skin. The needle is then removed, leaving a small, hollow, flexible plastic tube, called a cannula. The insulin is delivered through this cannula. The syringe and infusion set are changed every 2-3 days. The pump can be disconnected from the infusion set only for short periods for swimming, bathing and occasionally for exercise.

The insulin pump is not automatic, and it is not considered an "artificial pancreas". It must be programmed to give insulin when needed. The "official" term for insulin pump therapy is continuous subcutaneous insulin infusion (CSII). Insulin pump therapy and multiple daily injections (MDI) are called intensive diabetes management because it is possible to keep blood sugars in a tighter range. Blood sugars must be checked at least 6 times a day for pump therapy to be safe and effective. **The insulin pump does not monitor blood sugar!** Real-time continuous glucose monitoring (CGM) is available and can work with some insulin pumps. This is with a transmitter and a sensor, inserted separately from the pump site. CGM measures sugar found under the skin (in the "interstitial fluid"), not blood sugar.

HOW DOES IT WORK?

An insulin pump tries to imitate what normally happens in the body. It can deliver insulin in exact amounts, as small as 0.025 units per hour. The insulin is delivered in 2 ways:

- **Basal:** a small amount of background insulin delivered continuously 24 hours a day. The basal rate keeps the glucose levels in the target range when no food is eaten (between meals and overnight). The pump can be programmed to deliver different basal rates throughout the 24-hour period, based on individual needs. Once the basal rates are set correctly, they need to be fine-tuned with growth or major changes in routine. Temporary basal rates are used for activity, illness, menstrual cycle, or other temporary changes in routines.
- **Bolus:** a larger amount of insulin delivered over a short period of time. A bolus can be given anytime, but **cannot** be pre-programmed. A **pre-meal** bolus is given based on the grams of carbohydrate to be eaten. A **correction** bolus is an extra amount of insulin given when the blood sugar is high.

Starting basal rates, bolus doses, insulin-to-carbohydrate ratios and correction formulas are set with the diabetes team according to each person's unique needs.

WHAT ARE THE BENEFITS OF INSULIN PUMP THERAPY?

1. **Precise dosing.** Insulin delivery is exact and matched to each person's unique needs. This makes it possible to keep blood sugars close to normal most of the time. It is also easier to manage the dawn phenomenon, growth spurts, sleeping in, overnight lows, illness and fussy eaters.
2. **Flexibility.** There is flexibility in the timing and size of meals. If programmed properly, blood sugars can be managed better during travel, exercise, illness, or with unpredictable schedules.
3. **More predictable absorption** of insulin because only rapid-acting insulin is used and mainly one area is used. This eliminates the problem of different absorption rates from different sites. The abdomen, buttock and hip area are the usual sites used.
4. **Fewer and less severe lows** because of more predictable and precise insulin delivery.
5. **Improved control of diabetes.** If the pump is used properly pump users can have better control of diabetes than they were able to get with injection therapy.

WHAT ARE THE CHALLENGES OF INSULIN PUMP THERAPY?

1. **Risk of ketoacidosis (DKA).** The pump only uses rapid-acting insulin. There is no deposit of long-acting insulin in the body. An interruption to the insulin delivery will cause blood sugars to rise quickly. Ketones can start developing in a few hours without insulin. Extra care needs to be taken to prevent and manage high blood sugars. Pump users must carry an insulin pen with rapid-acting insulin and be prepared to use it if they have 2 unexplained high blood sugars in a row. They also need to check for ketones when the blood sugar is over 15 mmol/L and with any nausea or vomiting.
2. **Infection at the infusion site.** Site rotation is just as important as it is with syringes. Infusion sites need to be rotated and changed every 2-3 days.
3. **Hypoglycemia.** For some people, tighter control of blood sugars can lead to more lows, although they are usually less severe.
4. **Weight gain and suboptimal nutrition.** Improved control of blood sugars can lead to weight gain, especially if there is increased snacking. Parents need to make sure children are still meeting their nutritional requirements.
5. **Body image concerns/psychological adjustment.** Some people don't like the idea of being attached to a device all the time.
6. **Steep learning curve.** Education is crucial for pump therapy to be successful. There is a lot of preparation and required reading while learning how to use an insulin pump. Today's insulin pumps are 'smart pumps' with lots of features. The information can be uploaded and reviewed. It is important to use the pump's 'smartness' because otherwise it is just an expensive syringe!

COST?

Pumps cost approximately \$7500. [BC Fair PharmaCare](#) will cover [insulin pumps](#) for everyone of all ages who meet [medical eligibility criteria](#) through their Special Authority process, subject to the family's deductible, co-pay and family maximum. Many extended health plans will also cover up to 80% of the cost of a pump. [Pump supplies](#) (infusion sets/kits and reservoirs/cartridges) cost about \$250 per month, and these are also covered by [BC Fair PharmaCare](#) and extended health plans. [BC Fair](#)

PharmaCare and most extended-benefit providers do not pay for continuous glucose monitoring systems and sensors.

INSULIN PUMP and CGMS MANUFACTURERS (in alphabetical order):

- **Insulet:** www.myomnipod.ca/ or Canada toll-free number: 1-855-763-4636.
OmniPod® Insulin Management System.
Contact: Andrew Muirhead (amuirhead@insulet.ca), phone 604-754-6195.
Online training program: www.myomnipod.ca/content/en/learning-center/
- **Medtronic Diabetes:** www.medtronicdiabetes.ca or Canada toll-free number 1-800-284-4416.
MiniMed® 670G insulin pump with SmartGuard™ technology.
Contact: Brenda Heaney (brenda.heaney@medtronic.com), phone 604-312-7101
Online product training courses: www.medtronicdiabetes.ca/mylearning
- **Tandem Diabetes:** <https://www.tandemdiabetes.com/> or toll-free 1-833-509-3598.
t:slim X2™ insulin Pump with Dexcom G5® Mobile CGM.
Contact: Dale Robertson ([drobertson@tandemdiabetes.com](mailto:d Robertson@tandemdiabetes.com)); phone 778-322-9292.
- **Dexcom:** dexcom.com/en-CA or Canada toll-free number: 1-844-832-1810
Dexcom G5® continuous glucose monitoring systems.
Contact: Anthony Petrovich (anthony.petrovich@dexcom.com), phone 604-363-8776.
Training webinars: dexcom.com/en-CA/dexcom-webinars-canada

BOOKS ON INSULIN PUMPS:

- *Pumping Insulin: Everything You Need for Success With an Insulin Pump (6th ed.)* (www.diabetesnet.com/pumping-insulin) by John Walsh and Ruth Roberts, Torrey Pines Press, ©2016.
- *The Calorie King® Calorie, Fat & Carbohydrate Counter* (www.calorieking.com) by Allan Borushek, ©2018. Also has a iOS app.

These books are available for purchase online at www.chapters.indigo.ca or www.amazon.ca.

ADDITIONAL QUESTIONS?

If you have additional questions, you can e-mail our insulin pump educators [Cristina](#) or [Sharleen](#) or leave a message at the Diabetes Clinic at 604-875-2868.

ARE YOU READY?

Read the checklist on the next page to see if you and your family are ready to move forward with insulin pumping or if you still have things to work on.

For more information on using Continuous Glucose Monitoring, see our handout
Continuous Glucose Monitoring (CGM) #1: The Basics

ARE YOU READY TO PUMP?

- You and your family have mastered the basics of diabetes care (glucose testing, insulin adjustment, meal planning, etc.), and you have demonstrated an understanding of how to match insulin to food and exercise. Your family life has adjusted to the diagnosis of diabetes. For most families, this takes at least one year.
- You want to improve blood sugars and have a more flexible lifestyle.
- Both you **and** your parents are interested.
- You have read the handout on [Insulin Pump Therapy #1: The Basics](#), available on our website.
- You have been checking blood sugars **at least** 4 times a day **and** recording the results in a logbook or uploading the results weekly.
- You and your parents analyze your blood sugars regularly and can independently make insulin adjustments when needed.
- Once on the pump, you are prepared to check blood sugar 9-10 times a day including night checks at midnight and 3:00 AM for the first few weeks, then a minimum of 6 times per day with monthly night checks.
- You and your family have realistic expectations about what an insulin pump can and cannot do and the time commitment involved in getting started.
- You can already count carbohydrates accurately. See our handout [Carbohydrate Counting](#). You will have to have worked through our entire [Carb Counting Quiz](#) handout before starting the pump. You can also take a look at our [online carb counting module](#).
- You rotate injection sites and use your abdomen regularly.
- For teens, you allow your parents to be involved and participate in your diabetes care.
- For younger children, parents need to know that school and daycare personnel may not be able to operate the pump. This needs to be discussed directly with the school. A parent must be available at all times in case of problems.
- You and your family are prepared to attend 2-3 pump education sessions and do all of the required home reading/preparation and follow-up.
- Your family is registered with [BC Fair Pharmacare](#).

If you feel you're ready to move ahead with insulin pumping, then look up our handout

[Insulin Pump Therapy #2: You've Decided on a Pump — Now What?](#)