



WaterlooWellington  
D I A B E T E S

## Insulin Pump Therapy

A guide for managing your insulin pump

This guide is to support you in managing your pump and to supplement the education you receive from your Diabetes Education Program. It is not intended to replace visits with your diabetes healthcare team or to provide medical advice.

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Congratulations on choosing to go on an insulin pump. For most people, an insulin pump offers more flexibility in eating and exercising, fewer injections and fewer blood sugar swings. As a result, you can often achieve improved glycemic control, as well as an improved quality of life. There is an increased risk of diabetic ketoacidosis if the insulin supply is interrupted, therefore, it is important to understand all aspects of your pump as well as overall diabetes management.

To benefit from a pump, means additional work on your part, as well as support on our part. We want to make sure that you have a successful start to pump therapy, and that it provides the benefits that you were anticipating. The following responsibilities are necessary for success on a pump.

### **Your responsibilities the first week:**

- Keep a consistent schedule for the first 2 weeks in order to set insulin doses correctly
- Test every 2 hours for the first 3 days on the pump during the day and at night
- Alternate your night time testing: 1 am, 3 am, 5 am, 7 am, and 2 am, 4 am, 6 am, and 8 am
- Take your daytime readings before and 2 hours after meals
- Miss your bedtime snack the first 3-4 nights
- Keep in regular contact with the Diabetes Centre in the first week



### **Your ongoing responsibilities:**

- Have a long term commitment to insulin pump therapy
- Have regular visits (every 3-4 months) with your endocrinologist/diabetes team
- Maintain sick day knowledge
- Monitor at least 4, preferably 6 times per day
- Maintain A1C < 10%
- Always carry rapid insulin (Humalog or NovoRapid) with you as a backup (either a pen or syringe)
- Always carry a new infusion set with you
- Always carry spare batteries with you



### **Your team's responsibilities:**

- Support you with teaching, and consultation
- Train you in the technical use of your pump
- Coach you in problem solving day to day blood sugar patterns
- Calculate starting dosages of insulin for the pump (along with your physician)
- Calculate and teach you on correction doses
- Assess, educate and review sick day management
- Review hypoglycemia and glucagon
- Provide you with trouble-shooting guidelines



### **A word about your logbook and food records**

A detailed logbook and food records will help to make changes to gain control of blood sugars. This is really important when you first start on the pump and we are trying to adjust the basal and bolus insulin doses. The more information we have, the easier it will be to identify trends or work through problems.

## Getting Started

You first need to determine, along with your diabetes team, how much insulin to use in the insulin pump. To do this you need to total the average number of units of insulin you use per day. To do this, add up all of your rapid insulin + your long acting insulin to give you your **total daily dose (TDD)**.

1. My Total Daily Dose (TDD) of insulin per day = \_\_\_\_\_ **a**
2. Reduce your dose by 25%. TDD = \_\_\_\_\_ x75% = \_\_\_\_\_ **b**

### To determine your basal dose of insulin:

3. Divide **b** by 2 = \_\_\_\_\_ **c**
4. Divide **c** by 24 = \_\_\_\_\_ **d This is your basal dose of insulin**

Your basal insulin provides the background insulin around the clock. Initially, many people start with a single basal rate when they begin pump therapy. Once you have attained some blood sugar readings overnight and during the day, you will often require minor adjustments in your basal rates and may require several basal rates.

### Fine tuning your basal rate:

When your basal rate is set correctly, you should be able to go to bed with a normal blood sugar, eat little or no bedtime snack and wake up with a normal blood sugar in the morning. A good target is to have your blood sugar stay level and not drop or rise more than 2 mmol/L during your sleep. Your team will ask you to avoid your bedtime snacks and to check every 2 hours the first week or so overnight, to determine your night-time basal rate. After that, they may ask you to skip breakfast or a meal to determine your correct basal dose during the day.

**Tip:** For great control, do the following steps in this sequence:

1. Determine your night-time basal rate
2. Test and adjust daytime basal rates
3. Test your carb/insulin ratios
4. Test your correction factor

**To determine your meal bolus dose of insulin:**

From clinical experience over the years, the “500 Rule” has been developed to calculate insulin to carbohydrate (CHO) ratio. How this works is the following, divide 500 by the total daily dose (TDD):

$$500 \div \text{_____ a} = \text{_____ e}$$

Therefore 1 unit rapid acting insulin covers \_\_\_\_\_ e grams of CHO. This is your starting “**insulin to CHO ratio**” for your meal bolus dose on your pump.

**Fine tuning your meal bolus:**

The amount of carbohydrate that will be eaten in a meal or snack determines how much bolus insulin is needed to cover it. For this reason, your food records and log book are very important in determining the correct bolus dose. Your team will ask you to check your blood sugar 2 hours after your meal to assess whether your bolus dose is correct. They may determine a different insulin to CHO ratio for each meal, depending on your records.

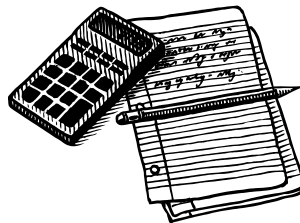
**Revised Insulin to CHO ratios:**

Breakfast: \_\_\_\_\_ units/ \_\_\_\_\_ grams carbohydrate

Lunch: \_\_\_\_\_ units/ \_\_\_\_\_ grams carbohydrate

Supper: \_\_\_\_\_ units/ \_\_\_\_\_ grams carbohydrate

Other: \_\_\_\_\_ units/ \_\_\_\_\_ grams carbohydrate





## Site Selection

The abdominal area is used most often since insulin absorption is best from this site. The subcutaneous area of the hip, thigh and upper buttock area may also be used. Areas to avoid include 2 inches around the navel, any area with scars, belt area or any area where clothing would constrict the site.

## Tips for Successful management

- Try to change your site during the day. Remember to check your blood sugar 1 ½ to 2 hours after your site change. If changing your site at night, set your alarm.
- Rotate the site and change the set every 2 to 3 days to prevent infections and elevated blood sugar readings.
- Wash your hands with soap before starting
- Use a skin protectant such as IV Prep or Skin Prep on the site. Using a circular motion from the center moving outward, wipe the skin and allow to air dry before inserting the set. Move the site at least 1" from the previous one.
- When putting on tape, stand up straight instead of sitting or in the bent-over position. This prevents tape from pulling.
- If perspiration causes the tape to loosen, try using an unscented antiperspirant around the edges of the tape. Other products can be applied to the skin prior to the set insertion including *Skin Tac* or Tincture of Benzoin if tape adhesion is a problem.
- Your pump will pick up any pressure on the tubing that might cause a blockage, but it won't pick up on a dislodged site, or a puncture in the tubing. Remember to inspect your site and tubing regularly and every night before you go to bed.
- Remove your pump if you are going on any rides at amusement parks, as some of the rides are operated with magnets which can affect your pump.

## Trouble-shooting

- If you have any technical problems with your pump, call the 1-800 # on the back of your pump.
- If for any reason you have to come off the pump, you will need to inject your insulin every 4 hours. Make sure you discuss with your certified pump trainer, how to replace your insulin if this should occur.



## Risks of an insulin pump

People using an insulin pump can be at higher risk for diabetic ketoacidosis because there is a small amount of insulin in the body at any given time. If the pump is not giving you insulin for any reason, blood sugars can start to rise within 90 minutes. This is usually caused by a dislodged cannula or a poor site. Often you are not aware of the poor site until you see a high blood sugar reading. This is why it is very important to test your blood sugars frequently in order to act quickly if your blood sugar is elevated.

## Diabetic Ketoacidosis

Diabetic ketoacidosis occurs when there is not enough insulin in the body. As a result, you are unable to use glucose for energy. Without glucose available, your body breaks down any fat stores that you have as an alternative source of energy. The process of fat breakdown produces ketones. Ketones are acidic and a buildup of them in your body causes ketoacidosis. Ketoacidosis is a dangerous condition and can worsen rapidly if not treated.

### **What causes diabetic ketoacidosis?**

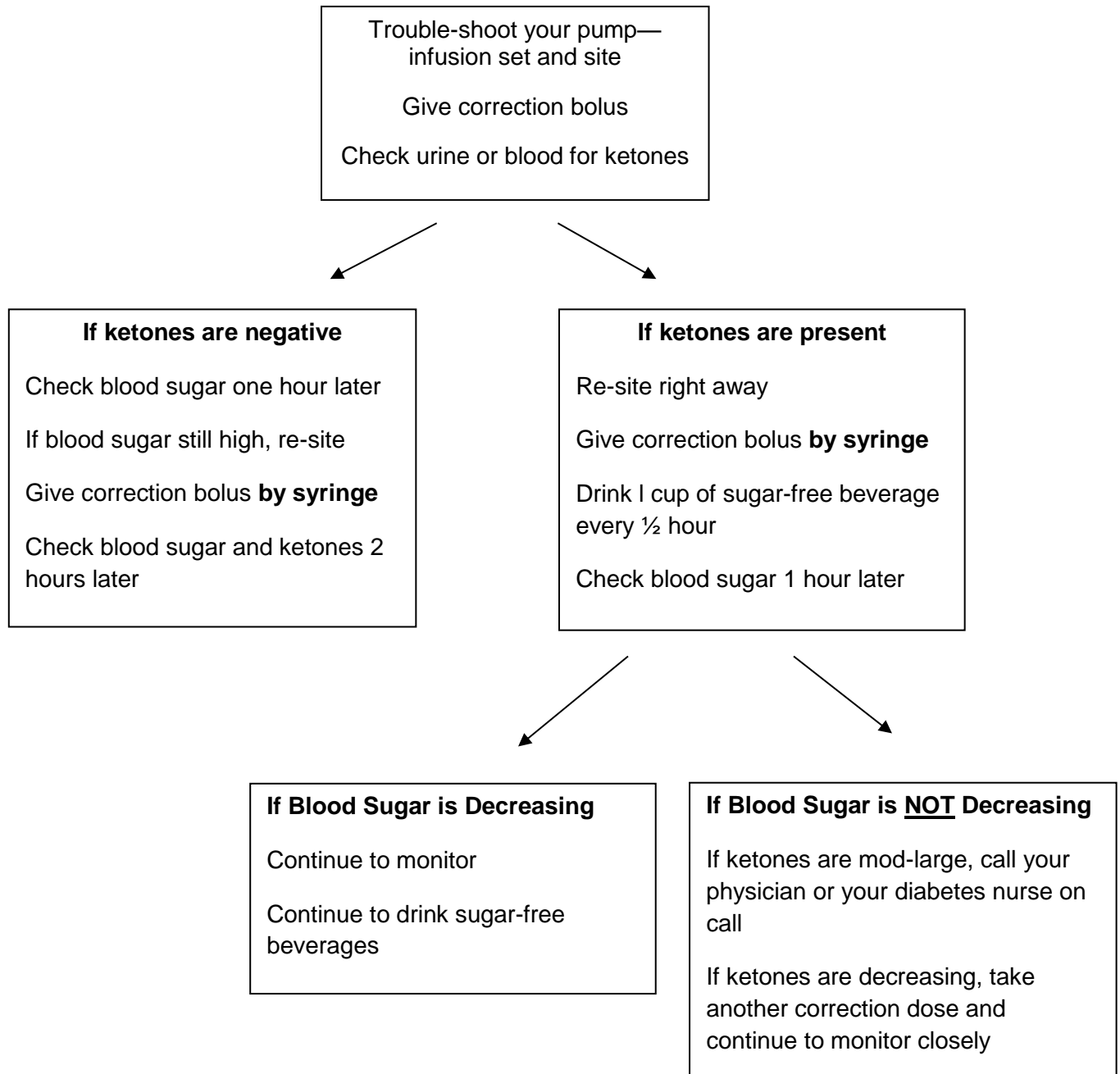
No insulin or not enough insulin

### **Signs and symptoms of Diabetic Ketoacidosis**

- Dry mouth and tongue, sore throat
- Thirst
- Frequent urination
- Elevated blood sugar
- Ketones in urine or blood
- Fruity smell to breath
- Stomach cramps
- Vomiting
- Leg cramps
- Deep heavy breathing
- Flushed appearance
- Drowsiness leading in time to unconsciousness



What to do if your pre-meal blood sugar is unexpectedly elevated over 14 mmol/L





## Sick Day Management on a Pump

Sick days or acute illnesses are expected events in everyone’s life. You need to be aware that an illness such as the flu or an infection can put your diabetes out of control. Monitoring is very important during this time—both blood sugars and ketones. Even though you may not be eating, your blood sugars can still run higher than expected due to the stress effect on your body. If your ketones become large, you may require hospitalization to correct your electrolyte imbalance.

### Goals for sick-day management include the following:

- Prevention of high blood sugars and diabetic ketoacidosis
- Prevention of hypoglycemia
- Maintenance of hydration: your body needs about 2200 mL (9 cups) of fluid daily to prevent dehydration

### Guidelines for Sick Day Management

	SITUATION 1	SITUATION 2	SITUATION 3	SITUATION 4
<b>Are you sick?</b>	Yes	Yes	Yes	Yes And Poor Appetite or Vomiting
<b>Blood sugar higher than 14 mMol/L?</b>	Yes	Yes	No	No Blood Sugar Less Than 6 mMol/L
<b>Ketones present, in any amount</b>	Yes	No	Yes Or No	Yes Or No
<b>What do you do?</b>	Give correction bolus right away  Set temporary basal rate to 10-20% higher rate  Recheck blood sugar and ketones in 2 hours	Set temporary basal rate to 10-20% higher rate  Drink <b>sugar-free</b> fluids—1 cup every ½ hour  Recheck blood sugar and ketones in 2 hours	Maintain same basal rate of insulin.  Recheck in 2 hours	Decrease basal rate by 10-20% .  Sip choices from the  <b>Sick Day Food Choices</b>  Recheck in 2 hours

It is important to remain hydrated. Try to drink 1 cup of sugar-free drinks every ½ hour.

**Sugar Free Fluid List**

- water
- clear tea
- clear soup broth
- diet pop
- \* Sugar Free Kool-Aid
- \* Crystal Light
- \* Soda water/Club Soda
- \* Jello Light

If you are unable to eat, you need to try to replace solid foods with glucose-containing fluids. You should try to sip or nibble on the sick day food choices over the 1-2 hour period. These choices are fast acting sugars. They do not last as long as other choices and that is why you must take them more often.

**Sick Day Food Choices**

1 Carbohydrate Choice = 15 grams of carbohydrate

**Fruit**

1 choice is equal to:



- Juice
- Applesauce

- 125 ml..... 1/2 cup
- 125ml..... 1/2 cup

**Starch**

1 choice is equal to:



- Cooked rolled oats 125ml..... ½ cup
- Cream of wheat 125ml..... ½ cup
- Rice Krispies/Corn Flakes 200ml..... ¾ cup
- Canned soup 250ml..... 1 cup
- Soda crackers 7
- Melba toast 4
- Toast 1 slice
- Arrowroot cookies 3
- English muffins ½
- Digestive cookies 2
- Plain muffin 1 small
- Graham crackers 3
- Ritz crackers 7

## Other Foods

Regular Pop	125 ml .....	½ cup
Ice cream	125 ml .....	½ cup
Popsicle		½
Sherbet	125 ml .....	½ cup
Regular Jello	125 ml .....	½ cup
Pudding	125 ml .....	½ cup

## Over the counter medications

When buying over-the-counter medications to treat an illness, you should ask for advice from a pharmacist. Many cold remedies and cough syrup contain sugar. Sugar-free products are available and should be selected.



## Hypoglycemia

As you know, many factors can cause low blood sugar, whether you are on a pump or injections. Most people on pumps actually report less frequent low blood sugars and less severe ones. It is still important to always be prepared for low blood sugars. Also, keep in mind that over time, your symptoms of low blood sugar may change.

Causes of hypoglycemia:

- Too much insulin
- Too little food
- Following alcohol
- During and after exercise (“lag effect” may last for 12 hours after exercise)
- Any time when your activity level is increased or your usual schedule is different such as vacation

No matter what the cause, you need to treat your low blood sugar immediately.

**Treatment for Low Blood sugar:**

**“The Rule of 15”**

**15 gms** of fast acting carbohydrate such as:

- 3-4 glucose tablets
- ½ cup of regular pop or juice
- 6 Lifesavers or hard candies
- 1 Tbsp honey or table sugar

Wait **15** minutes, Recheck your blood sugar  
If less than 4mmol/L, repeat above  
Follow-up with a snack of **15 gm** carb and a protein source

You are likely aware of your symptoms of low blood sugars, but did you know that 50% of lows are known to occur at night and are often asymptomatic? You may experience the following symptoms, which may be related to a low blood sugar:

- Nightmares
- Waking up with a headache
- Damp night clothes, sheets or pillow
- Restlessness

If you do experience several lows, it is important to try to determine the cause of your low blood sugar, and try to prevent it the next time.



### Questions to ask yourself:

- Is my basal rate too high? (especially if you are having frequent lows)
- Are my basal rates programmed correctly?
- Do I need to adjust my insulin to carb ratio or correction factor?
- Are my targets too low?
- Am I estimating my carbs accurately?
- Am I doing the calculations correctly to determine my bolus doses?
- Am I over-correcting?
- Are my bolus doses overlapping?

Do not get frustrated if you cannot figure out the cause of an occasional episode of low blood sugar. Sometimes with diabetes, not every low or high can be explained

### Hypoglycemia Unawareness

If you have hypoglycemia unawareness, you are unable to recognize the early warning symptoms of low blood sugar levels. This can occur sometimes if you have had diabetes for a long time; if you are pregnant; or if you have had frequent recurrent low blood sugars from running your blood sugars in tight control.

You can improve hypoglycemia unawareness by setting your targets higher for a period of time until you can start to feel symptoms again. Speak to your physician or educator about appropriate targets for yourself. Meanwhile, make sure your family members or friends are familiar with glucagon administration.

## Glucagon

Glucagon is a hormone that works the opposite of insulin; it stimulates the liver to release glucose or sugar into the bloodstream which will raise glucose in the blood stream. It is recommended that everyone who takes insulin should have a Glucagon Emergency Kit (a prescription item).

Things to remember about glucagon:

- It has an expiry date—so check and replace as necessary
- Once mixed, it is only good for 24 hours
- It should be kept in an agreed upon place so everyone can find it
- It is to be given in an emergency situation when you cannot give it to yourself—it must be given by someone else

Make sure family members or friends are familiar with administering glucagon.

## Managing Exercise on a Pump

The effect of exercise on blood sugars is variable from person to person and can be related to:

- Diabetes control
- Time and content of last meal
- Fitness level
- Type and duration of activity

When you first start on a pump, it is suggested that you refrain from doing exercise until your basal rates are on target. If you have a consistent exercise routine, this is not as much of an issue.

Once you are comfortable with your pump management, it is essential that you monitor your blood sugars before and after exercise to help establish your glycemic response to a particular activity. In general, during exercise, your blood sugar levels drop and you need less insulin. This is because your body is working harder and uses up glucose for the extra fuel muscles need. This can continue even after you have stopped exercising. This is called the “lag effect”.

For high-intensity exercise though, sometimes your blood sugars will go up. This is related to the release of stress hormones. In this case, the insulin dose may not need to be decreased during the activity, or it may be safer to correct after the exercise. For this type of exercise, it is best to work closely with your physician or diabetes educator.



In other cases, if your blood sugar is high prior to exercise (>14 mmol/L) and your insulin levels are low, your blood sugar level can rise with the increased activity. This is a dangerous situation, and can lead to ketoacidosis (refer to diabetic ketoacidosis section).

**General Guidelines when exercising:**

- Check your blood sugar before, during and after activity to establish your specific patterns.
- If you are eating right after a meal, you can lower your meal-time bolus of insulin or eat extra carbohydrate
- Eat extra carbohydrate to compensate for the activity—start with 15 gm of carb for 30 minutes of activity
- Program your pump to deliver a temporary basal rate reduction before, during and/or after the activity. A general guideline is to lower the basal rate by ~50%
- Drink plenty of water to stay properly hydrated
- Carry carbohydrates to treat low blood sugars



**If you disconnect the pump during exercise:**

- You may remove your pump during exercise for up to **one** hour.
- You may need to give an insulin bolus prior to disconnecting from the pump
- If you are planning to be disconnected for longer than one hour, you may need to reconnect and give yourself a bolus

**My personal plan for exercise:**

Activity: \_\_\_\_\_

Plan:

Activity: \_\_\_\_\_

Plan:



## Travel Guidelines:

Before you are scheduled to leave on your trip, call or visit your Diabetes Education Program to obtain written instructions for possible adjustments while you are away.

### Preparation

- Obtain a letter from your health care professional indicating you have diabetes and are wearing an insulin pump and are required to carry supplies.
- Carry all medications with the pharmacy prescription label attached

### Airport Screening Guidelines

- Always carry all insulin, pump and BG monitoring supplies with you in your carry-on luggage
- Blood glucose meters and the pump should be carried through the security screening area
- If questioned, notify screeners that you are wearing an insulin pump. Explain that you cannot remove it from your body, and offer to show your travel letter.



## Guidelines for Pump Use if you are hospitalized:

There are situations when you may need to be hospitalized. Please remember that many health care professionals are not familiar with insulin pumps, so it is important to remember that you are the expert in managing your pump. As insulin pumps become more popular, hospitals are starting to prepare policies and procedures for self-management. Meanwhile, you may need to educate the hospital staff or be asked to demonstrate your knowledge of the pump.

The documents on the following 2 pages are useful for you to have with you and share with the hospital staff.

### Take with you to hospital:

- pump supplies, including extra sets, insulin and batteries
- meter, strips and lancets
- “*Your Guidelines for Pump use if you are Hospitalized*” (Page 18)
- “*Letter to Hospital Staff*” (Page 19)

## Your Guidelines for Pump Use if You are Hospitalized

***The following information should be available to the hospital staff:***

- 1) The phone number of the pump-prescribing physician for consultation.
- 2) Pump description in your hospital chart
- 3) A piece of paper with your basal rates, insulin-to-carbohydrate and correction factor.
- 4) Instructions to call \_\_\_\_\_ (your Diabetes Program).
- 5) Instruction for calling the Help Line: \_\_\_\_\_ to answer any questions regarding the insulin pump.
- 6) Written orders to:
  - a. leave the pump in place and to continue the basal rate, even if you are unable to eat.
  - b. allow you and hospital staff to perform blood glucose monitoring at least before meals and bedtime. More frequent monitoring may be necessary.
  - c. have an individualized bolus algorithm for meals and for correction of high blood glucose.
  - d. check for ketones if blood sugar > 16 mmol/L and to have you check your pump and site re-site if necessary.
  - e. allow your family to assist in site and rate changes.
- 7) For elective surgical and diagnostic procedures, your pump-prescribing physician should review orders with the admitting physician, and if applicable, the anesthesiologist.

**Do not allow hospital staff to remove the insulin infusion pump unless insulin therapy is continued by IV or injection. Due to the small amount of circulating insulin, Diabetic Ketoacidosis (DKA) will result very quickly if the pump is discontinued.**

To: Hospital Staff

This patient uses an insulin infusion pump to manage his/her diabetes. The pump delivers a steady, measured dose of rapid-acting insulin (NovoRapid, Humalog or Apridra). The pump is not automatic, but must be programmed by the patient to match his/her needs. The pump holds a syringe (also known as a cartridge or a reservoir) filled with insulin and is connected to an infusion set, which is inserted subcutaneously with a cannula. The syringe and infusion set are changed every 2-3 days.

The pump delivers a slow steady dose of insulin continuously which is called the “**basal**” dose and is calculated to closely mimic the body’s normal release of insulin. Generally the rate is approximately 50% of the total daily insulin dosage divided over 24 hours.

In addition to the basal dose of insulin, the patient must give themselves a “**bolus**” dose of insulin with each meal. This dose is not pre-programmed. The patient must check his or her blood glucose with a blood glucose meter prior to eating and then program the pump to give insulin based on his/her pre-determined carb/insulin ratio; blood sugar reading; and anticipated exercise. The patient is very skilled and knowledgeable about determining his/her dose.

NB. If the patient is using a Medtronic MiniMed pump, he/she may also have a glucose sensor inserted separately from the pump insertion. This glucose sensor measures a continuous real-time glucose reading.

Pump therapy during a hospitalization or surgery provides the best means for normalizing the patient’s blood glucose through these times of physiological stress. The best resource for pump management during the hospitalization is the **patient**. Confidence in the patient’s ability to make appropriate management decisions will greatly enhance the outcome of the hospitalization and the interaction between the patient and staff.

#### **SPECIAL WARNING FOR PATIENTS AND STAFF:**

**Do not remove the insulin infusion pump unless insulin therapy is continued by IV or SC. Due to the small amount of circulating insulin, Diabetic Ketoacidosis (DKA) will result very quickly if the pump is discontinued. If the pump is discontinued, the patient will need rapid-acting insulin immediately.**

Please call \_\_\_\_\_ (Diabetes Education Program) if necessary or please refer to the Waterloo Wellington Diabetes Policy and Procedure: **Use of Continuous Subcutaneous Insulin Infusion (CSII) Pumps in Hospitalized Patients** ([www.waterloowellingtondiabetes.ca/commonforms](http://www.waterloowellingtondiabetes.ca/commonforms) ).

## References:

Walsh, J., Roberts, R., *Pumping Insulin*, (third edition), Torrey Pines Press: San Diego, ISBN 1-884804-84-5

Bolderman, K, *Putting Your Patients on the Pump*, American Diabetes Association, 2002, ISBN 1-58040-148-1

BC Children's Hospital, Endocrinology and Diabetes Unit, [www.endodiab.bcchildrens.ca](http://www.endodiab.bcchildrens.ca)

Animas, *My Insulin Pump Workbook*, Animas Corporation, [www.animascorp.com](http://www.animascorp.com)

Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Canadian Diabetes Association 2013 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada. *Can J Diabetes* 2013;37(suppl 1): S1-S212.

Insulin Pump manuals from Credit Valley Diabetes Care Centre (2008), Grand River Hospital Diabetes Education Centre (2006).