Insulin Pump

The **insulin pump** is an external, battery-powered medical device used for the continuous administration of insulin in the treatment of diabetes mellitus, also known as continuous subcutaneous insulin infusion therapy. It is used to achieve tight blood sugar control and lifestyle flexibility while minimizing the effects of low blood sugar (hypoglycemia).

The device includes:

- the pump (including controls, processing module, and batteries)
- a disposable reservoir for insulin (inside the pump)
- a disposable infusion set, including a cannula for subcutaneous insertion (under the skin) and a tubing system to interface the insulin reservoir to the cannula. The infusion set should be changed and site rotated every 2-3 days.

An insulin pump is an alternative to multiple daily injections of insulin by insulin syringe or an insulin pen and allows for intensive insulin therapy when used in conjunction with blood glucose monitoring and carb counting.

To use an insulin pump, the reservoir must first be filled with insulin. Some pumps use prefilled cartridges. Most, however, are filled with the insulin prescribed for the user (usually Apidra, Humalog,or Novolog).

A. Setup includes:

1. Open a new (sterile) empty pump reservoir
2. Withdraw the plunger to the amount of insulin needed for 2-3 days
3. Insert the needle into a vial of fast-acting insulin
4. Inject the air from the reservoir into the vial to prevent a vacuum forming in the vial as insulin withdraws
5. Draw insulin into the reservoir with the plunger
6. Tap gently with a small item (pen or pencil), squirting out any air bubbles from the reservoir into the vial
7. Remove the reservoir from the vial, and unscrew the plunger from the reservoir making sure not to remove any insulin
8. Carefully remove the needle and close the lid on the needle
9. Attach the reservoir to the infusion set tubing
10. Install the assembly into the pump and prime the tubing (this pushes insulin and any air bubbles through the tubing). This is done with the pump disconnected from the body to prevent accidental insulin delivery
11. Attach to the infusion site to a body (and prime the cannula to see if a new set has been inserted correctly)
12. Some systems automate the infusion and priming steps.
    - *The Omnipod* integrates the infusion set, tubing, and insulin reservoir and has an automated infusion process that primes the insulin and inserts the cannula to the body automatically after a command from the PDM (Personal Diabetes Manager), which controls the insulin pump functions.

B. Dosing

1. An insulin pump allows the replacement of slow-acting insulin for basal needs with a continuous infusion of rapid-acting insulin.

2. The insulin pump delivers a single type of rapid-acting insulin in two ways.

   a) Bolus Dose: A dose of insulin infused by patient with a self-administering pump for meals or hyperglycemia. This dose is adjusted by the patient according to settings determined by a physician based on the blood glucose readings, food intake, and expected exercise.

   b) **Basal Rate:** A continuous delivery of insulin via a self-administering insulin pump. This is the amount of insulin the patient requires to maintain a normal metabolic state when fasting.

   Basal rate patterns
   The pattern for delivering basal insulin throughout the day can also be customized with a pattern to suit the pump user.
   - A reduction of basal at night to prevent low blood sugar in infants and toddlers.
   - An increase of basal at night to counteract high blood sugar levels due to growth hormone in teenagers.
   - A pre-dawn increase to prevent high blood sugar due to the dawn effect in adults and teens.
   - In a proactive plan before regularly scheduled exercise times such as morning gym for elementary school children or after-school basketball practice for high school children.

C. Advantages of pumping insulin

1. Pumpers report better quality of life (QOL) compared to using other devices for administering insulin. The improvement in QOL is reported in type 1 and insulin-requiring type 2 diabetes subjects on pumps.
2. The use of rapid-acting insulin for basal needs offers relative freedom from a structured meal and exercise regime previously needed to control blood sugar with slow-acting insulin.
3. Programmable basal rates allow for scheduled insulin deliveries of varying amounts at different times of the day. This is especially useful in controlling events such as Dawn phenomenon.
4. Many pumpers feel that bolusing insulin from a pump is more convenient and discreet than injection.
5. Insulin pumps make it possible to deliver more precise amounts of insulin than can be injected using a syringe. This supports tighter control over blood sugar and Hemoglobin A1c levels, reducing the chance of long-term complications associated with diabetes. This is predicted to result in a long-term cost savings relative to multiple daily injections.
6. Many modern "smart" pumps have a "bolus wizard" that calculates how much bolus insulin you need taking into account your expected carbohydrate intake, blood sugar level, and still-active insulin.
7. Insulin pumps can provide an accurate record of insulin usage through their history menus. On many insulin pumps, this history can be uploaded to a computer and graphed for trend analysis.

8. Neuropathy is a troublesome complication of diabetes resistant to usual treatment. There are reports of alleviation or even total disappearance of resistant neuropathic pain with the use of insulin pumps.
9. Recent studies of use of insulin pumps in Type 2 diabetes have shown profound improvements in HbA1c and neuropathy pain.

D. Disadvantages of pumping insulin

1. Insulin pumps, cartridges, and infusion sets are far more expensive than syringes used for insulin injection.
2. Since the insulin pump needs to be worn most of the time, pump users need strategies to participate in activities that may damage the pump, such as rough sports and activities in the water. Some users may find that wearing the pump all the time (together with the infusion set tubing) is uncomfortable or unwieldy.
3. An episode of diabetic ketoacidosis may occur if the pump user does not receive sufficient fast acting insulin for many hours. This can happen if the pump battery is discharged, if the insulin reservoir runs empty, the tubing becomes loose and insulin leaks rather than being injected, or if the cannula becomes bent or kinked in the body, preventing delivery. Therefore pump users typically monitor their blood sugars more frequently to evaluate the effectiveness of insulin delivery.
4. Possibility of insulin pump malfunctioning, and having to resort back to multiple daily injections until a replacement becomes available. However most pump manufacturers will usually have a program that will get a new pump to the user within 24 hours or allow the user to buy a second pump as a backup for a small fee. Additionally the pump itself will make many safety checks throughout the day, in some cases up to 4,000,000, and may have a second microprocessor dedicated to this.
5. Users may experience scar tissue buildup around the inserted cannula, resulting in a hard bump under the skin after the cannula is removed. The scar tissue does not heal particularly fast, so years of wearing the pump and changing the infusion site will cause the user to start running out of viable "spots" to wear the pump. In addition, the areas with scar tissue buildup generally have lower insulin sensitivity and may affect basal rates and bolus amounts. In some extreme cases, the insulin delivery will appear to have no/little effect on lowering blood glucose levels and the site must be changed.
6. Users may experience allergic reactions and other skin irritation from the adhesive on the back of an infusion set. Experience may vary according to the individual, the pump manufacturer, and the type of infusion set used.
7. A larger supply of insulin may be required in order to use the pump. Many units of insulin can be "wasted" while refilling the pump's reservoir or changing an infusion site. This may affect prescription and dosage information.

E. Supplies Needed for School

1. Blood Glucose Monitor
2. Pump
3. Pump Instructions
4. Batteries
5. Extra Delivery Set
6. Insulin to fill Pump Reservoir
7. Insulin pen or insulin and syringe in event of pump failure.

PROCEDURE FOR INSULIN ADMINISTRATION VIA INSULIN PUMP

Essential Steps	Key Points and Precautions
1. Preparation for Bolus	Organization saves time and prevents the student from being left alone
a. Gather supplies: 1) Pump 2) CHO Intake Count 3) Blood Glucose Meter	
b. Wash hands and apply gloves.	Universal precautions - reduces the risk of disease transmission
c. Allow student to select testing site.	Encourages student participation, promotes independence.
d. Clean testing site with alcohol swab or soap and water.	Reduces the risk of spreading germs
e. Perform pre-meal blood sugar check	
f.	
2. Dosing	
a. Calculate CHO intake	Increases accuracy of administering proper dosage of the insulin
3. Delivery	
a. Follow manufacturer direction for insulin each individual pump used. 1) Enter pre meal blood glucose value 2) Enter CHO intake 3) Double check recommended bolus 4) Press appropriate button to administer bolus	Each type/brand of pump has its own set of directions. Follow the steps applicable to your particular pump to ensure correct operation and bolus delivery.
b. Document the time, blood glucose value, CHO intake and units bolused via pump.	

Insulin Administration: Injection - Insulin Pump Skills Checklist [ ] Initial [ ] Review

Student's Name: _____ Date of Birth: _____

Person Trained: _____ Position: _____

	Demo Date	Return Demonstration					
		Date	Date	Date	Date	Date	Date
Cleans top of cabinet/cart where procedure will be performed and medication administered							
Discuss purpose of insulin pump							
Identify components of insulin pump and delivery set							
A. Preparation and Blood Glucose Check							
1. Gather supplies							
2. Wash hands and apply gloves							
3. Allow student to select testing site							
4. Clean testing site with alcohol wipe or soap and water							
5. Test blood glucose using student's glucometer per glucometer instructions							
B. Dosing 6. Determine student's CHO intake based using CHO intake calculation chart							
C. Delivery 7. Following pump instructions							
8. Enter pre-meal blood glucose value							
9. Enter CHO intake							
10. Confirm amount of insulin to be administered via pump							
11. Press appropriate button to administer insulin via pump							
D. Document the time, dosage, site, and blood glucose value							

Student Specific/Comments:_____

Overall Rating: ____**PASS** *Successful completion of a minimum of five demonstrations with 100% accuracy*

____ **FAIL** *Practical must be repeated. Trainer must complete Summary of Skills. Form and attach to this checklist.*

_____ _____ _____ _____

Date: School RN Signature Date Employee Signature