 **Physicians**  
PEDIATRIC ENDOCRINOLOGY  
Strong & Smart. Evidence. Every. Day.

**INSULIN PUMP THERAPY**  
THE WHO, WHAT, WHEN,  
WHERE, AND HOW

Heather M. Rush, APRN, CDE  
Louisville, KY

---

---

---

---

---

---

---

---

**CONFLICT OF INTEREST DISCLOSURE**

**Conflicts of Interest**  
None  
Heather Rush

A conflict of interest exists when an individual is in a position to profit directly or indirectly through application of authority, influence, or knowledge in relation to the affairs of PENS. A conflict of interest also exists if a relative benefits or when the organization is adversely affected in any way.

---

---

---

---

---

---

---

---

**OBJECTIVES**

- Describe insulin pump therapy – how does it help in diabetes management.
- State the training process for an insulin pump.
- Explain pump management after training.
- Discuss the specific considerations when managing an insulin pump.

---

---

---

---

---

---

---

---

WHO IS AN APPROPRIATE CANDIDATE FOR AN INSULIN PUMP?

WHO?

---

---

---

---

---

---


---

---

WHO IS AN APPROPRIATE CANDIDATE?

Patients with:

- Poor glycemic control
- Frequent of severe hypoglycemia
- Hypoglycemia unawareness
- Nighttime hypoglycemia
- "Brittle" diabetes or high glucose variability
- Post-meal hyperglycemia
- Dawn phenomenon
- Variable school/activity schedule



---

---

---

---

---

---

---

---

PATIENT CHARACTERISTICS

Someone who:

- Self monitors BG levels (minimum of 4 times/day).
- Is motivated to learn something new with diabetes management.
- Will remain compliant with training & provider /educator visits.
- Has support of family & friends.
- Understands carb counting.

---

---

---

---

---

---

---

---

WHAT IS AN INSULIN PUMP?

WHAT?

---

---

---

---

---


---

---

---

WHAT IS AN INSULIN PUMP?

- Device that delivers small doses (basal) of fast-acting insulin 24/7 & then able to give larger doses (bolus) when eating meals.
- Placed on skin (like a sticker) with a small tube (cannula) that sits directly under the skin to help deliver the insulin into the body.
- The site is changed every 2-3 days based on recommendations from diabetes team.




---

---

---

---

---

---

---

---

TERMINOLOGY

**Basal insulin** – small, continuous pulses of ‘background’ insulin are released into the tissue where the cannula (or needle) is located

**Bolus insulin** – larger dose of insulin is released after the blood sugar and/or carbohydrates eating are inputted into the pump and the dosage calculated

---

---

---

---

---

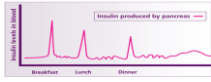
---

---

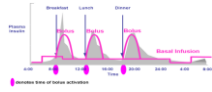
---

### HOW DO THEY COMPARE

THE PANCREAS



THE INSULIN PUMP



---

---

---

---

---

---

---

---

### MOST POPULAR BRANDS



---

---

---

---

---

---

---

---

### ADVANTAGES OF INSULIN PUMPS

- Eliminates individual injections
- Delivers insulin more accurately
- Can result in fewer swings of BG levels
- Makes delivery of insulin more flexible
- Eliminates unpredictable effects of long-acting insulin

---

---

---

---

---

---

---

---

### DISADVANTAGES OF INSULIN PUMPS

- Can become the cause of DKA if the catheter comes out or becomes kinked due to displacement, resulting in the child not receiving insulin for hours.
- Can be expensive.
- Tubing can be bothersome.
- Training can be lengthy as relearning how to care for diabetes.
- Skin or site infections.

---

---

---

---

---

---

---

---

### WHERE DOES THE WEIGHT FALL?



---

---

---

---

---

---

---

---

WHEN IS AN IDEAL TIME TO START AN INSULIN PUMP?

WHEN?

---

---

---

---

---

---

---

---

IDEAL TIME

Does one exist??

Is it variable??



---

---

---

---

---

---

---

---

DECISION TO START

- Should not be taken lightly.
- Need realistic goals / expectations.
- Finances may be a consideration as well.
- Insurance plans – 6 months.

---

---

---

---

---

---

---

---

WHERE DOES THE TRAINING TAKE PLACE?

WHERE?

---

---

---

---

---

---

---

---

**WHERE**

**Office?**

**Separate location?**

**Patient's home?**



---

---

---

---

---

---

---

---

**INSULIN PUMP PROCESS**

**Varies based on diabetes centers**

1. A pump class, where the family can learn about insulin pump options and functions.  
\* Child may choose to have a site inserted to experience the feeling.
2. Alert office of which pump interested in pursuing.
3. Office will send paperwork to company who will process and check insurance coverage.
4. Pump company will contact you with the information for your final decision.
5. Sometimes an outside company is used to get you the supplies.
6. Insulin pump supplies will be shipped to your home.
7. Pump initiation training will be scheduled by pump trainer.

---

---

---

---

---

---

---

---

**PRE PUMP PROCEDURE**

**Normal pancreas actions vs diabetic pancreas**

**Current insulin therapy (MDI) vs pump therapy**

**Basal vs bolus therapy**

- \* 0.1 unit vs 0.5 unit
- \* Normal/extended bolus
- \* Insulin on board

**Indications for pump**

**Complications that can arise**

- \* Hypoglycemia
- \* Hypoglycemia/ketacidosis
- \* Malfunctions (extra supplies)

**Blood sugar monitoring with pump**

- \* Check more frequently
- \* Downloading at home to send to office

**Pump features**

- \* Temp basal to help with illness/exercise
- \* Bolus calculations - correction/carb

**Demonstrate 'special' features of pump**

- \* Insertion
- \* Waterproof
- \* Sensor ability

---

---

---

---

---

---

---

---

## PUMP START PROCEDURE

### Review Intro to Pump worksheet

#### Pump specific

- Pump overview
- Set-up completed
  - Basal rates
  - Bolus features
  - Alerts/alarms/reminders
- Site selection
  - Rotation schedule
  - Clean prior to insertion
  - IV prep available if needed
  - Site insertion

- Blood glucose monitoring
  - Meter linked (if applicable)
  - BG checked & put into pump
  - Bolus given (if needed)
- Review/conclusion
  - Review site change and bolus administration
  - Review ways to change settings (when needed)
  - Follow-up schedule
  - Download data

#### Review all questions/concerns

---

---

---

---

---

---

---

---

---

---

## SCHEDULE

### 1<sup>st</sup> month schedule

#### Day 1

- Pump training (pump specific) - professional sensor placed (?)

#### Day 3

- Phone conversation with site change (if possible)

#### Day 5

- BG review (hypo/hyper) - phone conversation

#### Day 7

- 1 week - apt in office
- Sensor download - adjustments made

#### Day 10

- Phone conversation - BG review

#### Day 14

- Phone conversation - questions/concerns pump upload discussed

#### Day 21

- Pump site review / pump upload

#### Day 28

- Follow-up pump apt at office
- Start personal CGM if applicable

**Pump upload (weekly to monthly) depending on education level & BG**

---

---

---

---

---

---

---

---

---

---

HOW DO YOU MANAGE AFTER AN INSULIN PUMP IS STARTED??

HOW?

---

---

---

---

---

---

---

---

---

---



## ADJUSTING BASAL RATES

- Divide day into 4 segments (overnight, breakfast, lunch, dinner) and evaluate 1 segment at a time.
- Begin with overnight basal evaluation.
- Should begin 4-5 hours after the last bolus dose.
- BG should be between 100-150 mg/dL at the start of the 'test'.
- Check BG level every 2 hours (for overnight, check before bed, at midnight, 2-3am, and when awoken).
- Basal rate adjustments made with BG data trending up or down for > 30 mg/dL.
- Look for repeated patterns before making adjustments.
- Change the basal rate 1-2 hours before the time that the BG levels begins its upward or downward trend.

---

---

---

---

---

---

---

---

---

---

### TESTING BASAL RATES

Allow a fasting basal rate to be tested for 24 hours on one pre-prandial insulin. It is not the goal of this test to determine a basal rate that brings the basal glucose level into a target range. After basal adjustment, the goal is to bring the basal glucose level into a target range. The goal of this test is to determine a basal rate that brings the basal glucose level into a target range. The goal of this test is to determine a basal rate that brings the basal glucose level into a target range.

Time of Day	Preparation	Time For BG Tests	Adjustments To Be Made If Basal Rate
Time 1 10 PM 11 PM 12 AM	Take insulin, eat, and go to bed. Do not eat again until 12 AM.	11 PM 12 AM 1 AM	IF BG is > 150 mg/dL, decrease basal rate by 10%. IF BG is < 100 mg/dL, increase basal rate by 10%.
Time 2 7 AM 8 AM	Do nothing at bedtime. Eat a breakfast and go to work.	Evening Evening	IF BG is > 150 mg/dL, decrease basal rate by 10%. IF BG is < 100 mg/dL, increase basal rate by 10%.
Time 3 12 PM 1 PM	Take late lunch and go to work.	Evening Evening	IF BG is > 150 mg/dL, decrease basal rate by 10%. IF BG is < 100 mg/dL, increase basal rate by 10%.

---

---

---

---

---

---

---

---

---

---

## ADJUSTING BOLUS DOSES

### Test IC ratio

- Check BG level before meal.
- If BG within range, proceed.
- Bolus for carb amount.
- Check BG level 2 hours after meal.
- An appropriate BG would be 40-80 mg/dL above the BG prior to meal (bolus is still working at this time).
- If < 40, increase carb ratio for less insulin.
- If > 80, decrease carb ratio for more insulin.

---

---

---

---

---

---

---

---

---

---

### ADJUSTING BOLUS RATES CONT

#### Test correction dose

- Take corrective dose when BG elevated & not planning to eat for awhile.
- Check BG level 3-4 hours afterwards (without eating in between).
- If BG level within 30 mg/dL of target at this time, correction dose is appropriate.
- Adjust accordingly if not.

---

---

---

---

---

---

---

---

### SELF-CARE

When is the child ready to:	Age (in years):
Count carbs	About 9 years
Test blood sugar	About 10 years
Give a bolus	About 10 years
Insert an infusion set	About 12 years
Determine a carb bolus	About 12 years

Information from Pumping Insulin.. Do you agree???

---

---

---

---

---

---

---

---

ADVANCED PUMP  
FEATURES



---

---

---

---

---

---

---

---

### TEMPORARY BASAL

- The basal rate refers to the small amount of fast-acting insulin delivered by the pump every few minutes throughout the day and night.
- The temporary basal rate is when the basal rate is temporarily increased or decreased for a specific period of time. This is NOT automatic. You would choose how much basal insulin you want (using a percentage of normal basal rate) and for how long.
- Examples of when this is helpful = exercise or illness
- Learning how to adjust the basal rate can help prevent hypoglycemia and hyperglycemia.

---

---

---

---

---

---

---

---

### DECREASING BASAL RATES

- Temporary basal rate decreases are used most frequently for managing periods of exercise. Sometimes it may be necessary to begin the temporary basal rate decrease prior to the beginning of exercise.
- It is important to remember how the pump states the increase/decrease percentage to make sure getting what need!



---

---

---

---

---

---

---

---

### TEMPORARY BASAL OF 0%

- Sometimes the patient might want to suspend their insulin pump for activity or hypoglycemia.
- An option would also be to decrease the temporary basal rate to 0%. The number of hours that the decreased basal rate is to be in effect also needs to be entered.
- The advantage of using this temporary basal rate of 0% , rather than turning off the pump, is that the pump will automatically resume the previous basal rate after the allotted time elapses. This avoids forgetting to turn the pump back on.

---

---

---

---

---

---

---

---

### INCREASING BASAL RATES

- Temporary basal rate increases are most commonly used with illnesses that increase the blood sugar levels.
- Basal rate increases may also help with long car trips (i.e. reduced activity), menstrual periods, stress or anything else that increases blood sugar levels.




---

---

---

---

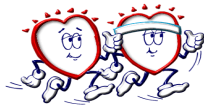
---

---

---

---

### ALTERNATE BASAL RATES



- Most pumps also allow alternate basal rate settings!
- This can be helpful for school days (with less activity) than weekends at home.

---

---

---

---

---

---

---

---

### BOLUS INSULIN

Bolus insulin doses refer to the quick bursts of insulin given to :

- cover the carbohydrates in meals and snacks, or
- lower high blood sugar levels

Bolus insulin is always inputted into the pump at the appropriate time based on the need for this insulin.

**\*\* REMEMBER THAT ALL INSULIN GIVEN VIA THE PUMP IS FAST-ACTING INSULIN \*\***

---

---

---

---

---

---

---

---

### BOLUS CALCULATIONS

- Insulin pumps have an advantage – they all have insulin dose calculators in them.
- Nowadays it is common practice to start all new pumpers with the bolus calculation feature set up.



---

---

---

---

---

---

---

---

### PROLONGED BOLUSING

- Prolonged boluses are extremely helpful with high fat/high carb meals that cause the blood sugar levels to remain high for a longer time after eating.
- These foods can vary for different people; however, commonly include pizza, Chinese, Mexican, Italian foods.

---

---

---

---

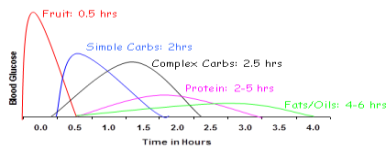
---

---

---

---

### IMPACT OF DIFFERENT FOODS ON BLOOD SUGAR



---

---

---

---

---

---

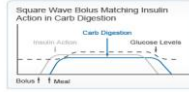
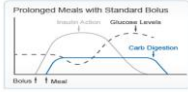
---

---

### WHAT DO THE BOLUSES LOOK LIKE?

STANDARD BOLUS

PROLONGED BOLUS




---

---

---

---

---

---

---

---

### HOW DO YOU DETERMINE THE PERCENTAGE?

**Trial & Error**

- Start with a 50/50 combination for 2 hours
- At the 2 hr mark, check BG level
- General rule of thumb:
- If low (< 70 mg/dL), give less of the immediate (40% now, 60% later)
  - If high (> 180 mg/dL), give more of the immediate (60% now, 40% later)
- \*this only works if BG level between\*  
\*100-200 mg/dL prior to meal \*

---

---

---

---

---

---

---

---

SPORTS




---

---

---

---

---

---

---

---

### ADJUSTMENTS

- Trial and error is often best way to determine how best to make changes
  - For short duration (< 30 minutes), no change needed
  - For intermediate duration (30-60 minutes), decrease basal rate by 5-20%
  - For longer duration and high intensity exercise, decrease basal rate by 30-50%
- Basal rate adjustments should begin 30-60 minutes prior to activity
- Lag effect – hypoglycemia for a prolonged period after exercise
- Disconnect pump
- Additional food if needed

---

---

---

---

---

---

---

---

THE END . . .  
Time for QUESTIONS!!!



THANKS FOR  
PARTICIPATING!

---

---

---

---

---

---

---

---

### REFERENCES

American Diabetes Association. (n.d.). Retrieved March 27, 2015, from <http://www.diabetes.org/>

Beaser, R. (2010). *Joslin's diabetes deskbook: A guide for primary care providers* (2nd ed.). Boston, MA: Joslin Diabetes Center.

Chase, H., & Messer, L. (2011). *Understanding insulin pumps & continuous glucose monitors* (2nd ed.). Denver, CO: Children's Diabetes Foundation at Denver.

Walsh, J., & Roberts, R. (2012). *Pumping insulin: Everything you need for success on an insulin pump* (5th ed.). San Diego, CA: Torrey Pines Press.

---

---

---

---

---

---

---

---