


**Back to Basics:  
A Diabetes Overview for  
Alabama School Nurses Part 3:  
Insulin Pump Therapy**

**Satellite Conference and Live Webcast  
Thursday, July 8, 2010  
12:30 – 1:30 p.m. Central Time**

Produced by the Alabama Department of Public Health  
Video Communications and Distance Learning Division


**Faculty**

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Children's Health System



CHILDREN'S  
HEALTH SYSTEM®

**Diabetes Control by Treating  
with Insulin Pump Therapy**




**Basal**

-PLUS-

**Bolus**

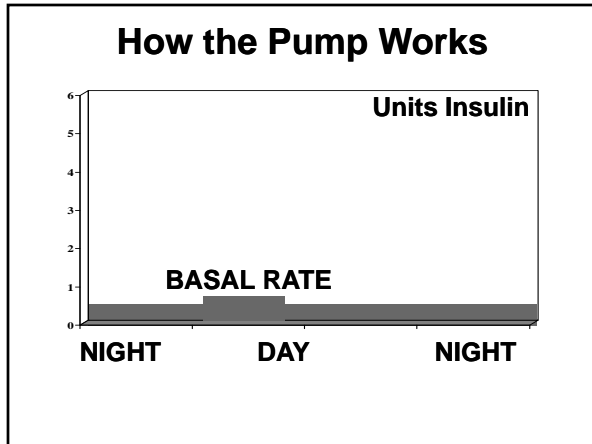
-WITH-

**Lispro (Humalog)  
Aspart (Novolog)  
Apidra**



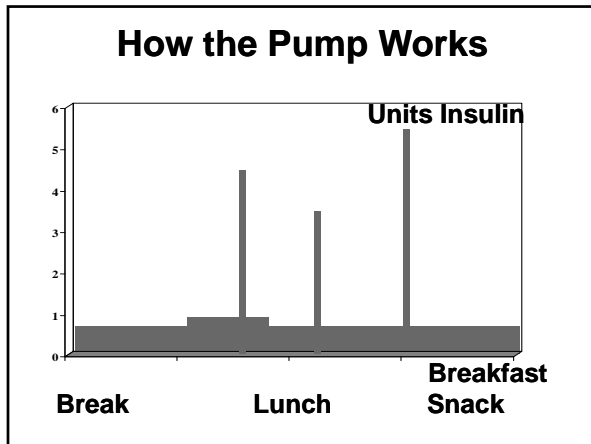
**How the Pump Works**

- The insulin pump delivers insulin very similar to the way the normal pancreas does
  - A small amount of insulin throughout the day and a delivery of insulin "on demand" when you eat or other times you need extra insulin



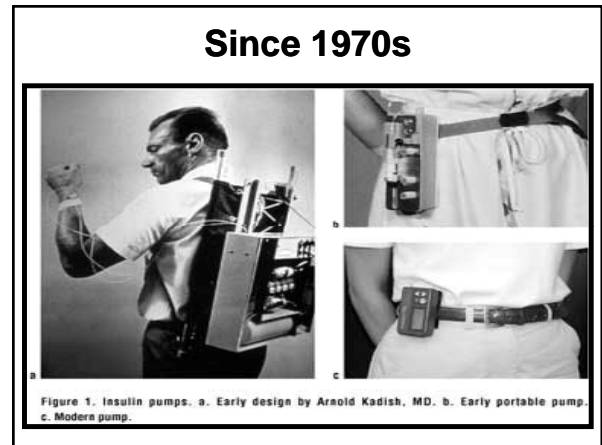
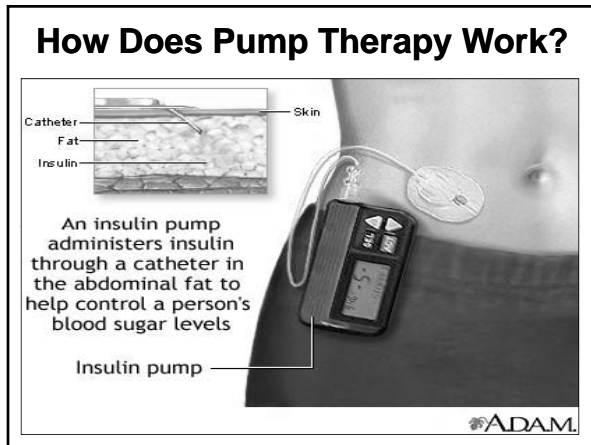
**How the Pump Works**

- Basal rate
  - A continuous flow of insulin given throughout the day
  - This rate can be programmed to increase or decrease according to your individual needs
  - A properly set basal rate will keep your blood glucose (BG) within target range with no food or exercise



### How the Pump Works

- Bolus
  - A delivery of insulin you give each time you eat or other times you need extra insulin



### Indications for Insulin Pump Therapy

- Failure of intensive therapy with multiple injections to safely achieve glycemic goal
- Need for flexibility for school/activity
- Low insulin doses
- Need for precise insulin delivery
  - Hypoglycemia unawareness

### Indications for Insulin Pump Therapy

- Minimize long-term complications
- Additional illnesses (Gastroparesis, CFRD)
- IMPROVE quality of life

## Insulin Pumps at School

- Helping kids be kids
- School questions



## Student Pump Skills

- Count carbohydrates
- Bolus for carbohydrates consumed
- Correction Bolus
- Set temporary Basal Rate
- Disconnect/reconnect with Infusion Set
- Fill Reservoir Prime Tubing

## Student Pump Skills

- Insert new Infusion Set
- Give injection with syringe
  - If needed
- Troubleshoot pump alarms

## Hyperglycemia Causes

- Bolus omitted or insufficient
- Cannula kinked
- Pump malfunction /or/ empty
  - Battery or reservoir
- Leak of insulin at infusion site
- SITE old/ INSULIN denatured (72 /48 hours)

## Hyperglycemia Signs

- Extreme thirst
- Frequent urination / urine Ketones
- Hunger
- Nausea / vomiting
- Hyperactive
- Headache
- Stomach ache
- Hyperglycemia (240 mg/dl)

## Hyperglycemia, DO THIS

Symptoms or Feeling Sick



✓BG (240) ⇔ ✓urine Ketones



Give Correction (pump vs syringe)

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Urine Ketones

Negative // Small-Trace // Moderate-Large

### Hypoglycemia CAUSES

- Excessive Basal rates
- Insulin: carbohydrate ratio miscalculated
- Intense activity level

### Hypoglycemia Signs

- Shaky
- Sweating
- Pale
- Dizziness / headache / confusion
- Inability to concentrate / daydreaming
- Angry / fighting / crying
- Unwilling or inability to swallow
- Unconscious / seizure

### Hypoglycemia, DO THIS

- Check blood glucose
- Follow rule of 15
- Suspend or stop pump
- Give GLUCAGON
  - Seizure or loss of consciousness
- Call 911, parent, physician

### Hypoglycemia, DO THIS

- If BG LOW before meal
  - Treat with 15-20 grams of carbohydrate
  - Do not bolus for carbs to treat low
- OR
- Enter pre-meal BG and meal carb's
- Pump will calculate a SUBTRACTION / NEGATIVE CORRECTION BOLUS
- Start Meal
- Give **BOLUS AFTER MEAL**, within 30 minutes of starting to eat

### Hypoglycemia, DO THIS

- If BG MODERATELY low
- Symptoms are:
  1. Changes in awareness, alertness, orientation
  2. Combative
  3. Needs help
  4. Difficulty swallowing

### Hypoglycemia, DO THIS

- If BG MODERATELY low
- Treat:
  - Suspend or Stop Pump
  - Giving glucose gel
  - Recheck blood sugar in 15 minutes
  - Restart the pump when blood glucose is above 90 mg/dl

## Hypoglycemia, DO THIS

- If BG **SEVERELY LOW**
- Symptoms are:
  1. Unconsciousness
  2. Seizure

## Hypoglycemia, DO THIS

- Treat:
  - Suspend or Stop Pump
  - Give glucagon into upper outer thigh, turn child/teen on side.
  - Call 911/ Parent
  - Then call (205) 939-9100 and ask for the Diabetes Doctor On-Call
  - Feed the Child a full meal when awake and alert & able to drink water without problems

## Pump Challenges in Teens

- Risk-taking behaviors
- Pushing the limits of therapy
  - Teens often miss boluses, run out of insulin, ignore warning alarms, omit catheter changes
- Parents must remain involved throughout childhood and adolescence regardless of the intelligence of the child / teen



## Bolus Calculations (Smart Pumps)

- Bolus calculations allow a personalized dose using
  - Insulin: carbohydrate ratio
  - Correction factor/sensitivity/ insulin sensitivity factor/negative correction
  - Target blood glucose

## Bolus Calculations (Smart Pumps)

- Remaining insulin on board/active insulin/ bolus on board/unused insulin



## Carbohydrate Bolus Change Time or Type

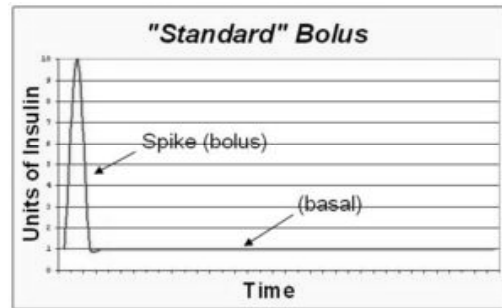
- Straight injection
  - Like syringe
- "Square wave" or extended bolus
  - Buffet eating or high fat meal
  - Gastroparesis

### Carbohydrate Bolus Change Time or Type

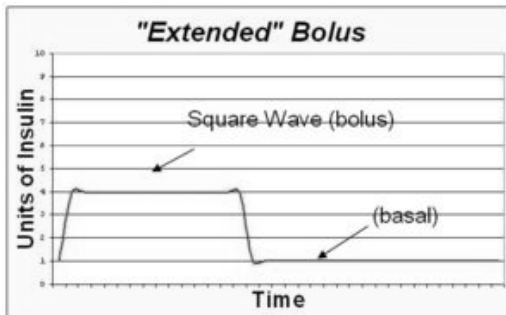
- Combination bolus
  - Part now, part extended
  - Pizza, Mexican



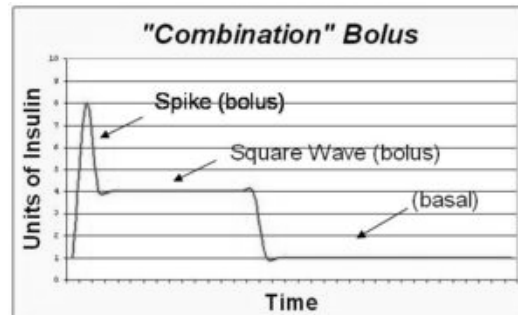
### Pump Bolus



### Pump Bolus



### Pump Bolus

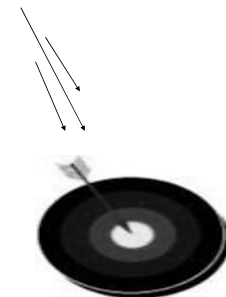


### Correction/Negative Bolus

- Even if blood glucose is above or below target
  - $$\frac{(BG - target)}{Insulin\ Sensitivity\ Factor} : \text{Correction Bolus}$$
- If calculation is...
  - (+) Positive, that amount is added to a pre-meal bolus
  - (-) Negative, blood glucose low, that amount is subtracted from a pre-meal bolus

### Target and BG Ranges

- 0-6 years
  - 100-180
- 6-12 years
  - 90-180
- 12+ years
  - 90-130



### Insulin on Board Feature

- It takes some time to use your entire bolus even with rapid-acting insulin
- When this feature is activated and you give a bolus, your pump will tell you how much Insulin on Board is currently remaining and will calculate a decreased bolus dose as an option

### Insulin on Board Feature

- This insulin pump feature prevents delivering too much insulin when correcting a high Blood Glucose
  - Carb Bolus            2.25 units
  - BG Bolus            +2.7 units
  - IOB                    -1.0 units
- Recommended Bolus = 3.95 units

### Temporary Basal Rates

- The basal insulin can be immediately adjusted with a temporary basal rate
  - % and duration
- Examples when this is helpful include
  - Long bus trip, more insulin is needed due to inactivity

### Temporary Basal Rates

- Illness or stress, more insulin needed due to insulin resistance
  - Ketones present, more insulin is needed
  - Exercise or sports activities, less insulin is needed
- OR
- DISCONNECT

### “Untethered Pumping”

- Prolonged disconnects
  - Athletic activity
- Replace % Basal with Lantus and give injections as indicated with Novolog
- Caution: monitor closely
  - Ketosis prone
  - “Rollercoaster” blood glucose despite dose adjustments

### Pumps Currently Available

- ACCU-CHEK Spirit



### Pumps Currently Available

- Animas : One-Touch Ping



### Pumps Currently Available

- Deltec Cozmo



### Pumps Currently Available

- Medtronic Mini Med: Paradigm

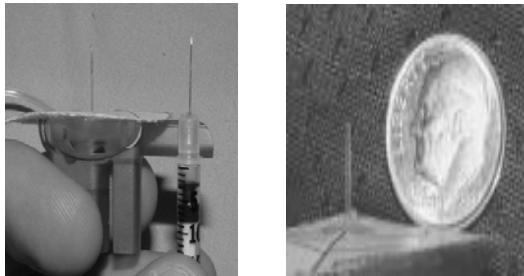


### Pumps Currently Available

- Omnipod



### Needle Size/Cannula Size



### Troubleshooting SAFETY

- Change it out





### Continuing Glucose Monitoring System (CGMS)

- Measures glucose via a glucose oxidase based electrochemical sensor



### Continuing Glucose Monitoring System (CGMS)



### Changing Perspective: Today

- Real time continuous glucose monitoring systems



Dexcom

### Changing Perspective: Today

- Real time continuous glucose monitoring systems



Medtronic

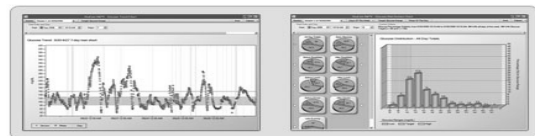
### Changing Perspective: Today

- Real time continuous glucose monitoring systems



Abbott

### Changing Perspective: Today



### **Contact Us**

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### **References**

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- **Borushek, A. (2004). The Doctor's Pocket Calorie, Fat, and Carbohydrate Counter. Family Health Publications, Costa Mesa, California.**

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