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EMPOWERING PATIENTS
FOR
INDIVIDUALIZED CARE




**HYPERGLYCEMIA
MANAGEMENT**
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HYPERGLYCEMIA MANAGEMENT

- SYMPTOMS OF HYPERGLYCEMIA
- BLOOD GLUCOSE (BG)/A1C GOALS
- HYPERGLYCEMIA—WHY DO WE CARE?
- CAUSES OF HYPERGLYCEMIA
- SEVERE HYPERGLYCEMIA
- HOW TO AVOID/IMPROVE HYPERGLYCEMIA
- USING TECHNOLOGY TO IMPROVE HYPERGLYCEMIA
- SPECIAL CIRCUMSTANCES IN HYPERGLYCEMIA MANAGEMENT




WOLF: ARE YOU HAVING TROUBLE?
MAY: MY METER KEEPS BEEPING AT ME AND SAYING "H!"




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HYPERGLYCEMIA MANAGEMENT: SYMPTOMS OF HYPERGLYCEMIA

- Excessive thirst
- Excessive urination
- Fatigue
- Blurred vision
- Unintentional weight loss




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HYPERGLYCEMIA MANAGEMENT: BLOOD GLUCOSE/A1C GOALS (ADA STANDARDS OF CARE 2018)

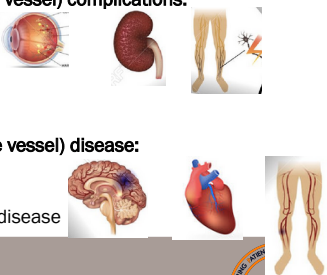
- Remember these goals are different for each individual, review your goals with your provider
- A1c goal <7.0% for majority of individuals to help prevent development and/or progression of diabetic complications
 - Tighter goal (<6.5%) may be set for new-onset diabetics, type 2 diabetics treated with lifestyle or metformin only
 - A1c goal <8% may be appropriate for older individuals, advanced diabetic vascular complications, hypoglycemic unawareness
- Pre-prandial (pre-meal) glucose goal: 80-130
- Post-prandial (post-meal, 2 hours after) glucose goal: <180

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HYPERGLYCEMIA MANAGEMENT: CONSEQUENCES OF LONG-STANDING HYPERGLYCEMIA


- **Microvascular (small vessel) complications:**
 - Retinopathy
 - Neuropathy
 - Nephropathy
- **Macrovascular (large vessel) disease:**
 - Stroke
 - Heart attack
 - Peripheral vascular disease




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HYPERGLYCEMIA MANAGEMENT: Lower A1c, with goal of <7%, decreases risk of developing microvascular complications and decreases risk of progression of microvascular complications!!!




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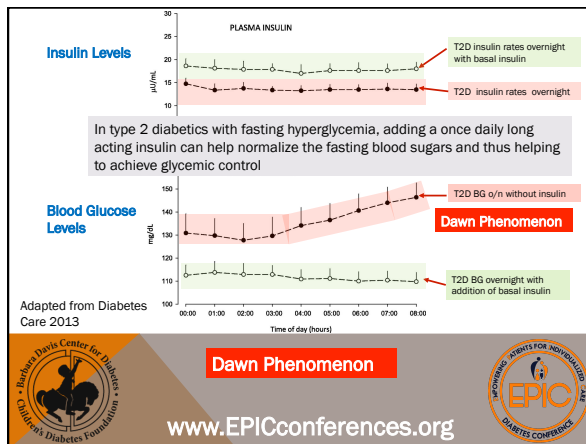


HYPERGLYCEMIA MANAGEMENT: A FEW POTENTIAL CAUSES OF HYPERGLYCEMIA

- **Fasting Hyperglycemia**
 - Not enough insulin at dinner the night before (can check ~3am to help determine if this is the cause)
- **Dawn phenomenon**
 - A rise in blood glucose levels 4am-8am due to increased hepatic (liver) production of glucose overnight. Can last until after breakfast
- **Post-meal Hyperglycemia**
- **Problems with Insulin absorption (lipohypertrophy)**
- **Stress**
 - Physical (ie illness, recovery from surgery, infection)
 - Emotional
- **Medications**
- **Insulin pump concerns**



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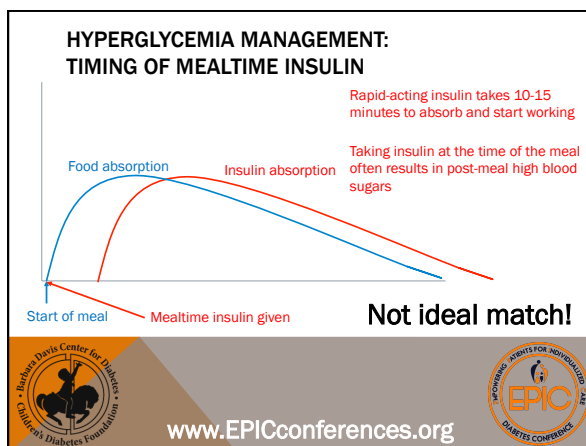


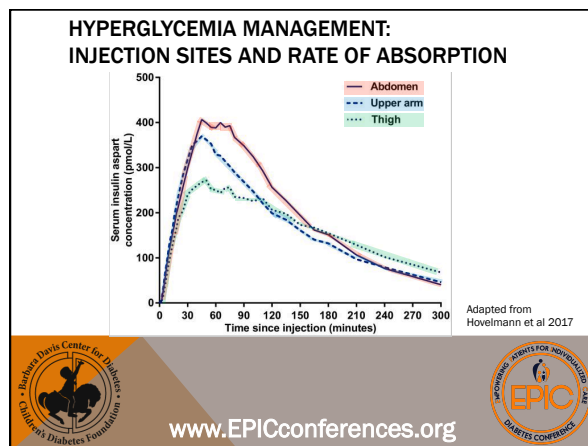
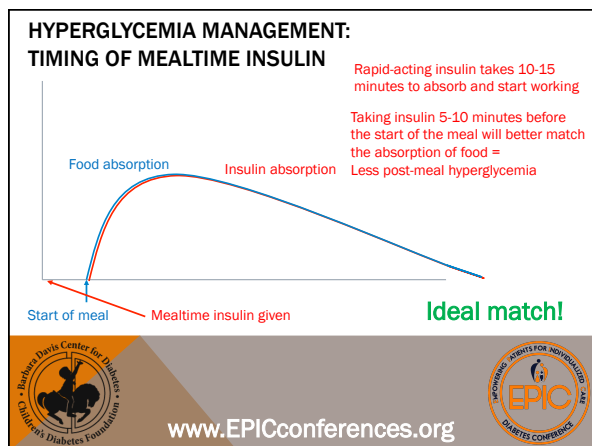
HYPERGLYCEMIA MANAGEMENT: POST-MEAL (POSTPRANDIAL) HYPERGLYCEMIA

- Missing mealtime insulin dose (or sulfonylurea if taking)
- High carbohydrate or high-glycemic index food at meal
- Incorrectly estimated mealtime insulin dose/eating more than planned at a meal
- Timing of mealtime insulin dose in relationship to when the meal starts
- Issues with insulin absorption



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HYPERGLYCEMIA MANAGEMENT: LIPOHYPERTROPHY

- **Tumor-like swelling of fatty tissue around subcutaneous insulin injection sites**
 - May feel like a hard lump at your injection site
- **Injection into these areas results in variable insulin absorption**
 - Can result in hyperglycemia after meals
- **Causes:**
 - Lack of rotation of insulin injection sites
 - Not changing insulin pen needle regularly

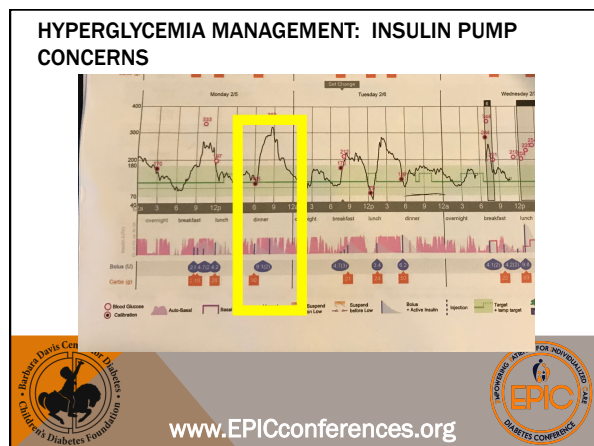
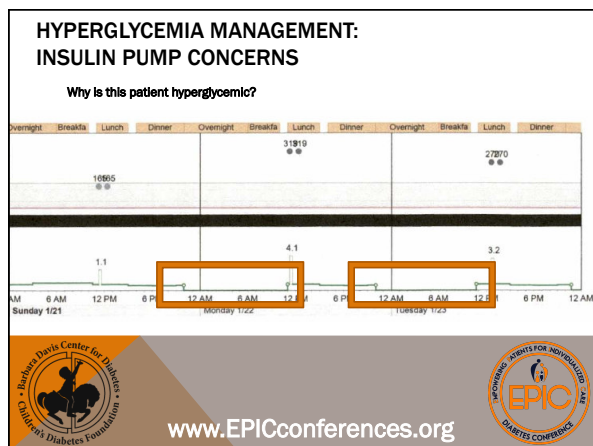
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HYPERGLYCEMIA MANAGEMENT: PROBLEMS WITH INSULIN PUMP DELIVERY/SITES

- Having pump in "suspend" feature for too long, or disconnected for >1 hour at a time
- Using a decreased "temporary basal rate" for too long
- Insulin pump failure
- Using same infusion set/tubing for too long (>3 days' duration)

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HYPERGLYCEMIA MANAGEMENT: SEVERE HYPERGLYCEMIA

- Infection is the most common cause
- If blood sugar persistently >240
 - Check urine ketones: if positive, seek medical care
- Can be associated with symptoms of abdominal pain, nausea
- If hyperglycemic and vomiting, go to the ER
- Persistently high blood sugars can lead to:
 - DKA: Diabetic Ketoacidosis
 - Occurs more often in type 1 diabetics, but can occur in type 2 diabetes
 - HHS: Hyperosmolar Hyperglycemic State
 - More likely to occur in patients >65 years old
 - Blood sugars can be >800

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HYPERGLYCEMIA MANAGEMENT: HOW TO HELP LOWER BLOOD SUGARS

- Stay well hydrated
- Avoid high glycemic index foods, meet with CDE for a refresher on carbohydrate counting
 - Increase fiber content at meals to slow absorption of carbohydrates
- Exercise
 - Avoid if blood sugar is >240mg/dl
 - Increases insulin sensitivity
 - Goal for type 2 diabetes is 150 minutes of moderate intensity exercise per week

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**HYPERGLYCEMIA MANAGEMENT:
HOW TO REDUCE FREQUENCY/DURATION OF
HYPERGLYCEMIA**

- **Increase frequency of monitoring blood glucose levels when on an intensive insulin regimen**
 - Associated with 0.2% reduction in A1c for every additional blood glucose test per day
- **Use of continuous glucose monitoring system (CGM)**
 - Associated with 0.5-2% reduction in A1c
 - The more you wear it, the more likely you will be able to achieve a reduction in your A1c



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HYPERGLYCEMIA MANAGEMENT: CGM OPTIONS

- Medtronic



- Dexcom G5



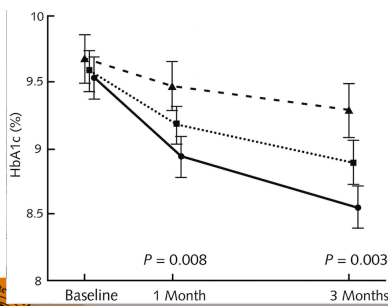
- Freestyle Libre



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HYPERGLYCEMIA MANAGEMENT: CGM OPTIONS



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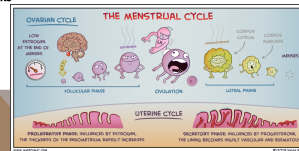
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HYPERGLYCEMIA MANAGEMENT

SPECIAL CIRCUMSTANCES: MENSTRUATION & LUTEAL PHASE HYPERGLYCEMIA

- Women with T1D experience changes in Insulin sensitivity throughout the menstrual cycle
- In pre-menopausal women with T1D, there is hyperglycemia and increased insulin resistance around the time of ovulation and during the luteal phase (2nd half) of the menstrual cycle
- In a typical 28-day cycle, luteal phase is day 14-28
- Might be explained by ↑ estrogen levels just prior to ovulation, and ↑ progesterone in the 2nd half of the cycle which can lead to ↓ calories taken in and ↓ carbohydrate intake





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HYPERGLYCEMIA MANAGEMENT

SPECIAL CIRCUMSTANCES: MENSTRUATION & LUTEAL PHASE HYPERGLYCEMIA

- In a small study of women with T1D, combination birth control pills did not eliminate the changes in glucose control seen during the luteal phase
- If on insulin pump, using temporary basals or a different basal pattern around the time of ovulation until the start of menses can help overcome this resistance
- If on MDI, temporarily increasing basal Insulin (Lantus, Levemir) can help with this phenomenon as well
- Closed loop systems may be very beneficial here given the ability to dynamically change insulin delivery from day to day







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HYPERGLYCEMIA MANAGEMENT

SPECIAL CIRCUMSTANCES: MENOPAUSE

- Limited data in the literature; most T2D data
- Small studies have shown glycemic control deteriorates in postmenopausal state
- Large clinical trial in postmenopausal women with T2D showed significant difference in A1C in those on hormone replacement therapy (HRT) vs. those not on HRT (7.9 vs 8.5)
- In postmenopausal women without diabetes, estrogen therapy has been associated with improved insulin sensitivity and ↓ fasting BGs
- Could HRT improve glycemic control and decrease risk of complications in women with diabetes??






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HYPERGLYCEMIA MANAGEMENT

SPECIAL CIRCUMSTANCES: EXERCISE

- Exercise effects on exercise type, BG, IOB, less
- Aerobic exercise (cycling) →
- Resistance weights, weights, resistance bands) →
- High Intensity vigorous exercise low/moderate BGs usually



EXERCISE
Welcome to America.






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HYPERGLYCEMIA MANAGEMENT

SPECIAL CIRCUMSTANCES: CAFFEINE

- Over 80% of adults in the US consume caffeine daily, mostly from beverages
- Caffeine affects BG levels despite lack of carbohydrates
- Caffeine intake, especially along with carbohydrates, may ↑ BGs and cause insulin resistance
- High BGs may take longer to recover
- In T1D, even black coffee can cause elevated BGs
- In a few small studies, caffeinated coffee caused BGs to increase up to 20% in the postprandial state
- For caffeinated beverages, adding an extra 5-10 grams of carbs to meal doses may be beneficial; in pump users increasing AM basal rate to account for caffeine effect

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SPECIAL CIRCUMSTANCES: STEROIDS

- Steroids (AKA corticosteroids, glucocorticoids) are known to raise BG levels
- Steroids are given to reduce inflammation; frequently used for asthma and arthritis
- Can be helpful for other autoimmune disorders as well
- Steroids cause insulin resistance, causing insulin (your own or injected insulin) to work less effectively
- Steroids also trigger extra glucose to be released by the liver
- Make sure to tell the provider prescribing steroids that you have diabetes so you can develop a diabetes treatment plan with your diabetes team.



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HYPERGLYCEMIA MANAGEMENT

SPECIAL CIRCUMSTANCES: STEROIDS

To counteract the steroid effect:

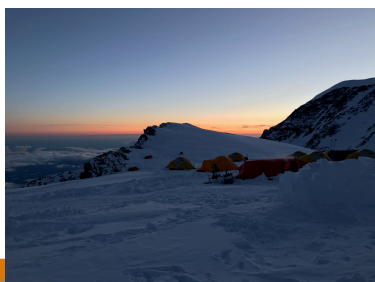
- Check BG levels more often (CGM helpful here)
- If you take insulin, you'll likely need to increase your dose (i.e. temporary basals, ↑ basal insulin, ↑ mealtime insulin, strengthen corrections)
- If you take pills (i.e. glyburide, glipizide, glimepiride), you may need to increase the dose, add additional medication, or possibly even add insulin temporarily
- As steroid dose is tapered down, diabetes drug doses will need to be tapered as well
- Steroid injections can affect BG levels for up to a few weeks
- Steroid inhalers and creams don't typically affect BG levels.



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HYPERGLYCEMIA MANAGEMENT: QUESTIONS??



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