

### Children Living with Diabetes

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Research focuses on Diabetes Technology and Artificial Pancreas

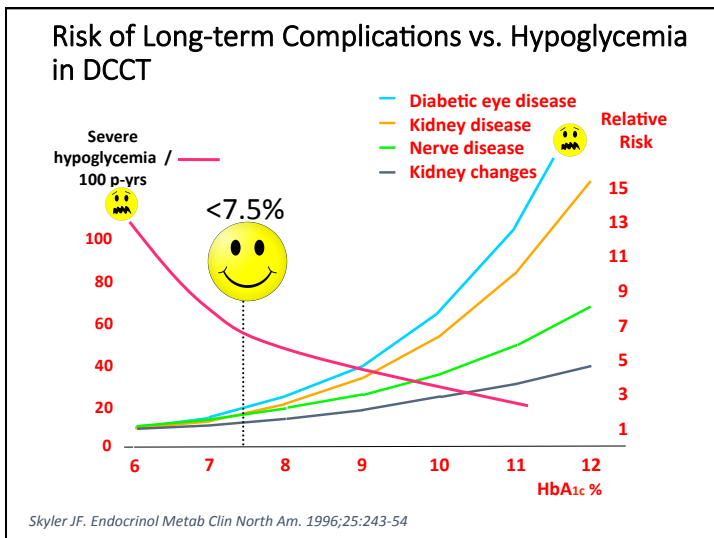
**Topics:**

- A1c and Balance of hyper/hypoglycemia risks
- Currently Available Pumps and CGM's
- Diabetes in Schools

**Topics:**

- Non-Adjunctive CGM in schools
- Exercise and diabetes
- Upcoming systems for children

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### TIPS TO IMPROVE A1C

- Never miss an insulin dose\*  
\* Missed Insulin Meal Boluses and Elevated HbA1c Levels in Children Receiving Insulin Pump Therapy. J. Burdick et al; Pediatrics 3/04, 113.3
- Administer meal dosing 20 minutes before eating (unless <80 mg/dl)\*  
\* Timing of Meal Insulin Boluses to Achieve Optimal Postprandial Glycemic Control in Patients with Type 1 Diabetes: E. Coby et al; Diabetes Technology and Therapeutics 12.3 173-177
- Utilize half unit insulin pens for more precise dosing (Humapen Luxura HD, Novopen Echo) or BD 3/10cc, half unit marked syringes  
\* New Insulin Delivery Recommendations: Mayo Clinic Proc. September 2016-91, (9):1233-1235
- Use 4mm pen needles (6mm syringe needle with a pinch up)\*
- Use of insulin pump for more precise dosing and extended boluses
- Use of continuous glucose monitoring
- Utilize linking equipment and review data weekly



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### TIPS TO DECREASE HYPOGLYCEMIA

- Lows tend to beget lows; monitor weekly uploads for need for dosing changes
- Utilize CGM with associated alerts and suspend capabilities
- Consider snacking during or minimizing insulin delivery while active
- If moderate to strenuous exercise during the afternoon or evening aim for a bedtime blood sugar >130, set a decreased temporary basal rate at bedtime or eat a bedtime snack
- Use pumps to deliver more accurate and timely bolus and basal insulin
- Hypo alert dogs?



Factors Associated with Nocturnal Hypoglycemia Hypoglycemia in At-Risk Adolescents and Young Adults with Type 1 Diabetes: D. Wilson, MD et al. Diabetes Technology and Therapeutics. 2015 Jun 1;17(6): 385-391.

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**Omnipod**      **Animas Ping, Animas Vibe**  
**T-slim, T-flex, X2**  
**Accucheck Spirit Combo**      **Medtronic 630G**  
**Medtronic Paradigm or 530G**

### CONTINUOUS GLUCOSE MONITORING – KNOW THE LANGUAGE

**Sensor** (the part that goes in the skin) 

**Transmitter** (the part that hooks to the sensor and sends info to the receiver) 

**Receiver** (where you see the info) 

### What about Diabetes in the School?

- Diabetes Resource Nurses
- Health Care Orders
- 504 plans






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**Dexcom G5 and Non-Adjunctive CGM Use**

- Until December 2016, CGM was considered to be adjunctive or “in addition to” fingerstick blood sugar testing.
- In response to demands from patients, in December 2016, the FDA approved correction dosing directly from the Dexcom G5 CGM





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**Colorado Kids with Diabetes – Care and Prevention Collaborative Guidelines for Non-Adjunctive CGM Dosing in Schools**  
<http://www.coloradokidswithdiabetes.org/state-guidelines/>

**General**

- The CGM should be calibrated twice a day generally when the blood sugar is stable and not when the child is about to eat. This is usually done at home, but can be verified in the CGM calibration history.
- Acetaminophen (Tylenol) can falsely elevate CGM values, and the CGM readings should not be used for dosing within 4-8 hours of acetaminophen administration. Be cautious as many combination “cold and flu” medications contain acetaminophen without having “Tylenol” in the name.
- Remember that if a child is sent to the school nurse’s office, another person must always accompany the child, especially if the child is hypoglycemic.

**Meals**

- For meal based correction boluses, the CGM value may be used in place of finger-stick testing provided the value is in the range of 80 to 250 mg/dL. If the CGM value is less than 80 mg/dL or greater than 250 mg/dL, then a finger-stick BG value should be obtained and correction dosing should occur based on the finger-stick value, as per the physician’s school order form.

**Lows**

- If a child feels that his/her blood sugar is low or if the CGM is reading < 80 mg/dL, then check a finger-stick BG and provide carbohydrates based on the finger-stick BG reading and symptoms and recheck finger-stick BG in 15 min. If still low, repeat the above.
- If the CGM is reading low, but the child is not symptomatic, confirm glucose with a finger-stick prior to treating. Treat according to the finger-stick value, as per the physician’s school order form.

**Highs**


- If the CGM is reading >250 mg/dL, then check BG with a finger-stick and correct based on the finger-stick value, as per the physician’s school order form.
- If the finger-stick BG is >300 mg/dL, check for serum or urine ketones and treat as per the physician’s school order form.







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**2016 Ski Camp in Breckenridge Colorado with UVA**

- In the winter of 2016 we conducted a study of 16 kids in Breckenridge, CO and 16 kids in Wintergreen, VA investigating the use of an artificial pancreas while skiing
- All kids at both sites were able to ski safely and the artificial pancreas was found to improve outcomes and safety.



	Artificial Pancreas	Usual Pump + CGM
% 70-180 mg/dL	64.7	71.3
Average BG	156	152
% < 70 mg/dL	3.2	1.8

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**Automation of Exercise and Other Things**





- Use of Device such as Fitbit or smart watch to measure movement, heart rate, etc to enable the system to detect and respond to exercise
- Our ski camp study showed that the use of a Fitbit is reliable for detecting exercise
- Other applications of this concept apply to the “internet of things”
  - Use of cell phone location services to determine where you are
  - Use of cell phone camera to replace carb counting
  - Cloud connectivity to allow for larger-scale data processing








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### Insulin Pumps and Pathway to Artificial Pancreas Systems



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**Medtronic:** 670G Approved Fall 2016 (14+ y/o), starting to ship April 2017. Trial for 7-13 y/o starting soon at BDC, 2-6 y/o trial will follow. Also working with groups in Cambridge and Israel on 690G and other future systems.
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**Insulet (Omnipod):** Conducting trials on hybrid artificial pancreas systems. Conducting hospital and outpatient trials.
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**Tandem (t:slim):** Predictive low glucose suspend trials are ongoing. Also now working with the UVA hybrid artificial pancreas system which is starting trials this spring.
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**Animas:** Very unclear. J&J recently announced that they are selling their diabetes companies which has called into question the time course for these studies. Originally proposed trials on hybrid closed loop system.

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### Insulin Pumps and Pathway to Artificial Pancreas Systems

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**In Control:** System from UVA. Descendent of the system we used at Ski Camp. Hybrid closed loop system. May run on cell phone or t:slim X2 pump. Trials starting this spring and summer.
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**iLet:** System from Boston University. Uses insulin and glucagon to control blood sugar in a hybrid closed loop system. Trials in children starting late 2017.
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**Bigfoot:** Hybrid closed loop system developed by father of a child with diabetes who is also the husband of a pediatrician with diabetes and the guy who built Nightscout who is also the father of a child with diabetes. Hybrid closed loop system. Ongoing trials.

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