Management of Diabetes in Children and Adolescents

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*Objectives/Goals*

* Develop an understanding of the management options available for children/teens with diabetes
* State goals for HbA1c and blood glucose levels for children/teens with diabetes
* State common emergencies related to children/teens with diabetes
* Recognize developmental stages of children/teens as they relate to managing diabetes
* Explore the types of insulin pumps and CGMS utilized for glucose management with children and teens
* ADA reports 215,000 people under age 20 have diabetes

* 1 out of approximately every 400 children have type 1 diabetes

* Non-Hispanic white youth have the highest rate of new cases of type 1 diabetes—22.6-24.8 per 100,000

* Youth developing type 1 diabetes has been growing at annual rate of 3%

* SEARCH data states that the prevalence of type 2 diabetes increased 21% among American youth from 2001-2009 and by 23% for type 1 diabetes.

* Auto-immune beta cell destruction with loss of insulin production.

* May have several positive antibodies: islet cell, GAD, IA-2, IA-2B, or insulin autoantibodies

* Must have 1 of these 3 on at least 2 occasions: Casual plasma glucose > 200mg/dl with symptoms of diabetes, fasting plasma glucose >126, 2hr glucose during 75 g oral glucose tolerance test >200mg/dl

* A1C levels between 5.7% and 6.4% are considered to have prediabetes and those with levels of 6.5% or higher are considered to have diabetes.
Management Goals for Children/Teens

* Normal growth & development: Growth should be assessed every 3-4 months.

* Optimal glycemic control: Should be individualized to achieve lowest A1c possible with minimal hypoglycemia.

* Minimal acute or chronic complications: Hyper/hypoglycemia prevention.

* Positive psychosocial adjustment: Consider developmental stage of child/adolescent

ADA Recommendations for Glucose Control in Children/Teens

* The American Diabetes Association recommends the following blood glucose ranges for children with Type 1 diabetes.

<table>
<thead>
<tr>
<th>Age</th>
<th>Before meals</th>
<th>Bedtime-Overnight</th>
<th>Goal A1c</th>
</tr>
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<tbody>
<tr>
<td>Birth-19 years</td>
<td>90-130</td>
<td>90-150</td>
<td>&lt;7.5%</td>
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</table>
**Which Insulin regimen will we use?**

* **Type of insulin used based upon:**
  * eating patterns and age of child
  * family patterns
  * is individualized to meet all of above

**Types of Insulin Utilized for Children/Teens**

* **DOSAGE:** Children typically require 0.7-1 unit of insulin per kg/body weight if they are in puberty or out of honeymoon.

* Ranges can be 0.5-1.5u/kg/day. Overweight children may require higher dosages. Consider age, eating patterns, and metabolic requirements.

* During honeymoon children/teens may need as little as 0.3u/kg/day. Newly diagnosed children detected early may require less insulin.

* Most children/teens enter a honeymoon phase with decreased insulin needs. Can last 2wks-2years
**Insulin Injection Sites**

**SITES:**
- Rotate sites. Young children will usually prefer arms, legs, & buttocks.
- Insulin is absorbed quickest from abdomen, then arms, then legs, and slowest from hips.
- Assess sites for hypertrophy or thickening before giving injections.
- Abdomen hips, thighs, and arms can used for insulin pump sites.

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**Insulin Dosing**

- When deciding on insulin types to be used, the diabetes team should take into account changing food intake, insulin requirements (based on weight/pubertal status), and physical activity.

- Consider availability of parent’s or school nurse to supervise lunch injections.

- 50% TDD – Usually given as long acting – basal insulin once daily.

- On some occasions NPH may be used twice daily as basal insulin.

- Other 50% given as rapid acting insulin to prevent hyperglycemia with meals/snacks or as correction.
Glargine (Lantus) insulin and Levemir (Detemir) insulin’s are 24 hour basal insulin’s. These should not be mixed in the same syringe with any other insulin’s.

Dose should be based on weight or previous total daily insulin dose (TDD). Dose is approximately 50% of TDD.

Child/teen does not need to have scheduled snacks unless increased activity is planned, such as: PE, recess, or sports. Add a 10 gram carb snack without insulin coverage during increased activity.

Lispro (Novolog) or Aspart (Humalog), or Apidra insulin’s are used to cover carbohydrates with meals and snacks. These are rapid acting insulin’s.

The diabetes team will prescribe an insulin to carbohydrate ratio. Parent’s are taught to watch for patterns of high/low blood glucose and how to adjust ratio’s at home.
* If blood glucose is high 3 hours after meals or low 1-3 hours after meals, consider adjusting the ratio.
* Older school age children and teens should be able to take insulin before the meal for the carbs they plan to eat as well as cover high blood glucose, this will cut down on missed class time.

* Very rigid regimen, requiring set doses of insulin at set times with set amount of carbohydrates at meals
* Greater risk of hypoglycemia with peaks of NPH insulin
* Insulin is usually dosed with : 2/3 TDD in AM before breakfast and 1/3 in PM. Further broken down to : AM 1/3 rapid acting insulin and 2/3NPH. PM: 50% rapid acting insulin and 50% NPH.
* NPH is often given at bed instead of before supper to help prevent lows in middle of night.
**Non-disposable Insulin Pens**

* Novo Pen Junior - Dials in ½ units after 1 unit. Always waste 2 units before dialing dose.
* Novo Echo Pen- Starts dialing at 0.5 units, then in half unit increments. Has memory that shows last dose given.
* HumaPen Luxura-HD - Newer version starts with ½ unit. Check pen to see if pen starts with ½ or 1 unit. Waste 2 units before dialing dose.

**Disposable Insulin Pens**

* Novolog Flexpens and Humalog Kwipens – Disposable pens. Dial in 1 unit increments. Waste 2 units before dialing dose.
* Pen needles - Always use a new needle. Newer BD “mini” or “nano” needles do not require pinching of skin and should go straight in with needle. Count to 10 before removing needle.
* Always remove the needle after use and do not store the pen with the needle on.
**Insulin Storage**

- Rapid acting insulin pens or cartridges can be kept room temp for 28 days. Not above 86 degrees
- Unopened vials and pens should be kept in refrigerator
- Always check expiration date
- Premixed pens and NPH can be kept room temp for 10-14 days - check package insert
- Pen needles should be removed after use and new needle used with every injection

**Basics of Carbohydrate Counting**

- Diabetes management is a balancing act. We are constantly balancing insulin with food, exercise, and other factors.

- Carbohydrates are the foods that affect the blood glucose the most. They are broken down to sugar. They are our energy foods.

- No sweet sodas or fruit punch drinks. Only 1 fruit or juice per meal.
Teaching Guidelines

* Basal/Bolus
  * Insulin must be taken with every meal and snack
  * Do not have a set amount of carbohydrates
  * 3 meals and 1-2 snacks
  * 10 gram carb snack before bed if needed
  * Free foods may be used without insulin coverage

* Split/Mixed
  * Set doses of carbohydrate to match set doses of insulin
  * Typical is 3 meals and 1-2 snacks
  * Free foods can be consumed between planned meals/snacks

Carbohydrate Counting

* 90% carbohydrates converted to glucose
* 50-60% protein converted to glucose
* 10% fat converted to glucose
* Pizza: the food that keeps on giving!
Carbohydrates are energy foods.
We do not recommend skipping carbs, so that an injection is not needed.
We recommend healthy food choices and encourage using the plate method.

Use food labels to calculate how many carbohydrates are in a serving of food item
In this example ½ cup = 13 grams carb
If you have 1 cup = 26 grams
In this example 2 crackers = 10 grams carbohydrate.

If your ratio is 1:20, then you would give 0.5 units of Novolog/Humalog/Apidra insulin.

If they ate 4 crackers then you would give 1 unit of Novolog/Humalog insulin.

If you calculate 0.7 units and they are going to PE then give 0.5 units (round down); if they are running high round up or follow medication orders.

Food labels and Calorie King are preferred reference points.

ADA Exchange List is your 2nd preferred reference.

FREE copy download: [www.eatright.org/HealthProfessionals/content.aspx?id=101](http://www.eatright.org/HealthProfessionals/content.aspx?id=101)
Type 2 Diabetes

* Incidence is increasing
* Diagnostic criteria: Same as type 1
* 33% have ketonuria at diagnosis
* 5-25% have ketoacidosis
* Linked to sedentary lifestyle

Type 2 Diabetes facts

* Underlying feature is insulin resistance
* Leads to increased insulin production – hyperinsulinemia with subnormal response to this insulin
* Insulin resistance if likely hereditary and may be associated with puberty
Management type 2 diabetes

- Treatment of Type 2 Diabetes is similar to Type 1 treatment, with increased focus on lifestyle modification
- Goal is to get to ideal body weight with increased exercise and healthy meal planning
- May have obesity, acanthosis nigricans, obstructive sleep apnea, hypertension, dyslipidemia, and polycystic ovarian syndrome
- Monitor for long term complications

Goals for management type 2 diabetes

- Normal growth and development
- Euglycemia
- Weight reduction if needed
- Decrease risk of co morbidities associated with insulin resistance
- Prevention of long term complications
Blood glucose goals type 2 diabetes

* ADA recommends fasting blood glucose <126
* Normal A1c
* Should monitor for complications- dilated eye exam and micro albuminuria screen yearly
* Screening for BP, lipids, foot exam, and macro vascular disease should be performed, but time frame is not defined.

Type 2 Diabetes Management

* Metformin (Glucophage) is only oral agent currently approved for children ages 10-16 years of age.
* Recommended starting dose is 500mg BID. Can be increased in 500mg increments for max dose of 2000 mg per day.
* Insulin is the quickest way to get blood glucose under control.
Possible causes

- not enough food
- exercise without snack
- too much insulin
- stress
- injection site
- nausea and vomiting

Symptoms:

- mild: sweating, trembling, difficulty concentrating, lightheadedness
- severe: inability to self-treat due to mental confusion, lethargy, unconsciousness

Sugar is the main source of fuel for the brain. Young children may not recognize symptoms of shakiness, fast heart rate, and may go quickly to symptoms of drowsiness, behavior change, confusion, double vision, loss of consciousness, and/or seizure.
**Hypoglycemia Prevention**

* Instruct patient/family to call for low blood glucose reading patterns.
* Instruct patient/family to check blood glucose before bed. If blood glucose is less than 100-125 add approximately 10 grams of complex carb with protein/fat at bed
* Recheck blood glucose at 2 am if needed

**Hypoglycemia Treatment**

* Blood glucose < 70-80 give 3-4 glucose tabs (15 grams) and recheck blood glucose in 15 minutes. Repeat as needed until over 70

* If unable to chew tabs use 3-4 ounces of juice or 15 grams glucose gel in cheek
* Hypoglycemia Treatment

* Glucagon is a hormone secreted by the pancreatic alpha cells. It stimulates the body to release glucose immediately.
* Turn to side after injecting, biggest side effect is nausea/vomiting
* Dosage:
  * 1 mg IM for adults and children >20kg
  * 0.5 mg IM for children under 20kg

* If blood glucose is > 240, urine ketones should be checked.
* **Follow correction scale** if it has been **3 hours** since last meal, snack, or correction insulin or follow orders provided by diabetes team.
* Encourage copious amounts of water (gallon’s)
* If unable to drink, vomiting, or CMP shows acidosis- IV fluids and IV insulin are needed
* Ketones do not occur from “eating the wrong foods”, they occur from missed insulin doses- usually long acting insulin (Lantus,Levemir, or NPH).
**Sick Day Rules for Type 1 Diabetes**

* It is important to have a sick day plan
* Do not skip long acting insulin—ever
* Check blood glucoses every 2 hours
* Check urine for ketones with every 2 hours, regardless of blood glucose.

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**Sick Day Rules**

* If child/teen has a stomach virus with vomiting /diarrhea diabetes team may lower long acting insulin dose for several days – never skip

* May not give rapid acting insulin until able to keep down solid food

* During colds, sore throats, and respiratory illnesses, blood glucose usually goes up. Give entire insulin dose and cover hyperglycemia with correction insulin every 3 hours
For nausea and vomiting with moderate to large ketones, call the diabetes team.

* Sick Day Rules for Diabetes

* For children/teens with type 2 diabetes on insulin, follow insulin and sick day diet guidelines for type 1 diabetes
* Hold Glucophage with nausea or vomiting. This may increase symptoms of GI upset.
* Sick Day Rules for Diabetes

* If blood glucose is running low may need to drink at least 10-15 grams carbohydrates in the form of sugar containing fluids every hour.
* This is best tolerated in 1-2 ounce amounts every 10-15 minutes. Good choices are Pedialyte, Gatorade, ginger-ale, coke, Jell-O and regular popsicles.

* ER Visits

* The family of any child who has moderate to large ketones with vomiting should page the Pediatric Endocrinology team
* If the physician directs a family to take the child to the ER then they should do this immediately
* If a child has moderate to large ketones with shortness of breath they should call EMS and get to the nearest ER
**Exercise with Diabetes**

- As a general rule for 30-60 minutes of exercise add 10-15 grams of complex carbohydrate before exercise. Start with blood glucose >100-150

- May need to add more carbohydrates depending on intensity of exercise and pre-exercise blood glucose

- Some children/teens like to sip G2 (Gatorade 2) during exercise to keep blood glucose up—don’t over treat

- Some children/teens notice an increase in blood glucose after exercise—adrenaline response

**Erikson’s Psychosocial Stages**

*Trust vs. Mistrust – 1st year of life.* Administer injections/finger sticks with calm attitude. Show affection during/after procedure

*Autonomy vs. Shame/Doubt - Toddler.* Offer simple choices of which finger, but must be firm with limits

*Initiative vs. Guilt - Preschool ages 3-5*  
Conscience develops. Magical thinking. May view procedures as punishment. Worried about intactness of body. Offer band aids and simple explanations
**Erickson’s developmental stages**

*Industry vs. Inferiority* - School age. Has a conscience, can share, & cooperate. Slowly introduce some Diabetes management task. Supervision is essential!

*Identity vs. Role Confusion* - Adolescents. Early adolescents are acutely aware of body image. Middle adolescents peer group is very important. Late Adolescents have greater separation from family, peers become less important and self identity is more important.

**Cognitive Developmental Stages/considerations**

*Infant/Toddler (birth-2 years)* - Sensorimotor stage - Period of rapid growth and development. Need to fit sleep/naps into regimen.

Infants usually nurse or eat predictably. Toddler eats erratically as growth slows.

**Differentiation** begins 4-5 months, separation-individuation 6 months, crawling 9 months, 10-12 month walking & manual skills – described as having “love affair with world”.


* **Infant/toddler**

* Consider every 3-4 hour feedings to prevent hypoglycemia
* Frequent monitoring- use fingers, toes, lateral aspect of heel.
* Diabetes in early years has been associated with impaired abstract and visual reasoning and attention deficits. May be associated with undiagnosed hypoglycemia or seizures.

* **Preschool age 3-5 years**

* Preoperational stage- Ages 2-7
* Developing motor skills
* Period of “magical thinking”
* Body integrity or intactness is important
* Have difficulty understanding need for insulin injections when they feel well.
* Allow for some choices with injection sites, finger sticks.
* Play therapy or allowing child to use dolls, etc… help them cope
* Consider eating/insulin patterns, day care education, and ability to report symptoms hypoglycemia
Concrete operational stage
* Avoids failure in school and activities
* Parent-child sharing and supervision is important in regards to diabetes task
* Consider school forms, PE, insulin, and nutritional needs
* Begins to think logically about concrete events

Adolescent
* Formal Operational Stage—Abstract reasoning
* Early Adolescence or preadolescence (12 years)
* Middle adolescence (13-15 yrs)
* Late adolescence (16-21yrs)
* Becomes aware of body image, struggles between parent/child, more involved with peers, parental criticism difficult for child
* Onset of puberty can cause need for increased insulin dose due to relative state of insulin resistance due to hormonal changes.
* Diabete can interfere with normal adolescent development. Concerns with appearance of injection sites and with self-identification as “a diabetic”.
* Physical growth and sexual maturation concerns
* Experimentation and rebellion usually centers around diabetes management
* Educate on substance abuse, prevention of STD’s/pregnancy
* Driving safety issues
* DKA- with girls may be weight loss plan

* Things to Consider Before Switching to Pump Therapy

* Willing to monitor blood glucose at least 4 times day
* Responsible parent/caregiver &/or adolescent
* Ability to count carbohydrates or designated person to assist with carbohydrate counting
* Ability to troubleshoot hyper/hypoglycemia
* Ability/willingness to keep in contact with diabetes team
* School plan for bolusing for meals / snacks
* Prefer A1C to be under 9%
Use of Insulin Pumps in Pediatric Patients

* Ability to fine tune insulin doses
* Gives more flexibility for mealtimes and food choices

Types of Insulin Pumps

* Commonly used insulin pump brands are: Medtronic Revel, Animas-One touch Ping, Omni Pod, T-Slim
* All pump companies have a 24 hour customer service hotline and will assist with mechanical questions/alarms
* Blood glucose > 240, check urine ketones

* **If ketones are negative**, give a high blood glucose bolus via pump if it has been 3 hours since last meal, snack or bolus.

* **If ketones are positive** - DO NOT use the pump, give an injection of Novolog/Humalog/Apidra based MD orders.

* Change pump site

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* Drink at least 8 ounces water every 30-45 minutes or give IV fluid bolus

* Recheck blood glucose in 1-2 hours to make sure blood glucose is coming down.
* Because children with diabetes are still growing, their insulin doses require frequent adjustments. Recommend Endocrine visits every 3 months.

* Monitoring blood glucose at least 4 times per day is important to identify trends requiring insulin dose, diet and/or exercise regimen changes.

**Continuous Glucose Monitoring**

* Use of continuous glucose monitoring (CGM) in pediatric patients
* Advantages of CGM
* Disadvantages of CGM
“Cindy” a known teenager with Type 1 Diabetes comes to ER with blood glucose >500, a 10 pound weight loss, and 8 hour h/o N/V… What do you need to assess next?

A. Urine and/or blood ketones  
B. CBC  
C. Pregnancy test  
D. Assess for Anorexia

What are the best test to differentiate type 1 from type 2 Diabetes?

A. Islet cell antibodies, GAD, anti-insulin antibodies  
B. Genetic testing  
C. Family history  
D. Obesity vs. thin build
What is the most common reason for a child or adolescent to go into DKA?

A. Insulin omission
B. Hypertrophied injection sites
C. Eating hot fudge sundaes
D. Not enough exercise

What are some of the effects of poor blood glucose control seen in children?

A. Poor growth
B. Dental caries
C. Micro albuminuria
D. Weight loss
E. All of above
*Which site is insulin absorbed the quickest?

* A. Abdomen
* B. Arms
* C. Hips
* D. thighs

*Questions*

*What are some tools that can be used to assist a child with coping with insulin injections?*

*What is the definition of a “free food?”*

*What is the universal thing that all children want / need??*
References

* American Association of Diabetes Educators: [http://www.diabeteseducator.org](http://www.diabeteseducator.org)*
* Juvenile Diabetes Research Foundation International: [http://www.jdrf.org](http://www.jdrf.org)
* JDRF References. [WWW.JDRG.org](http://www.jdrf.org)
* National Diabetes Education Program, a joint program of NIH and CDC: [http://www.yourdiabetesinfo.org](http://www.yourdiabetesinfo.org)