

Home and Outpatient Management of Type 1 Diabetes (Children and Adolescents)

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Key Points

- Children and adolescents have inherent biological characteristics that dictate specific diabetes management guidelines.
- Adult caregiver's close involvement in this population's diabetes care is essential to ensure the best outcome.
- Diabetes control during childhood has been proven to have a lasting effect on the long-term risk of diabetes-related chronic complications.
- Continuing diabetes education of the patient and family is required to ensure the best outcome.
- Self-management of diabetes evolves with time as children mature and developmentally appropriate skills progress with age.
- Transition to adult care is a planned process that should involve the entirety of the health team.

Definition, Assessment, Diagnosis

Criteria for the Diagnosis of Diabetes

- Symptoms of diabetes and a casual plasma glucose ≥ 200 mg/dl (11.1 mmol/l).
 - *Casual is defined as any time of day without regard to time since last meal.*
 - *The classic symptoms of diabetes include polyuria, polydipsia, and unexplained weight loss.*

OR

- Fasting plasma glucose ≥ 126 mg/dl (7.0 mmol/l).
 - *Fasting is defined as no caloric intake for at least 8 hr.*

OR

- 2-h plasma glucose ≥ 200 mg/dl (11.1 mmol/l) during an oral glucose tolerance test.
 - *The test should be performed as described by the World Health Organization, using a glucose load of 75g anhydrous glucose dissolved in water or 1.75 g/kg body wt. if weight is <40 pounds (18 kg).*
- Isolated hyperglycemia in the setting of an acute illness may be due to other causes.
- Presence of pancreatic autoantibodies signify autoimmune Type 1 diabetes.¹

Table 1. Criteria for the Diagnosis of Diabetes

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A1C $\geq 6.5\%$. The test should be performed in a laboratory using a method that is NGSP certified and standardized to the DCCT assay.*
OR
FPG ≥ 126 mg/dL (7.0 mmol/L). Fasting is defined as no caloric intake for at least 8 h.*
OR
2-h PG ≥ 200 mg/dL (11.1 mmol/L) during an OGTT. The test should be performed as described by the WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.*
OR
In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose ≥ 200 mg/dL (11.1 mmol/L).

*In the absence of unequivocal hyperglycemia, results should be confirmed by repeat testing.

Source: American Diabetes Association. Classification and diagnosis of diabetes. Sec. 2. In *Standards of Medical Care in Diabetes—2015*. Diabetes Care 2015;38(Suppl. 1):S8–S16.

http://care.diabetesjournals.org/content/38/Supplement_1/S8.full

Management and Treatment Recommendations

Initial care

- Ideally, every newly diagnosed child with diabetes should be evaluated by a qualified diabetes team (pediatric endocrinologist, nurse educator, dietician, mental health professional)

Diabetes Education

- Studies in children with type 1 diabetes have demonstrated that patient and family education, delivery of intensive diabetes case management, and close telephone contact with the diabetes team are associated with reduced hospitalizations, emergency room visits, and overall costs to the payer and patient.^{2,3,4}

- Education should be provided by the diabetes team with a context that addresses family dynamics and issues facing the whole family and should always be sensitive to child’s age and developmental stage.
- Ongoing education regarding prevention of acute and chronic complications should be provided.

Glycemic Control

- Maintain glucose levels as near to normal as safely possible.
- DCCT/ EDIC² findings support thesis that diabetes control during adolescence has lasting effect on rate of chronic complications in adulthood
- New recommendation from ADA- American Diabetes Association- keep HbA1c < 7.5% if younger than 19 years. Also ISPAD (International Society for Pediatric and Adolescent Diabetes) recommendation.
- Personalized treatment: (ADA guidelines)

Table 2. American Diabetes Association Definition and Goals for Hemoglobin A1C

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Blood glucose and A1C goals for type 1 diabetes across all pediatric age-groups

Blood Glucose Goal Range		A1C	Rationale
Before meals	Bedtime/overnight		
90–130 mg/dL (5.0–7.2 mmol/L)	90–150 mg/dL (5.0–8.3 mmol/L)	<7.5% (58 mmol/mol)	A lower goal (<7.0% [53 mmol/mol]) is reasonable if it can be achieved without excessive hypoglycemia

Key concepts in setting glycemic goals:

- Goals should be *individualized*, and lower goals may be reasonable based on a benefit–risk assessment.
- Blood glucose goals should be modified in children with frequent hypoglycemia or hypoglycemia unawareness.
- Postprandial blood glucose values should be measured when there is a discrepancy between preprandial blood glucose values and A1C levels and to assess preprandial insulin doses in those on basal–bolus regimens.

Source: American Diabetes Association.

Children and adolescents. Sec. 11. In Standards of Medical Care in Diabetesd2016. Diabetes Care 2016;39(Suppl. 1):S86–S93. Retrieved October 3, 2016, from http://care.diabetesjournals.org/content/diacare/39/Supplement_1/S86.full.pdf

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HbA1c%	BG (mg/dL)
7	154
8	183
9	212
10	240
11	269
12	298

Age (years)	HbA1c %	BG Before meals (mg/dL)	BG Bedtime/Overnight (mg/dL)
< 6	7.5-8.5	100-180	110-200
6-12	< 8	90-180	100-180
13-19	< 7.5	90-130	90-150

Source: [Diabetes Care 2016 Jan; 39\(Supplement 1\): S86-S93.](http://dx.doi.org/10.2337/dc16-S014)
<http://dx.doi.org/10.2337/dc16-S014>

- Insulin Management
 - Types of insulin used in childhood (used in combination)
 - Rapid-acting insulin analogs (Lispro/ Humalog®, Aspart/ NovoLog®, Glulisine/ Apidra®)
 - Short-acting insulin (Regular)
 - Rarely used: Intermediate-acting insulin (NPH and Lente)
 - Long-acting insulin analogs (Glargine/ Lantus®, Detemir/ Levemir®)
 - Delivery methods
 - Syringes
 - Insulin pens
 - Insulin pumps (continuous subcutaneous insulin infusion devices)
 - Insulin daily requirements dependent on
 - Age (younger age= smaller doses)/ Pubertal status (increased GH secretion during pubertal years= higher insulin requirements)
 - Weight (obesity= higher insulin requirements)
 - Level of physical activity or exercise intensity (increased exercise may require lower insulin doses)
 - State of health (acute illnesses will usually increase insulin requirements)
 - Carbohydrate intake on a meal by meal basis (high carbohydrate content will require higher insulin dose)
 - Basal bolus insulin regimens - Combine long-acting peakless insulin given once/day with rapid-acting insulin analogs administered at each meal and snack
 - Lantus® or Levemir® combined with Humalog®/Apidra® or NovoLog® are examples
 - Dosing of long acting insulin is based on child's weight and age, titration aims to normalize fasting glycemia
 - Dosing of rapid acting insulin is based on pre-meal glycemia, carbohydrate intake, and expected level of activity over the next 3 hours after the meal; titration aims to normalize 2 hour-postprandial glycemia.
 - Insulin pumps
 - Able to deliver insulin in 0.025 unit increments
 - Particularly useful in infants who require very small doses of insulin and are

- vulnerable to hypoglycemic events
- Adult supervision of all aspects of pump usage is required at all ages.
- Pumps utilize only rapid acting insulin for both basal and bolus needs.
- Pump delivers insulin subcutaneously through a small catheter that is changed every 2-3 days.
- Hourly delivery of insulin is programmed into pump's computer and larger bolus doses can be delivered at mealtimes.
- Blood Glucose (BG) Self-Monitoring
 - Ideally, insulin therapy should be based on frequent monitoring of BG levels.
 - For optimal control, BG levels should be monitored at least 4 times per day in children who are clinically stable and have good diabetes control.
 - Children with good diabetes control should periodically test post-prandial, before and after exercise, and 2:00AM nocturnal BG levels in order to preserve optimal control.
 - Children and adolescents with sub-optimal diabetes control should monitor BG levels more frequently (pre and post meals; before and after exercise; bedtime; 2:00AM; and fasting BG levels may be required until diabetes control improves)

Nutrition

- Obesity and nutritionally lacking diets affect this population of children as it does the pediatric population in general.
- Consultation with a dietician to develop a medical nutrition plan is desirable.
- Annual evaluation of height, weight, BMI, and formal nutrition consultation are desirable.
- Caloric intake should be adequate for growth and restricted if child becomes overweight.

Exercise

- CDC and American Academy of Sports Medicine recommend $\geq 30-60$ minutes of moderate physical activity daily.
- Ingestion of 15-30 g Carbohydrate before moderate exercise is recommended to keep BG levels above desired range (10-20 g for smaller, younger children may be enough)
- For prolonged, vigorous exercise expected to continue for several hours, hourly BG monitoring is desirable both during and after the activities; insulin requirements may be decreased up to several hours after strenuous exercise (i.e. competitive sports, cycling, swimming, cross-country skiing, long-distance running).
- Sedentary activity should be discouraged (non-school related screen time < 2 hours/day)

Psychosocial Issues Affecting the Diabetes Care Plan

- Social worker as part of diabetes team is invaluable
- Child characteristics predicting difficulties with diabetes care
 - Other health problems
 - Poor school attendance
 - Learning disabilities
 - Emotional or behavioral disorders and psychiatric illness
- Family characteristics predicting difficulties
 - Single parent home
 - Chronic physical or mental illness in parent, including substance abuse
 - Major life change for the parent
 - Overly permissive or controlling parenting styles
 - Lack of adequate health insurance
 - Complex child-care arrangement

- Health/ cultural/ religious beliefs that may interfere

Immunizations

- All children and adolescents with diabetes should receive all immunizations as recommended by the American Academy of Pediatrics.
- In the fall, influenza immunization should be given to those >6 months of age.

Diabetes Care in School and Daycare Settings

- Child should be able to participate in all school activities.
- “Care of Children with Diabetes in the School and Day Care Setting”⁵ outlines the responsibilities of the child, the parent, and the school/day care to ensure a safe learning environment for the child.
 - [Diabetes Care in the School and Day Care Setting](#)
- “Helping the Student with Diabetes Succeed: A Guide for School Personnel” by the National Diabetes Education Program (NDEP) also contains an example of a diabetes medical management plan.
 - [Helping the Student with Diabetes Succeed: A Guide for School Personnel](#)

Sick Day Management

- Families can access sick day guidelines online
 - [Patient Instructions for Sick Days](#)
- Goals of sick day management:
 - Prevention and early treatment of hypo- and hyperglycemia, ketosis, and prevention of diabetic ketoacidosis.
 - Increased frequency of BG monitoring and ketonuria screening
 - Close tracking of food and fluid intake required to prevent dehydration
 - Inability to tolerate oral fluids and persistent large ketonuria should be evaluated and managed at the emergency department

Screening and Management of Complications

Nephropathy

- Annual screening for albuminuria with a random spot urine sample for albumin-to-creatinine ratio at the start of puberty or at age 10 whichever is earlier (once the child has had diabetes for 5 years).
- ACE inhibitors are the treatment of choice if albuminuria has been confirmed on 3 different samples obtained over a 6-month interval.

Hypertension

- Blood pressure should be measured at each routine visit.
- ACE inhibitors (which are teratogenic agents) are the treatment of choice for confirmed hypertension in a diabetic person.

Dyslipidemia

- Obtain fasting lipid profile in pre-pubertal children soon after diagnosis if there is a family

history of hypercholesterolemia or a cardiovascular event before the age of 55.

- Otherwise obtain lipid profile after the age of 10 or at time of puberty and re-measure annually if abnormal.
- If fasting LDL is < 100 mg/dl, repeat measurement every 5 years.

Retinopathy

- Dilated annual retinal exam should be considered at the start of puberty or at age 10 years, whichever is earlier, once the child has had diabetes for 3-5 years.

Celiac Disease

- Consider screening for celiac disease by measuring IgA tissue transglutaminase or antiendomysial antibodies soon after diagnosis of type 1 diabetes.
- A gluten free diet is needed for children with biopsy- confirmed celiac disease.

Autoimmune Thyroid Disease

- Consider testing children with type 1 diabetes for antithyroid peroxidase and antithyroglobulin antibodies soon after the diagnosis.
- Measure thyroid-stimulating hormone concentrations soon after the diagnosis of type 1 diabetes and after glucose control has been established. If normal, consider rechecking every 1-2 years or sooner if the patient develops symptoms suggestive of thyroid dysfunction, thyromegaly, an abnormal growth rate, or an unexplained glycemic variation.

Adolescence and Risk Behaviors

- Increased insulin resistance during pubertal development
- Developmentally appropriate rebelliousness, experimentation, and risk-taking behaviors complicate diabetes management.
- Routinely screen diabetic youth for depression after age 10 on an annual basis.
- Gradual shifting of responsibility of care onto the teenager (individualized timeline according to child's maturity level and personality)
- Partnership between child and parent
- Transition to adult care should be planned and overtly discussed in clinic integrating all members of the diabetes care team.
 - Discussion of transition to adult care should be initiated a few years before it is planned to occur.
- The National Diabetes Education Program website found at <http://ndep.nih.gov/> has excellent educational materials related to transition of care and diabetes in the college setting.

This guideline was developed to improve health care access in Arkansas and to aid health care providers in making decisions about appropriate patient care. The needs of the individual patient, resources available, and limitations unique to the institution or type of practice may warrant variations.

References

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