

IV. STANDARDS OF CARE FOR DIABETES IN CHILDREN AND ADOLESCENTS

TABLE 12
A. Quick Reference Guide for Pediatric Type 1 and 2 Diabetes

	ASSESSMENT FREQUENCY CATEGORIES			
	Initially	Annually	Other	Every Visit
GENERAL				
Comprehensive History and Physical	X			
Brief History and Physical				X
Height and Weight	X	X		X
Blood Pressure	X	X		X
Dilated Eye Exam	X (type 2)	X ¹		
Dental Exam	X		X twice/yr	
Foot Exam				
Visual	X	X (type 1)		X (type 2)
Comprehensive	X	X		
Referral to Podiatrist	X* (type 2)	X*		
Referral to diabetes educator	X		X*	
EKG	X ²	X ^{2*}		
Referral to Pediatric Endocrinologist	X*		X quarterly	
LABORATORY EVALUATIONS				
Hemoglobin A1c	X	X	X quarterly	
Lipid Profile	X	X if normal,	every 2 yrs	
Comprehensive & Basic Metabolic Panel	X	X		
UA Microalbumin/Creatine Ratio	X (type 2)	X ³		
TSH	X*	X*		
Celiac Disease Screening	X (type 1)			
Liver Panel	X (type 2)	X (type 2)		
PREVENTION/INTERVENTION				
Consider ACE Inhibitors/ARB	X* (type 2)	X*		
Tobacco Cessation	X*			X*
Immunizations	X assess current status		X follow AAP guidelines	
Pre/Post Pregnancy Counseling	X*	X*		
Multi-vitamin of Choice	X	X		
Consider Comorbidities	X	X		
SELF-MANAGEMENT EDUCATION				
Psycho-social adjustment	X	X		
Knowledge of disease (Risks/Complications)	X	X*		
Barriers to Care	X			X
SMBG/Log				X
Nutrition (MNT)	X	X		
Physical Activity	X	X		
Weight Management	X	X		
Medication Review	X	X		

* Or as indicated per level of control or symptoms

¹ In type 1, 3-5 yrs after diagnosis if >9 years of age

² NA in type 1, as indicated in type 2

³ In type 1, within 5 years of diagnosis or puberty

About 176,500 people aged 20 years or younger have diabetes. This represents about 0.2% of all people in this age group. Approximately one in every 400-600 children and adolescents has type 1 diabetes (www.cdc.gov/diabetes/pubs/estimates05.htm).

Although type 2 diabetes can occur in youth, the nationally representative data that would be needed to monitor diabetes trends in youth by type are not available. Clinically-based reports and regional studies suggest that type 2 diabetes, although still rare, is being diagnosed more frequently in children and adolescents; particularly in American Indians, African Americans, and Hispanic Americans (www.cdc.gov/diabetes/pubs/estimates05.htm).

A team equipped to manage both the physical and emotional growth needs of the child, while working in partnership with parents/guardians, should provide the care for these patients. Early consultation and referral to a pediatric endocrinologist should be strongly considered.

The primary goals of diabetes management in childhood are:

- Ensure an adequate level of knowledge of diabetes to all caregivers and increase self-care so the child can take over the responsibility of the disease as he/she matures.
- Maintain optimal glycemic control to prevent acute and chronic complications.
- Ensure normal growth and development of the child.
- Assist in providing a good quality of life for the child and family.

B. Initial Evaluation

A complete medical evaluation should be performed to diagnose the patient, detect the presence or absence of diabetes complications, formulate a management plan and provide a base for continuing care.

History and Physical Examination

Components of the initial visit for a new diagnosis should include:

Medical History

- Symptoms:
 - **Type 1** usually presents with polyuria, polydipsia, polyphagia, weight loss and fatigue; vomiting, abdominal pain and dehydration may be the immediate symptoms that bring the child to medical care
 - **Type 2** usually presents as glycosuria, ketones may or may not be present, absent or mild polyuria and polydipsia, ketosis may be present in 25% of the cases, hypertension and lipid disorders may also occur
- Eating patterns, nutritional status, growth and development patterns
- Exercise history
- Presence or history of any infections (urinary tract infections, boils, exacerbation of acne, genital or perineal candidiasis)
- Medications, both prescriptions and over-the-counter (including nutrient and herbal supplements)
- Risk factors for atherosclerosis
- History and treatment of other conditions, including endocrine and eating disorders
- Family history of diabetes and other endocrine disorders (consider PCOS in females with type 2 DM)
- Lifestyle, cultural, psychosocial, educational, and economic factors that might influence the management of diabetes
- Behavior changes/poor performances in school
- Tobacco, alcohol, and/or controlled substance use
- Contraception and reproductive and sexual history
- Immunizations

Physical Exam

- Height and weight (use growth charts for ht/wt, and BMI)
 - **Type 1** usually presents as normal or underweight, with recent weight loss (with the increase in childhood obesity this may not always be present), growth failure may also be present
 - **Type 2** usually presents as overweight (weight for height is greater than the 85 percentile) with little or no weight loss
- Sexual maturation staging
- Blood pressure and pulse
- Fundoscopic evaluation
- HEENT (head, eyes, ears, nose and throat)
- Thyroid palpation
- Cardiac examination
- Abdominal examination (e.g., for hepatomegaly)
- Evaluation of pulses
- Hand/finger and foot examination
- Skin examination (for acanthosis nigricans in type 2)
- Neurological examination
- Signs of disease that can cause diabetes

Initial Laboratory Evaluation

- If DKA suspected: serum glucose, electrolytes, arterial or venous pH, serum or urine ketones
- If diagnosis of type of diabetes is uncertain, consider testing islet cell antibodies, insulin or c-peptide levels; consultation with a pediatric endocrinologist is recommended prior to testing
- A1c
- Microalbuminuria, if type 2
- TSH yearly in all type 1 patients, in type 2 diabetes if clinically indicated
- Screen for celiac disease in type 1 if family history or clinical suspicion
- Lipid profile once blood glucose control has been achieved

Referrals

- Pediatric endocrinologist, preferably at time of diagnosis
- Diabetes Self-Management Training, including medical nutrition therapy and self-blood glucose monitoring; education goals should be age-specific
- Eye exam in newly diagnosed children with type 2 diabetes (refer children with type 1 within 5 yrs. of diagnosis or at puberty)
- Behavioral specialist, as indicated
- Other specialties and services as appropriate
- Family planning for adolescent females who are sexually active
- Screening for depression in children ≥ 10 years of age

C. Follow-up Evaluation

Quarterly Assessments:

The health care team should see the child with diabetes at least quarterly. Follow-up visits with the diabetes care team should include assessment of:

- Height, weight, BMI (placed on growth charts)
- Other health or developmental problems, including associated disorders (thyroid or celiac disease; skin, foot, bacterial or fungal problems; eating disorders; depression)
- Glycemic control, including incidence of hypo- and hyperglycemia, A1c
- Injection sites and techniques
- Self-management skills including nutrition, physical activity, and self-blood glucose monitoring

- Changes in performance or behavior (particularly school absences/problems), leisure and sport activities, and psychosocial progress
- Information on driving, employment, tobacco use, sexual activity, drugs and alcohol
- Address any concerns that occur within the family due to having a child with diabetes
- Make referrals to other specialists as needed
- Frequency of hypoglycemia and presence of hypoglycemia unawareness

Yearly Assessments Should Include:

- Screenings for complications including blood and urine tests, blood pressure, eye tests, TSH, lipids, and dental exams
- Puberty and sexual maturation
- Growth
- Immunization status
- Contraceptive use and family planning for sexually active adolescents
- Updating self-management goals with more responsibility for self-care given to the child or adolescent and less with the parent or guardian based upon stage of development and maturity
- For older adolescents, discuss transitioning to adult care
- Screening for family and patient dynamics that may impact diabetes management

D. Target Indicators of Glycemic Control

The American Diabetes Association has published a statement for the care of children and adolescents with type 1 diabetes. The established goals are age specific and set as a reference point. Glycemic control goals must be individualized based upon the age of the child, history of hypoglycemia, and presence of other risk factors.

TABLE 13

Age-Specific Target Indicators for Children/Adolescents with Type 1 Diabetes

Age-specific values	Preprandial BG*	Bedtime/overnight BG	A1c
< 6 years old	100-180 mg/dL	110-200 mg/dL	< 8.5% (but >7.5%)
6-12 years old	90-180 mg/dL	100-180 mg/dL	<8%
13-19 years old	90-130 mg/dL	90-150 mg/dL	<7.5% or lower if it can be achieved without excessive hypoglycemia

E. Prevention and Management of Diabetes Complications

Acute

Hypoglycemia

Hypoglycemia is the most frequent acute complication in type 1 diabetes. Mild forms may cause a variety of reversible signs and symptoms characteristic of neurological dysfunction. Severe prolonged hypoglycemia with convulsions has the potential to cause permanent central nervous system impairment, especially in young children.

The blood glucose threshold for an autonomic response will vary based upon the level of metabolic control. With poor control, the response will occur at a higher blood glucose level. In a child with good control, the response will occur at a lower blood glucose level.

* BG throughout these Recommendations means plasma or serum glucose. For a discussion on the ways of measuring glucose in the blood and their differences, see the Appendix, page 93.

Nocturnal Hypoglycemia

The autonomic threshold is lowered during sleep. Nocturnal hypoglycemia is frequent, often prolonged and usually asymptomatic. Counter-regulatory responses may be impaired during sleep. Nocturnal hypoglycemia should be suspected if the pre-breakfast blood glucose is low, or if any of the following occur: nightmares, seizures, periods of confusion with lethargy on awakening, morning headaches, or altered moods. Severe glucosuria with or without mild ketonuria upon arising is considered to be evidence of rebound hyperglycemia following insulin-induced hypoglycemia (Somogyi effect). Testing blood glucose at regular intervals during the night or use of continuous glucose monitoring may confirm nocturnal hypoglycemia. Bedtime blood glucose levels are not predictable of nocturnal hypoglycemia; however, predictability improves with midnight readings.

Prevention

Educating children, adolescents, their families, and other caregivers about hypoglycemia is important. Particular attention should be given to:

- Early warning signs and symptoms
- Usefulness of frequent BG monitoring
- Effects of increased exercise
- Preventive effects of food items high in carbohydrates (especially fiber or those containing resistance starch)
- Emergency source of glucose or sucrose always available
- Providing glucagon and educating on its use
- Understanding of insulin action time and management
- Appropriate BG targets for the day and bedtime
- Wearing proper ID stating the child or adolescent has diabetes

Treatment

It is important to test BG levels to confirm hypoglycemia. When confirmation is made and the child is conscious, administer 5–15 gm of glucose or simple carbohydrates (sports drink, juice, low fat milk, regular soft drink, etc.), wait 15 minutes, retest BG level. If BG has improved, then follow treatment with the next meal or a snack. If BG level has not improved, repeat treatment.

If the child has lost consciousness and/or is having convulsions, treatment is urgent. Administer glucagon 0.5 mg for ages less than 12 years, 1.0 mg for ages 12 years or older, (or 0.1-0.2 mg/10 kg body weight). It is best administered intramuscular. If glucagon is not available, advise family or caregivers to call for emergency personnel.

Diabetes Ketoacidosis (DKA)

DKA can occur under a variety of circumstances. Children may present at diagnosis or after having the disease. DKA presents a greater risk of cerebral edema in children, especially <15 years old. Physicians with experience in dealing with children and DKA (pediatric endocrinologists or intensivists) should direct the care as much as possible. DKA that occurs after diagnosis is commonly due to insulin omission. This may be due to other illnesses, trauma, surgery, emotional stress, eating disorders, or undiagnosed pregnancy. Proper evaluation of children or adolescents with recurrent DKA should occur. Referrals for self-management and/or psychological counseling for the child and family may be recommended.

Chronic

Hypertension

Children and adolescents with diabetes should have their blood pressures obtained and evaluated at each visit. Upward trends even within a normal range may indicate need for further investigation. Parental hypertension can pre-dispose the child to hypertension. Reassessment of the parents' blood pressure should occur as the parents get older.

Definition

Hypertension is defined as an average systolic or diastolic blood pressure ≥ 95 th percentile for age, gender and height percentile measured on at least 3 separate days. “High-normal” blood pressure occurs when the average systolic or diastolic blood pressure is ≥ 90 th and < 95 th percentile for age, gender, and height percentile over 3 different days. Two references are available at:

- www.nhlbi.nih.gov/health/prof/heart/hbp/hbp_ped.pdf
- www.cdc.gov/nchs/about/major/nhanes/ggrowthcharts/charts.htm

Treatment

Lifestyle intervention should be started. Referral for MNT related to hypertension and the DASH guidelines (Dietary Approaches to Stop Hypertension) and exercise should be initiated. Tobacco cessation should occur if indicated. If lifestyle interventions are not enough, then ACE inhibitors can be considered with titration to achieve a blood pressure below the 90th percentile. Additional antihypertensive medication can be considered if ACE inhibitors alone do not control the blood pressure. Educate adolescent females that ACE inhibitors are not indicated in pregnancy.

Dyslipidemia and Cardiovascular Disease

According to the National Education Cholesterol Program for Pediatrics (NCEP-Peds), factors contributing to atherosclerosis in children and youth are the same as adults. Screening should be performed on children with type 1 diabetes > 2 years of age after diagnosis once blood glucose control has been established, if there is a family history for CVD or the family history is unknown. Children with type 2 diabetes should be screened once blood glucose control has been resolved. If normal lipid values are obtained, screening should be repeated every 5 years. Optimal lipid levels are based upon the Third Adult Treatment Panel (ATPIII) and the American Heart Association (AHA):

- LDL < 100 mg/dL
- HDL > 35 mg/dL
- Triglycerides < 150 mg/dL.

Treatment

When lipid values are above the recommended targets, the following interventions are recommended:

- Maximize BG control
- Provide nutrition counseling implementing the AHA step 2 diet (dietary cholesterol < 200 mg/day and saturated fat $< 7\%$ of total calories)
- Increase physical activity and decrease sedentary behavior
- Retest lipids at 3 and 6 months to determine if the interventions were effective; if lipid goals are reached retest yearly
- When lipid goals are not met, further intervention is needed based upon LDL levels
 - LDL 100-129 mg/dL - maximize nonpharmacologic treatment
 - LDL 130-159 mg/dL - consider medication, basing the treatment decision on the child's complete CVD risk profile
 - LDL greater than or equal to 160 mg/dL - begin medication
 - Resins are considered first-choice treatment for this age group
 - Statins can be used if compliance with resins is poor and age is > 10 years; start at lowest dose and increase based upon LDL levels and side effects; monitor LFTs and discontinue medication if LFTs are greater than three times the upper limit of normal or if child complains of muscle pain or soreness; carefully consider use of statins in sexually active females; discuss the risks associate with this drug in relationship to pregnancy
 - Ezetimibe is recommended if statins alone do not improve the LDL level; carefully consider use of lipid-lowering agents in sexually active females; drug-therapy should be stopped if pregnancy is known or suspected
- When triglycerides are above target, maximize BG control and lifestyle interventions; if levels are greater than 1000 mg/dL, consider treatment with a fibric acid or fish oils
- Minimize other CVD risk factors; achieve and maintain a healthy weight and blood pressure; discourage tobacco use

Retinopathy

The first eye exam should be obtained when the child is ≥ 10 years old and has had diabetes 3-5 years. Annual follow-up is recommended unless otherwise directed by the eye care specialist. A young woman planning pregnancy should receive an eye exam prior to conception and the first trimester. Follow-up exams are at the discretion of the physician.

Nephropathy

Annual microalbuminuria screening should be started once the child is 10 years old and/or has had diabetes for 5 years. An abnormal value should be repeated since a number of factors can impact albumin excretion. Once diagnosis is confirmed, an ACE inhibitor can be titrated to normalize the microalbumin excretion, but exercise caution in females who may become pregnant. Cessation of tobacco use, obtaining normal blood pressure, and treatment of elevated LDL should also occur, when indicated. If this treatment is not successful, referral to a nephrologist is recommended.

Neuropathy

Children do not typically develop neuropathy if they have satisfactory blood glucose control. Education on foot care should be done initially and annually thereafter. Annual foot exams should begin at puberty. In the presence of poor control, patients should be questioned and examined for:

- Symptoms of numbness, pain, cramps, and paresthesia
- Skin sensation, vibration sense and light touch
- Ankle reflexes

F. Therapeutic Options

1. Type 1 Diabetes

Children with type 1 diabetes are dependent on insulin for survival. The most widely used insulin concentration is 100 units/mL (U 100).

Please refer to Table 6 on page 10-11 for a listing of insulins.

Pre-mixed insulin preparations are also available. The use of pre-mixed insulins removes the flexibility offered by separate adjustments of the two types of insulin and is not recommended in the treatment of children.

Insulin Regimens

The choice of the insulin regimen will depend on glycemic goals, age of child, duration of diabetes, lifestyle, and patient/family preferences. Consultation with a pediatric endocrinologist is advised.

Frequently used regimens include the following:

- *Two injections daily* of a mixture of short or rapid and intermediate-acting insulins (before breakfast and the main evening meal).
- *Three injections daily* of short or rapid-acting insulin before each meal; intermediate-acting insulin with the evening meal; or variations on this dosing.
- *Basal-bolus regimen* of short-acting or rapid-acting insulin before main meals; intermediate or long acting insulin at bedtime, and/or before breakfast and/or at lunchtime.
- *Insulin pump regimens* of rapid-acting insulin used to mimic a basal-bolus routine.

Dosage Guidelines

Insulin dosage varies greatly and changes over time. It requires regular review and reassessment including:

- Age
- Weight
- Stage of puberty
- Duration and phase of diabetes
- State of injection sites

- Nutritional intake and distribution
- Physical activity patterns
- Daily routine
- Results of BG monitoring and A1c
- Intercurrent illness

During the “honeymoon” period, daily insulin dose is often less than 0.5 units/kg/day. Pre-pubertal children usually require 0.7-1.0 units/kg/day. During puberty, requirements may range up to 2 units/kg/day. The correct dose of insulin is that which achieves the best attainable glycemic control for the child or adolescent.

Distribution of Dose

Children on twice daily regimens may require more (approximately two-thirds) of their total daily insulin in the morning, and less (one-third) in the evening. Approximately one-third of the insulin dose may be short-acting insulin and two-thirds may be intermediate acting insulin, although these ratios change with advanced age and maturity of the child.

On basal-bolus regimes, night time intermediate or long-acting insulin may represent 30-50% of the total daily insulin; 50-70% as rapid or short-acting insulins divided up between three and four pre-meal boluses.

When switching to an insulin pump, the total daily dose of all insulin used may be decreased by approximately 25%. This amount is then divided in half to establish an initial basal rate. The remaining amount is used for the bolus. The basal-bolus amount will vary based upon the child and previous factors listed. Switching to an insulin pump should be done only under the supervision of a pump educator working with the diabetes specialist.

Development of skills in the independent adjustment of insulin doses varies greatly among children and families. Self-management training can assist in helping children and their families become proficient in insulin adjustment techniques.

2. Type 2 Diabetes

Fewer than 10% of youth with type 2 diabetes can be treated with diet and exercise alone; pharmacological intervention is generally required.

Currently, metformin is the only oral medication approved for use in children 10 years and older. Dosage starts at 500 mg once or twice a day. If needed, it can be increased by 500 mg each week to a maximum dose of 2000 mg per day. Consultation with a pediatric endocrinologist is recommended if pharmacological intervention is considered. Renal function should be checked before and then annually, thereafter. Metformin is contraindicated if serum creatinine levels are greater than or equal to 1.4 mg/dL (females) and 1.5 mg/dL (males).

Insulin can also be used to reach euglycemia either alone or with metformin. Insulin regimens may be similar to the type 1 population or basal insulin alone may be needed.

Further Information

The American Diabetes Association (ADA) has further information regarding the management of children with diabetes in schools and camps. This can be found in the ADA Clinical Practice Recommendations or at www.diabetes.org. Other sources for information include:

- Juvenile Diabetes Association: www.jdfcure.org
- Children with Diabetes: www.childrenwithdiabetes.com

REFERENCE SECTION IV

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