12. Children and Adolescents: *Standards of Medical Care in Diabetes—2018*

American Diabetes Association

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The American Diabetes Association (ADA) "Standards of Medical Care in Diabetes" includes ADA's current clinical practice recommendations and is intended to provide the components of diabetes care, general treatment goals and guidelines, and tools to evaluate quality of care. Members of the ADA Professional Practice Committee, a multidisciplinary expert committee, are responsible for updating the Standards of Care annually, or more frequently as warranted. For a detailed description of ADA standards, statements, and reports, as well as the evidence-grading system for ADA's clinical practice recommendations, please refer to the Standards of Care Introduction. Readers who wish to comment on the Standards of Care are invited to do so at professional.diabetes.org/SOC.

TYPE 1 DIABETES

Three-quarters of all cases of type 1 diabetes are diagnosed in individuals <18 years of age (although recent data using genetic risk scoring would suggest that over 40% of patients with autoimmune diabetes are diagnosed over the age of 30 years) (1). The provider must consider the unique aspects of care and management of children and adolescents with type 1 diabetes, such as changes in insulin sensitivity related to physical growth and sexual maturation, ability to provide self-care, supervision in the child care and school environment, and neurological vulnerability to hypoglycemia and hyperglycemia in young children, as well as possible adverse neurocognitive effects of diabetic ketoacidosis (DKA) (2,3). Attention to family dynamics, developmental stages, and physiological differences related to sexual maturity are all essential in developing and implementing an optimal diabetes treatment plan (4). Due to the nature of clinical research in children, the recommendations for children and adolescents are less likely to be based on clinical trial evidence. However, expert opinion and a review of available and relevant experimental data are summarized in the American Diabetes Association (ADA) position statement "Type 1 Diabetes Through the Life Span" (5) and have been updated in the ADA position statement "Type 1 Diabetes in Children and Adolescents: A Position Statement by the American Diabetes Association" (6).

A multidisciplinary team of specialists trained in pediatric diabetes management and sensitive to the challenges of children and adolescents with type 1 diabetes and their families should provide care for this population. It is essential that diabetes self-management education and support (DSMES), medical nutrition therapy, and psychosocial support be provided at diagnosis and regularly thereafter in a developmentally appropriate format that builds on prior knowledge by individuals experienced with the educational, nutritional, behavioral, and emotional needs of the growing child and family. The appropriate balance between adult supervision and independent self-care should be defined at the first interaction and reevaluated at subsequent visits.

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The balance between adult supervision and independent self-care will evolve as the adolescent gradually becomes an emerging young adult.

Diabetes Self-management Education and Support

Recommendation

- Youth with type 1 diabetes and parents/caregivers (for patients aged <18 years) should receive culturally sensitive and developmentally appropriate individualized diabetes self-management education and support according to national standards at diagnosis and routinely thereafter. **B**

No matter how sound the medical regimen, it can only be effective if the family and/or affected individuals are able to implement it. Family involvement is a vital component of optimal diabetes management throughout childhood and adolescence. Health care providers (the diabetes care team) who care for children and adolescents must be capable of evaluating the educational, behavioral, emotional, and psychosocial factors that impact implementation of a treatment plan and must work with the individual and family to overcome barriers or redefine goals as appropriate. DSME and DSMS require periodic reassessment, especially as the youth grows, develops, and acquires the need for greater independent self-care skills. In addition, it is necessary to assess the educational needs and skills of day care providers, school nurses, or other school personnel who participate in the care of the young child with diabetes (7).

School and Child Care

As a large portion of a child's day is spent in school, close communication with and the cooperation of school or day care personnel are essential for optimal diabetes management, safety, and maximal academic opportunities. Refer to the ADA position statements "Diabetes Care in the School Setting" (8) and "Care of Young Children With Diabetes in the Child Care Setting" (9) for additional details.

Psychosocial Issues

Recommendations

- At diagnosis and during routine follow-up care, assess psychosocial issues and family stresses that could impact adherence to diabetes management and provide appropriate referrals to trained mental health professionals, preferably experienced in childhood diabetes. **E**
- Mental health professionals should be considered integral members of the pediatric diabetes multidisciplinary team. **E**
- Encourage developmentally appropriate family involvement in diabetes management tasks for children and adolescents, recognizing that premature transfer of diabetes care to the child can result in nonadherence and deterioration in glycemic control. **A**
- Providers should consider asking youth and their parents about social adjustment (peer relationships) and school performance to determine whether further intervention is needed. **B**
- Assess youth with diabetes for psychosocial and diabetes-related distress, generally starting at 7–8 years of age. **B**
- At diagnosis and during routine follow-up care, consider assessing psychosocial issues and family stresses that could impact diabetes management and provide appropriate referrals to trained mental health professionals, preferably experienced in childhood diabetes. **E**
- Offer adolescents time by themselves with their care provider(s) starting at age 12 years, or when developmentally appropriate. **E**
- Starting at puberty, preconception counseling should be incorporated into routine diabetes care for all girls of childbearing potential. **A**

Rapid and dynamic cognitive, developmental, and emotional changes occur during childhood, adolescence, and emerging adulthood. Diabetes management during childhood and adolescence places substantial burdens on the youth and family, necessitating ongoing assessment of psychosocial status and diabetes distress during routine diabetes visits (10–14). Early detection of depression, anxiety, eating disorders, and learning disabilities can facilitate effective treatment options and help minimize adverse effects on diabetes management and disease outcomes (15). Furthermore, the complexities of diabetes management require ongoing parental involvement in care throughout childhood with developmentally appropriate family teamwork between the growing child/teen and parent in order to maintain adherence and to prevent deterioration in glycemic control (16,17). As diabetes-specific family conflict is related to poorer adherence and glycemic control, it is appropriate to inquire about such conflict during visits and to either help to negotiate a plan for resolution or refer to an appropriate mental health specialist (18). Monitoring of social adjustment (peer relationships) and school performance can facilitate both well-being and academic achievement (19). Suboptimal glycemic control is a risk factor for below average school performance and increased absenteeism (20).

Shared decision-making with youth regarding the adoption of regimen components and self-management behaviors can improve diabetes self-efficacy, adherence, and metabolic outcomes (21). Although cognitive abilities vary, the ethical position often adopted is the "mature minor rule," whereby children after age 12 or 13 years who appear to be "mature" have the right to consent or withhold consent to general medical treatment, except in cases in which refusal would significantly endanger health (22).

Beginning at the onset of puberty or at diagnosis of diabetes, all adolescent girls and women with childbearing potential should receive education about the risks of malformations associated with unplanned pregnancies and poor metabolic control and the use of effective contraception to prevent unplanned pregnancy. Preconception counseling using developmentally appropriate educational tools enables adolescent girls to make well-informed decisions (23). Preconception counseling resources tailored for adolescents are available at no cost through the ADA (24). Refer to the recent ADA position statement "Psychosocial Care for People With Diabetes" for further details (15).

Screening

Screening for psychosocial distress and mental health problems is an important component of ongoing care. It is important to consider the impact of diabetes on quality of life as well as the development

of mental health problems related to diabetes distress, fear of hypoglycemia (and hyperglycemia), symptoms of anxiety, disordered eating behaviors as well as eating disorders, and symptoms of depression (25). Consider assessing youth for diabetes distress, generally starting at 7 or 8 years of age (15). Consider screening for depression and disordered eating behaviors using available screening tools (10,26). With respect to disordered eating, it is important to recognize the unique and dangerous disordered eating behavior of insulin omission for weight control in type 1 diabetes (27). The presence of a mental health professional on pediatric multidisciplinary teams highlights the importance of attending to the psychosocial issues of diabetes. These psychosocial factors are significantly related to nonadherence, suboptimal glycemic control, reduced quality of life, and higher rates of acute and chronic diabetes complications.

Glycemic Control

Recommendations

- The majority of children and adolescents with type 1 diabetes should be treated with intensive insulin regimens, either via multiple daily injections or continuous subcutaneous insulin infusion. **A**
- All children and adolescents with type 1 diabetes should self-monitor blood glucose levels multiple times daily, including premeal, prebedtime, and as needed for safety in specific clinical situations such as exercise, driving, or for symptoms of hypoglycemia. **B**
- Continuous glucose monitoring should be considered in children and adolescents with type 1 diabetes, whether using injections or continuous subcutaneous insulin infusion, as an additional tool to help improve glycemic control. Benefits of continuous glucose monitoring correlate with adherence to ongoing use of the device. **B**
- Automated insulin delivery systems improve glycemic control and reduce hypoglycemia in adolescents and should be considered in adolescents with type 1 diabetes. **B**
- An A1C goal of <7.5% (58 mmol/mol) is recommended across all pediatric age-groups. **E**

Current standards for diabetes management reflect the need to lower glucose as safely as possible. This should be done with stepwise goals. When establishing individualized glycemic targets, special consideration should be given to the risk of hypoglycemia in young children (aged <6 years) who are often unable to recognize, articulate, and/or manage hypoglycemia.

Type 1 diabetes can be associated with adverse effects on cognition during childhood and adolescence. Factors that contribute to adverse effects on brain development and function include young age or DKA at onset of type 1 diabetes, severe hypoglycemia at <6 years of age, and chronic hyperglycemia (28,29). However, meticulous use of new therapeutic modalities, such as rapid- and long-acting insulin analogs, technological advances (e.g., continuous glucose monitors, low-glucose suspend insulin pumps, and automated insulin delivery systems), and intensive self-management education now make it more feasible to achieve excellent glycemic control while reducing the incidence of severe hypoglycemia (30–39). A strong relationship exists between frequency of blood glucose monitoring and glycemic control (32–41).

The Diabetes Control and Complications Trial (DCCT), which did not enroll children <13 years of age, demonstrated that near normalization of blood glucose levels was more difficult to achieve in adolescents than in adults. Nevertheless, the increased use of basal-bolus regimens, insulin pumps, frequent blood glucose monitoring, goal setting, and improved patient education in youth from infancy through adolescence have been associated with more children reaching the blood glucose targets recommended by ADA (42–45), particularly in those families in which both the parents and the child with diabetes participate jointly to perform the required diabetes-related tasks. Furthermore, studies documenting neurocognitive imaging differences related to hyperglycemia in children provide another motivation for lowering glycemic targets (2).

In selecting glycemic goals, the long-term health benefits of achieving a lower A1C should be balanced against the risks of hypoglycemia and the developmental burdens of intensive regimens in children and youth. In addition, achieving lower A1C levels is more likely to be related to setting lower A1C targets (46,47). A1C and blood glucose goals are presented in **Table 12.1**.

Autoimmune Conditions

Recommendation

- Assess for the presence of autoimmune conditions associated with type 1 diabetes soon after the diagnosis and if symptoms develop. **B**

Because of the increased frequency of other autoimmune diseases in type 1 diabetes, screening for thyroid dysfunction and celiac disease should be considered (48,49). Periodic screening in asymptomatic individuals has been recommended, but the optimal frequency and benefit of screening are unclear.

Although much less common than thyroid dysfunction and celiac disease, other autoimmune conditions, such as Addison

Table 12.1—Blood glucose and A1C goals for children and adolescents with type 1 diabetes

Blood glucose goal range			
Before meals	Bedtime/overnight	A1C	Rationale
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 or pump regimens.

disease (primary adrenal insufficiency), autoimmune hepatitis, autoimmune gastritis, dermatomyositis, and myasthenia gravis, occur more commonly in the population with type 1 diabetes than in the general pediatric population and should be assessed and monitored as clinically indicated.

Thyroid Disease

Recommendations

- Consider testing individuals with type 1 diabetes for antithyroid peroxidase and antithyroglobulin antibodies soon after the diagnosis. **E**
- Measure thyroid-stimulating hormone concentrations at diagnosis when clinically stable or soon after glycemic 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. **A**

Autoimmune thyroid disease is the most common autoimmune disorder associated with diabetes, occurring in 17–30% of patients with type 1 diabetes (50). At the time of diagnosis, about 25% of children with type 1 diabetes have thyroid autoantibodies (51); their presence is predictive of thyroid dysfunction—most commonly hypothyroidism, although hyperthyroidism occurs in ~0.5% of patients with type 1 diabetes (52, 53). For thyroid autoantibodies, a recent study from Sweden indicated antithyroid peroxidase antibodies were more predictive than antithyroglobulin antibodies in multivariate analysis (54). Thyroid function tests may be misleading (euthyroid sick syndrome) if performed at the time of diagnosis owing to the effect of previous hyperglycemia, ketosis or ketoacidosis, weight loss, etc. Therefore, if performed at diagnosis and slightly abnormal, thyroid function tests should be performed soon after a period of metabolic stability and good glycemic control. Subclinical hypothyroidism may be associated with increased risk of symptomatic hypoglycemia (55) and reduced linear growth rate. Hyperthyroidism alters glucose metabolism and usually causes deterioration of glycemic control.

Celiac Disease

Recommendations

- Screen individuals with type 1 diabetes for celiac disease soon after the diagnosis of diabetes by measuring IgA tissue transglutaminase antibodies, with documentation of normal total serum IgA levels or, if IgA deficient, IgG tissue transglutamine and deamidated gliadin antibodies. **B**
- Repeat screening within 2 years of diabetes diagnosis and then again after 5 years and consider more frequent screening in children who have symptoms or a first-degree relative with celiac disease. **B**
- Individuals with biopsy-confirmed celiac disease should be placed on a gluten-free diet and have a consultation with a dietitian experienced in managing both diabetes and celiac disease. **B**

Celiac disease is an immune-mediated disorder that occurs with increased frequency in patients with type 1 diabetes (1.6–16.4% of individuals compared with 0.3–1% in the general population) (48,49, 56–58,59).

Screening. Screening for celiac disease includes measuring serum levels of IgA and tissue transglutaminase antibodies, or, with IgA deficiency, screening can include measuring IgG tissue transglutaminase antibodies or IgG deamidated gliadin peptide antibodies. Because most cases of celiac disease are diagnosed within the first 5 years after the diagnosis of type 1 diabetes, screening should be considered at the time of diagnosis and repeated at 2 and then 5 years (58).

Although celiac disease can be diagnosed more than 10 years after diabetes diagnosis, there are insufficient data after 5 years to determine the optimal screening frequency. Measurement of tissue transglutaminase antibody should be considered at other times in patients with symptoms suggestive of celiac disease (58). A small-bowel biopsy in antibody-positive children is recommended to confirm the diagnosis (60). European guidelines on screening for celiac disease in children (not specific to children with type 1 diabetes) suggest that biopsy may not be necessary in symptomatic children with high antibody titers (i.e., greater than 10 times the upper limit of normal) provided that further testing is performed (verification of endomysial antibody positivity on a separate blood sample). It is also advisable to check for HLA types in patients who are diagnosed without a small intestinal biopsy. Asymptomatic at-risk children should have an intestinal biopsy (61).

In symptomatic children with type 1 diabetes and confirmed celiac disease, gluten-free diets reduce symptoms and rates of hypoglycemia (62). The challenging dietary restrictions associated with having both type 1 diabetes and celiac disease place a significant burden on individuals. Therefore, a biopsy to confirm the diagnosis of celiac disease is recommended, especially in asymptomatic children, before endorsing significant dietary changes. A gluten-free diet was beneficial in asymptomatic adults with positive antibodies confirmed by biopsy (63).

Management of Cardiovascular Risk Factors

Hypertension

Recommendations

Screening

- Blood pressure should be measured at each routine visit. Children found to have high-normal blood pressure (systolic blood pressure or diastolic blood pressure ≥90th percentile for age, sex, and height) or hypertension (systolic blood pressure or diastolic blood pressure ≥95th percentile for age, sex, and height) should have elevated blood pressure confirmed on 3 separate days. **B**

Treatment

- Initial treatment of high-normal blood pressure (systolic blood pressure or diastolic blood pressure consistently ≥90th percentile for age, sex, and height) includes dietary modification and increased exercise, if appropriate, aimed at weight control. If target blood pressure is not reached within 3–6 months of initiating lifestyle intervention, pharmacologic treatment should be considered. **E**
- In addition to lifestyle modification, pharmacologic treatment of hypertension (systolic blood pressure or diastolic blood pressure consistently ≥95th percentile for age, sex, and height) should be considered as

soon as hypertension is confirmed. E
- ACE inhibitors or angiotensin receptor blockers may be considered for the treatment of elevated (>30 mg/g) urinary albumin-to-creatinine ratio (B) and hypertension (E) in children and adolescents, following reproductive counseling and implementation of effective birth control due to the potential teratogenic effects of both drug classes. E
- The goal of treatment is blood pressure consistently <90th percentile for age, sex, and height. E

Blood pressure measurements should be performed using the appropriate size cuff with the child seated and relaxed. Hypertension should be confirmed on at least 3 separate days. Evaluation should proceed as clinically indicated. Treatment is generally initiated with an ACE inhibitor, but an angiotensin receptor blocker can be used if the ACE inhibitor is not tolerated (e.g., due to cough) (64).

Normal blood pressure levels for age, sex, and height and appropriate methods for measurement are available online at nhlbi.nih.gov/files/docs/resources/heart/hbp_ped.pdf.

Dyslipidemia

Recommendations

Testing
- Obtain a lipid profile in children ≥10 years of age soon after the diagnosis of diabetes (after glucose control has been established). If abnormal, repeat lipid profile after fasting. E
- If lipids are abnormal, annual monitoring is reasonable. If LDL cholesterol values are within the accepted risk level (<100 mg/dL [2.6 mmol/L]), a lipid profile repeated every 5 years is reasonable. E

Treatment
- Initial therapy should consist of optimizing glucose control and medical nutrition therapy using a Step 2 American Heart Association diet to decrease the amount of saturated fat in the diet. B
- After the age of 10 years, addition of a statin is suggested in patients who, despite medical nutrition therapy and lifestyle changes, continue to have LDL cholesterol >160 mg/dL (4.1 mmol/L) or LDL cholesterol >130 mg/dL (3.4 mmol/L) and one or more cardiovascular disease risk factors, following reproductive counseling and implementation of effective birth control due to the potential teratogenic effects of statins. B
- The goal of therapy is an LDL cholesterol value <100 mg/dL (2.6 mmol/L). E

Population-based studies estimate that 14–45% of children with type 1 diabetes have two or more atherosclerotic cardiovascular disease (ASCVD) risk factors (65–67), and the prevalence of CVD risk factors increases with age (67), with girls having a higher risk burden than boys (66).

Pathophysiology. The atherosclerotic process begins in childhood, and although ASCVD events are not expected to occur during childhood, observations using a variety of methodologies show that youth with type 1 diabetes may have subclinical CVD within the first decade of diagnosis (68–70). Studies of carotid intima-media thickness have yielded inconsistent results (64).

Treatment. Pediatric lipid guidelines provide some guidance relevant to children with type 1 diabetes (71–73); however, there are few studies on modifying lipid levels in children with type 1 diabetes. A 6-month trial of dietary counseling produced a significant improvement in lipid levels (74); likewise, a lifestyle intervention trial with 6 months of exercise in adolescents demonstrated improvement in lipid levels (75).

Although intervention data are sparse, the American Heart Association categorizes children with type 1 diabetes in the highest tier for cardiovascular risk and recommends both lifestyle and pharmacologic treatment for those with elevated LDL cholesterol levels (73,76). Initial therapy should be with a Step 2 American Heart Association diet, which restricts saturated fat to 7% of total calories and restricts dietary cholesterol to 200 mg/day. Data from randomized clinical trials in children as young as 7 months of age indicate that this diet is safe and does not interfere with normal growth and development (77).

For children with a significant family history of CVD, the National Heart, Lung, and Blood Institute recommends obtaining a fasting lipid panel beginning at 2 years of age (71). Abnormal results from a random lipid panel should be confirmed with a fasting lipid panel. Data from the SEARCH for Diabetes in Youth (SEARCH) study show that improved glucose control over a 2-year period is associated with a more favorable lipid profile; however, improved glycemic control alone will not normalize lipids in youth with type 1 diabetes and dyslipidemia (78).

Neither long-term safety nor cardiovascular outcome efficacy of statin therapy has been established for children; however, studies have shown short-term safety equivalent to that seen in adults and efficacy in lowering LDL cholesterol levels in familial hypercholesterolemia or severe hyperlipidemia, improving endothelial function and causing regression of carotid intimal thickening (79,80). Statins are not approved for patients aged <10 years, and statin treatment should generally not be used in children with type 1 diabetes before this age. Statins are contraindicated in pregnancy; therefore, prevention of unplanned pregnancies is of paramount importance for postpubertal girls (see Section 13 "Management of Diabetes in Pregnancy" for more information). The multicenter, randomized, placebo-controlled Adolescent Type 1 Diabetes Cardio-Renal Intervention Trial (AdDIT) provides safety data on pharmacologic treatment with an ACE inhibitor and statin in adolescents with type 1 diabetes.

Smoking

Recommendation

- Elicit a smoking history at initial and follow-up diabetes visits; discourage smoking in youth who do not smoke, and encourage smoking cessation in those who do smoke. A

The adverse health effects of smoking are well recognized with respect to future cancer and CVD risk. Despite this, smoking rates are significantly higher among youth with diabetes than among youth without diabetes (81,82). In youth with diabetes, it is important to avoid additional CVD risk factors. Smoking increases the risk of onset of albuminuria; therefore, smoking avoidance is important to prevent both microvascular and macrovascular complications (71,83). Discouraging cigarette smoking, including e-cigarettes,

is an important part of routine diabetes care. In younger children, it is important to assess exposure to cigarette smoke in the home due to the adverse effects of secondhand smoke and to discourage youth from ever smoking if exposed to smokers in childhood.

Microvascular Complications

Diabetic Kidney Disease

Recommendations

Screening

- Annual screening for albuminuria with a random spot urine sample for albumin-to-creatinine ratio should be performed at puberty or at age ≥10 years, whichever is earlier, once the child has had diabetes for 5 years. **B**

Treatment

- When persistently elevated urinary albumin-to-creatinine ratio (>30 mg/g) is documented with at least two of three urine samples, treatment with an ACE inhibitor or angiotensin receptor blocker may be considered and the dose titrated to maintain blood pressure within the age-appropriate normal range. The urine samples should be obtained over a 6-month interval following efforts to improve glycemic control and normalize blood pressure. **B**

Data from 7,549 participants <20 years of age in the T1D Exchange clinic registry emphasize the importance of good glycemic and blood pressure control, particularly as diabetes duration increases, in order to reduce the risk of diabetic kidney disease. The data also underscore the importance of routine screening to ensure early diagnosis and timely treatment of albuminuria (84). An estimation of glomerular filtration rate (GFR), calculated using GFR estimating equations from the serum creatinine, height, age, and sex (85), should be considered at baseline and repeated as indicated based on clinical status, age, diabetes duration, and therapies. Improved methods are needed to screen for early GFR loss, since estimated GFR is inaccurate at GFR >60 ml/min/1.73 m^2 (85,86). The AdDIT study in adolescents with type 1 diabetes demonstrated safety of ACE inhibitor treatment, but did not change the urinary albumin-to-creatinine ratio over the course of the study (87).

Retinopathy

Recommendations

- An initial dilated and comprehensive eye examination is recommended once youth have had type 1 diabetes for 3–5 years, provided they are age ≥10 years or puberty has started, whichever is earlier. **B**
- After the initial examination, annual routine follow-up is generally recommended. Less-frequent examinations, every 2 years, may be acceptable on the advice of an eye care professional and based on risk factor assessment. **E**

Retinopathy (like albuminuria) most commonly occurs after the onset of puberty and after 5–10 years of diabetes duration (88). Referrals should be made to eye care professionals with expertise in diabetic retinopathy and experience in counseling the pediatric patient and family on the importance of early prevention and intervention.

Neuropathy

Recommendation

- Consider an annual comprehensive foot exam at the start of puberty or at age ≥10 years, whichever is earlier, once the youth has had type 1 diabetes for 5 years. **B**

Diabetic neuropathy rarely occurs in prepubertal children or after only 1–2 years of diabetes (88), although data suggest a prevalence of distal peripheral neuropathy of 7% in 1,734 youth with type 1 diabetes and associated with the presence of CVD risk factors (89). A comprehensive foot exam, including inspection, palpation of dorsalis pedis and posterior tibial pulses, and determination of proprioception, vibration, and monofilament sensation, should be performed annually along with an assessment of symptoms of neuropathic pain (90). Foot inspection can be performed at each visit to educate youth regarding the importance of foot care (see Section 10 "Microvascular Complications and Foot Care").

TYPE 2 DIABETES

For information on testing for type 2 diabetes and prediabetes in children and adolescents, please refer to Section 2 "Classification and Diagnosis of Diabetes." For additional support for these recommendations, see the ADA position statement "Evaluation and Management of Youth-Onset Type 2 Diabetes (*91*).

Type 2 diabetes in youth has increased over the past 20 years, and recent estimates suggest an incidence of ~5,000 new cases per year in the U.S. (92). The Centers for Disease Control and Prevention published projections for type 2 diabetes prevalence using the SEARCH database—assuming a 2.3% annual increase, the prevalence in those under 20 years of age will quadruple in 40 years (93,94).

Evidence suggests that type 2 diabetes in youth is different not only from type 1 diabetes but also from type 2 diabetes in adults and has unique features, such as a more rapidly progressive decline in β-cell function and accelerated development of diabetes complications (95,96). Type 2 diabetes disproportionately impacts youth of ethnic and racial minorities and can occur in complex psychosocial and cultural environments, which may make it difficult to sustain healthy lifestyle changes and self-management behaviors. Additional risk factors associated with type 2 diabetes in youth include adiposity, family history of diabetes, female sex, and low socioeconomic status (96).

As with type 1 diabetes, youth with type 2 diabetes spend much of the day in school. Therefore, close communication with and the cooperation of school personnel are essential for optimal diabetes management, safety, and maximal academic opportunities.

Recommendations

Screening and Diagnosis

- Risk-based screening for prediabetes and/or type 2 diabetes should be considered in children and adolescents after the onset of puberty or ≥10 years of age, whichever occurs earlier, who are overweight (BMI >85th %) or obese (BMI >95th %) and who have one or more additional risk factors for diabetes (see **Table 2.5**). **A**
- If tests are normal, repeat testing at a minimum of 3-year intervals **E**, or more frequently if BMI is increasing. **C**
- Fasting plasma glucose, 2-h plasma glucose during a 75-g oral glucose tolerance test, and A1C can be used

to test for prediabetes or diabetes in children and adolescents. **B**

In the last decade, the incidence and prevalence of type 2 diabetes in adolescents has increased dramatically, especially in racial and ethnic minority populations (97). A few recent studies suggest oral glucose tolerance tests or fasting plasma glucose values as more suitable diagnostic tests than A1C in the pediatric population, especially among certain ethnicities (98). However, many of these studies do not recognize that diabetes diagnostic criteria are based on long-term health outcomes, and validations are not currently available in the pediatric population (99). ADA acknowledges the limited data supporting A1C for diagnosing type 2 diabetes in children and adolescents. Although A1C is not recommended for diagnosis of diabetes in children with cystic fibrosis or symptoms suggestive of acute onset of type 1 diabetes and only A1C assays without interference are appropriate for children with hemoglobinopathies, ADA continues to recommend A1C for diagnosis of type 2 diabetes in this population (100,101).

Diagnostic Challenges

Given the current obesity epidemic, distinguishing between type 1 and type 2 diabetes in children can be difficult. Overweight and obesity are common in children with type 1 diabetes (102), and diabetes-associated autoantibodies and ketosis may be present in pediatric patients with features of type 2 diabetes (including obesity and acanthosis nigricans) (103). At onset, DKA occurs in ~6% of youth aged 10–19 years with type 2 diabetes (104). Accurate diagnosis is critical, as treatment regimens, educational approaches, dietary advice, and outcomes differ markedly between patients with the two diagnoses.

Management

Recommendations

Lifestyle Management

- Overweight or obese youth with type 2 diabetes and their families should be provided with developmentally and culturally appropriate comprehensive lifestyle programs that are integrated with diabetes management to achieve 7–10% decrease in excess weight. **C**
- Given the necessity of long-term weight management for children and adolescents with type 2 diabetes, lifestyle intervention should be based on a chronic care model and offered in the context of diabetes care. **E**
- Youth with diabetes, like all children, should be encouraged to participate in at least 60 min of moderate to vigorous physical activity per day (and strength training on at least 3 days/week) **B** and to decrease sedentary behavior. **C**
- Nutrition for youth with type 2 diabetes, like all children, should focus on healthy eating patterns that emphasize consumption of nutrient-dense, high-quality foods and decreased consumption of calorie-dense, nutrient-poor foods, particularly sugar-added beverages. **B**

Pharmacologic Management

- Initiate pharmacologic therapy, in addition to lifestyle therapy, at diagnosis of type 2 diabetes. **A**
- In metabolically stable patients (A1C $<$8.5% and asymptomatic), metformin is the initial pharmacologic treatment of choice if renal function is $>$30 ml/min/1.73 m^2. **A**
- Youth with marked hyperglycemia (blood glucose $\geq$250 mg/dL [13.9 mmol/L], A1C $\geq$8.5% [69 mmol/mol]) without ketoacidosis at diagnosis who are symptomatic with polyuria, polydipsia, nocturia, and/or weight loss should be treated initially with basal insulin while metformin is initiated and titrated to maximally tolerated dose to achieve A1C goal. **E**
- When the A1C target is no longer met with metformin monotherapy, or if contraindications or intolerable side effects of metformin develop, basal insulin therapy should be initiated. **E**
- In patients initially treated with basal insulin and metformin who are meeting glucose targets based on home blood glucose monitoring, basal insulin can be tapered over 2–6 weeks by decreasing the insulin dose by 10–30% every few days. **A**
- Use of medications not approved by the U.S. Food and Drug Administration for youth with type 2 diabetes is not recommended outside of research trials. **B**
- All youth with type 2 diabetes and their families should receive comprehensive diabetes self-management education and support that is specific to youth with type 2 diabetes and culturally competent. **B**

The general treatment goals for youth with type 2 diabetes are the same as those for youth with type 1 diabetes. A multidisciplinary diabetes team, including a physician, diabetes nurse educator, registered dietitian, and psychologist or social worker, is essential. In addition to blood glucose control, initial treatment must include management of comorbidities such as obesity, dyslipidemia, hypertension, and microvascular complications.

Current treatment options for youth-onset type 2 diabetes are limited to two approved drugs—insulin and metformin (95). Presentation with ketosis or ketoacidosis requires a period of insulin therapy until fasting and postprandial glycemia have been restored to normal or near-normal levels. Metformin therapy may be used as an adjunct after resolution of ketosis/ketoacidosis. Initial treatment should also be with insulin when the distinction between type 1 diabetes and type 2 diabetes is unclear and in patients who have random blood glucose concentrations 250 mg/dL (13.9 mmol/L) and/or A1C $\geq$8.5% (69 mmol/mol) (105).

Patients and their families must prioritize lifestyle modifications such as eating a balanced diet, achieving and maintaining a healthy weight, and exercising regularly. A family-centered approach to nutrition and lifestyle modification is essential in children with type 2 diabetes, and nutrition recommendations should be culturally appropriate and sensitive to family resources (see Section 4 "Lifestyle Management"). Given the complex social and environmental context surrounding youth with type 2 diabetes, individual-level lifestyle interventions may not be sufficient to target the complex interplay of family dynamics, mental health, community readiness, and the broader environmental system (95).

When insulin treatment is not required, initiation of metformin is recommended. The Treatment Options for Type 2 Diabetes in Adolescents and Youth (TODAY) study found that metformin alone provided durable glycemic control (A1C $\leq$8% [64 mmol/mol] for 6 months) in approximately half of the subjects (106). To date,

the TODAY study is the only trial combining lifestyle and metformin therapy in youth with type 2 diabetes; the combination did not perform better than metformin alone in achieving durable glycemic control (106).

Small retrospective analyses and a recent prospective multicenter nonrandomized study suggest that bariatric or metabolic surgery may have similar benefits in obese adolescents with type 2 diabetes compared with those observed in adults. Teenagers experience similar degrees of weight loss, diabetes remission, and improvement of cardiometabolic risk factors for at least 3 years after surgery (107). No randomized trials, however, have yet compared the effectiveness and safety of surgery to those of conventional treatment options in adolescents (108).

Comorbidities

Comorbidities may already be present at the time of diagnosis of type 2 diabetes in youth (96,109). Therefore, blood pressure measurement, a fasting lipid panel, assessment of random urine albumin-to-creatinine ratio, and a dilated eye examination should be performed at diagnosis. Thereafter, screening guidelines and treatment recommendations for hypertension, dyslipidemia, urine albumin excretion, and retinopathy are similar to those for youth with type 1 diabetes. Additional problems that may need to be addressed include polycystic ovary disease and other comorbidities associated with pediatric obesity, such as sleep apnea, hepatic steatosis, orthopedic complications, and psychosocial concerns. The ADA consensus report "Youth-Onset Type 2 Diabetes Consensus Report: Current Status, Challenges, and Priorities" (95) and an American Academy of Pediatrics clinical practice guideline (110) provide guidance on the prevention, screening, and treatment of type 2 diabetes and its comorbidities in children and adolescents.

TRANSITION FROM PEDIATRIC TO ADULT CARE

Recommendations

- Pediatric diabetes providers and families should begin to prepare youth for transition in early adolescence and, at the latest, at least 1 year before the transition to adult health care. **E**
- Both pediatric and adult diabetes care providers should provide support and links to resources for transitioning young adults. **B**

Care and close supervision of diabetes management are increasingly shifted from parents and other adults to the youth with type 1 or type 2 diabetes throughout childhood and adolescence. The shift from pediatric to adult health care providers, however, often occurs abruptly as the older teen enters the next developmental stage referred to as emerging adulthood (111), which is a critical period for young people who have diabetes. During this period of major life transitions, youth begin to move out of their parents' homes and must become fully responsible for their diabetes care. Their new responsibilities include self-management of their diabetes, making medical appointments, and financing health care, once they are no longer covered by their parents' health insurance plans (ongoing coverage until age 26 years is currently available under provisions of the U.S. Affordable Care Act). In addition to lapses in health care, this is also a period associated with deterioration in glycemic control; increased occurrence of acute complications; psychosocial, emotional, and behavioral challenges; and the emergence of chronic complications (112–115). The transition period from pediatric to adult care is prone to fragmentation in health care delivery, which may adversely impact health care quality, cost, and outcomes (116).

Although scientific evidence is limited, it is clear that comprehensive and coordinated planning that begins in early adolescence, or at least 1 year before the date of transition, is necessary to facilitate a seamless transition from pediatric to adult health care (112,113,117–119). A comprehensive discussion regarding the challenges faced during this period, including specific recommendations, is found in the ADA position statement "Diabetes Care for Emerging Adults: Recommendations for Transition From Pediatric to Adult Diabetes Care Systems" (113).

The Endocrine Society in collaboration with the ADA and other organizations has developed transition tools for clinicians and youth and families (118).

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