14. Children and Adolescents: Standards of Care in Diabetes—2025

*American Diabetes Association Professional Practice Committee**

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The American Diabetes Association (ADA) "Standards of Care in Diabetes" includes the 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, an interprofessional 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 and a full list of Professional Practice Committee members, please refer to Introduction and Methodology. Readers who wish to comment on the Standards of Care are invited to do so at professional.diabetes.org/SOC.

The management of diabetes in children and adolescents (individuals <18 years of age) cannot simply be derived from care routinely provided to adults with diabetes. The epidemiology, pathophysiology, developmental considerations, and response to therapy in pediatric diabetes are often different from those of adult diabetes. There are also differences in recommended care for children and adolescents with type 1 diabetes, type 2 diabetes, and other forms of diabetes. This section is divided into two major parts: the first part addresses care for children and adolescents with type 1 diabetes, and the second part addresses care for children and adolescents with type 2 diabetes. Monogenic diabetes (neonatal diabetes and maturity-onset diabetes of the young) and cystic fibrosis-related diabetes, which are often present in youth, are discussed in Section 2, "Diagnosis and Classification of Diabetes." **Table 14.1*A*** and **Table 14.1*B*** provide an overview of the recommendations for screening and treatment of complications and related conditions in pediatric type 1 diabetes and type 2 diabetes, respectively. In addition to comprehensive diabetes care, youth with diabetes should receive age-appropriate and developmentally appropriate pediatric care, including immunizations as recommended by the Centers for Disease Control and Prevention (CDC) (1). To ensure continuity of care as a person with diabetes becomes an adult, guidance is provided at the end of this section on the transition from pediatric to adult diabetes care.

Due to the nature of pediatric clinical research, the recommendations for children and adolescents with diabetes 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 statements "Type 1 Diabetes in Children and Adolescents" (2) and "Evaluation and Management of Youth-Onset Type 2 Diabetes" (3). Finally, other sections in the Standards of Care may have recommendations that apply to youth with diabetes and are referenced in the narrative of this section.

**A complete list of members of the American Diabetes Association Professional Practice Committee can be found at https://doi.org/10.2337/dc25-SINT.*

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Table 14.1*A*—Recommendations for screening and treatment of complications and related conditions in pediatric type 1 diabetes

	Thyroid disease	Celiac disease	Hypertension	Nephropathy	Retinopathy	Neuropathy	Dyslipidemia
Corresponding recommendations	14.29 and 14.30	14.31–14.33	14.34–14.37	14.43 and 14.44	14.45–14.47	14.48	14.38–14.42
Method	Thyroid-stimulating hormone; consider antithyroglobulin and antithyroid peroxidase antibodies	IgA tTG if total IgA normal; IgG tTG and deamidated gliadin antibodies if IgA deficient	Blood pressure monitoring	Albumin-to-creatinine ratio; random sample acceptable initially	Dilated fundoscopy or retinal photography	Foot exam with foot pulses, pinprick, 10-g monofilament sensation tests, vibration, and ankle reflexes	Lipid profile, nonfasting acceptable initially
When to start	Soon after diagnosis	Soon after diagnosis	At diagnosis	Puberty or ≥10 years old, whichever is earlier, and diabetes duration of 5 years	Puberty or ≥11 years old, whichever is earlier, and diabetes duration of 3–5 years	Puberty or ≥10 years old, whichever is earlier, and diabetes duration of 5 years	Soon after diagnosis; preferably after glycemia has improved and ≥2 years old
Follow-up frequency	Every 1–2 years if thyroid antibodies negative; more often if symptoms develop or presence of thyroid antibodies	Within 2 years and then at 5 years after diagnosis; sooner if symptoms develop	Every visit	If normal, annually; if abnormal, repeat with confirmation in two of three samples over 6 months (first morning void is recommended)	If normal, every 2 years; consider less frequently (every 4 years) if A1C <8% and eye professional agrees	If normal, annually	If LDL <100 mg/dL, repeat at 9–11 years old; then, if <100 mg/dL, every 3 years
Goal	NA	NA	<90th percentile for age, sex, and height; if ≥13 years old, <120/80 mmHg	Albumin-to-creatinine ratio <30 mg/g	No retinopathy	No neuropathy	LDL <100 mg/dL
Treatment	Appropriate treatment of underlying thyroid disorder	After confirmation, start gluten-free diet	Lifestyle modification for elevated blood pressure (90th to <95th percentile for age, sex, and height or, if ≥13 years old, 120–129/<80 mmHg); lifestyle modification and ACE inhibitor or ARB* for hypertension (≥95th percentile for age, sex, and height or, if ≥13 years old, ≥130/80 mmHg)	Optimize glycemia and blood pressure; ACE inhibitor* if albumin-to-creatinine ratio is elevated in two of three samples over 6 months	Optimize glycemia; treatment per ophthalmology	Optimize glycemia; referral to neurology	If abnormal, optimize glycemia and medical nutrition therapy; if after 6 months LDL >160 mg/dL or >130 mg/dL with cardiovascular risk factor(s), initiate statin therapy (for those aged >10 years)*

ARB, angiotensin receptor blocker; NA, not applicable; tTG, tissue transglutaminase. *Due to the potential teratogenic effects, individuals of childbearing age should receive reproductive counseling, and medication should be avoided in individuals of childbearing age who are not using reliable contraception.

Table 14.1*B*—Recommendations for screening and treatment of complications and related conditions in pediatric type 2 diabetes

	Hypertension	Nephropathy	Neuropathy	Retinopathy	Dyslipidemia	Metabolic dysfunction–associated steatotic liver disease	Obstructive sleep apnea	Polycystic ovary syndrome (for adolescent female individuals)
Corresponding recommendations	14.72–14.75	14.76–14.80	14.81 and 14.82	14.83–14.86	14.93–14.97	14.87 and 14.88	14.89	14.90 and 14.91
Method	Blood pressure monitoring	Albumin-to-creatinine ratio; random sample acceptable initially	Foot exam with foot pulses, pinprick, 10-g monofilament sensation tests, vibration, and ankle reflexes	Dilated fundoscopy	Lipid profile	AST and ALT measurement	Screening for symptoms	Screening for symptoms; laboratory evaluation if positive symptoms
When to start	At diagnosis	At diagnosis	At diagnosis	At or soon after diagnosis	Soon after diagnosis, preferably after glycemia has improved	At diagnosis	At diagnosis	At diagnosis
Follow-up frequency	Every visit	If normal, annually; if abnormal, repeat with confirmation in two of three samples over 6 months	If normal, annually	If normal, annually or every 2 years if glycemic goals are achieved	Annually	Annually	Every visit	Every visit
Goal	<90th percentile for age, sex, and height; if ≥13 years old, <130/80 mmHg	<30 mg/g	No neuropathy	No retinopathy	LDL <100 mg/dL, HDL >35 mg/dL, triglycerides <150 mg/dL	NA	NA	NA
Treatment	Lifestyle modification for elevated blood pressure (90th to <95th percentile for age, sex, and height or, if ≥13 years old, 120–129/<80 mmHg); lifestyle modification and ACE inhibitor or ARB* for hypertension (≥95th percentile for age, sex, and height or, if ≥13 years, ≥130/80 mmHg)	Optimize glycemia and blood pressure; ACE inhibitor* if albumin-to-creatinine ratio is elevated in two of three samples over 6 months	Optimize glycemia; referral to neurology	Optimize glycemia; treatment per ophthalmology	If abnormal, optimize glycemia and medical nutrition therapy; if LDL >130 mg/dL after 6 months, initiate statin therapy (for those aged >10 years);* if triglycerides >400 mg/dL fasting or >1,000 mg/dL nonfasting, begin fibrate	Refer to gastroenterology for persistently elevated or worsening transaminases	If positive symptoms, refer to sleep specialist and polysomnogram	If no contraindications, oral contraceptive pills; medical nutrition therapy; metformin

ARB, angiotensin receptor blocker; NA, not applicable; tTG, tissue transglutaminase. *Due to the potential teratogenic effects, individuals of childbearing age should receive reproductive counseling, and medication should be avoided in individuals of childbearing age who are not using reliable contraception.

TYPE 1 DIABETES

Type 1 diabetes is the most common form of diabetes in youth (4), although there are more adults living with and diagnosed with type 1 diabetes (5). The health care professional 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 childcare and school environment, neurological vulnerability to hypoglycemia and hyperglycemia in young children, and possible adverse neurocognitive effects of diabetic ketoacidosis (DKA) (6,7). Attention to family dynamics, developmental stages, and physiologic differences related to sexual maturity is essential in developing and implementing an optimal diabetes treatment plan (8). Additionally, more people (adults and youth) with type 1 diabetes are experiencing obesity than in the past, which adds to the complexity of living with and managing type 1 diabetes (9).

An interprofessional team trained in pediatric diabetes management and sensitive to the challenges of children and adolescents with type 1 diabetes and their families should provide diabetes-specific care for this population. It is essential that diabetes self-management education and support (DSMES), medical nutrition therapy (MNT), and psychosocial and behavioral support be provided at diagnosis and routinely (e.g., at each follow-up visit) thereafter in a developmentally appropriate format that builds on prior knowledge by a team of health care professionals experienced with the biological, educational, nutritional, behavioral, and emotional needs of the growing child and family. The diabetes team, considering the youth's developmental and psychosocial needs, should ask about and discuss diabetes management responsibilities with youth and parents or caregivers on an ongoing basis.

Diabetes Self-Management Education and Support

Recommendation

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

Self-management in pediatric diabetes involves both the youth and their parents or adult caregivers. No matter how sound the medical plan is, it will only be effective if the family and/or affected individuals can implement it. Family involvement is a vital component of optimal diabetes management throughout childhood and adolescence. As parents or caregivers are critical to diabetes self-management in youth, diabetes care requires an approach that places the youth and their parents or caregivers at the center of the care model. The pediatric diabetes care team must be capable of evaluating the educational, behavioral, emotional, and psychosocial factors that impact treatment plan implementation and must work with the youth and family to overcome barriers or redefine goals as appropriate. As the youth grows, develops, and acquires the need and desire for greater independent self-care skills, DSMES requires periodic and routine (e.g., at each follow-up visit) reassessment. The pediatric diabetes team should work with the youth and their parents or caregivers to ensure there is not a premature transfer of self-management tasks to the youth during this time. In addition, it is important to assess the educational needs and skills of, and provide training to, daycare workers, school nurses, and school personnel who are responsible for the care and supervision of the child with diabetes (2,10,11).

Nutrition Therapy

Recommendations

14.2 Individualized medical nutrition therapy (MNT) is recommended for youth with type 1 diabetes as an essential component of the overall treatment plan. **A**

14.3 Monitoring carbohydrate intake, whether by carbohydrate counting or experience-based estimation, is a key component to optimizing glycemic management. **B**

14.4 Advise youth with type 1 diabetes and their caregivers to strive for an eating pattern emphasizing key nutrition principles (including nonstarchy vegetables, whole fruits, legumes, fish and other lean protein, whole grains, nuts and seeds, and low-fat dairy products, and minimize consumption of red meat, sugar-sweetened beverages, sweets, refined grains, and processed foods). **B**

14.5 Meal composition impacts postprandial glucose excursions. Education on the impact of high-fat and high-protein meals and the adjustment of insulin dosing is necessary. **A**

14.6 Strongly advise comprehensive nutrition education at diagnosis, and at least annually as needed, by an experienced registered dietitian nutritionist to assess the eating pattern in relation to weight status, age-appropriate growth, and cardiovascular disease risk factors. **E**

Nutrition management should be individualized: family habits, food preferences, religious or cultural needs, finances, schedules, physical activity, and the youth's and family's abilities in numeracy, literacy, and self-management should be considered. Visits with a registered dietitian nutritionist, preferably experienced in working with pediatric populations with diabetes, should include assessment for changes in food preferences over time, access to food, growth and development, weight status, cardiovascular risk, and potential for disordered eating. Following recommended eating patterns is associated with better glycemic outcomes in youth with type 1 diabetes (12).

Although carbohydrate content is the primary variable for calculation of mealtime insulin doses, meals with higher fat and protein content can cause early hypoglycemia and delayed postprandial glucose excursions. Some adjustments in insulin dosing, including an increase in the calculated dose and a split dose, will improve postprandial glucose management (13–17).

Physical Activity and Exercise

Recommendations

14.7 Physical activity is recommended for all youth with type 1 diabetes with the goal of 60 min of moderate- to vigorous-intensity aerobic activity daily, with vigorous muscle-strengthening and bone-strengthening activities at least 3 days per week. **C**

14.8 Advise frequent glucose monitoring before, during, and after exercise,

via blood glucose meter and/or continuous glucose monitoring (CGM), to prevent, detect, and treat hypoglycemia and hyperglycemia associated with exercise. C

14.9 Youth and their parents or caregivers should receive education on goals and management of glycemia before, during, and after physical activity, individualized according to the type and intensity of the planned physical activity. C

14.10 Youth and their parents or caregivers should be educated on strategies to prevent hypoglycemia during, after, and overnight following physical activity and exercise. Treatment for hypoglycemia should be accessible before, during, and after engaging in activity. C

Physical activity and structured exercise positively impact metabolic and psychological health in children with type 1 diabetes (18). While it can have positive effects on insulin sensitivity, physical fitness, strength building, cardiorespiratory fitness, weight management, social interaction, mood, self-esteem building, and the creation of healthful habits for adulthood, it also has the potential to cause both hypoglycemia and hyperglycemia.

See below for strategies to mitigate hypoglycemia risk and minimize hyperglycemia associated with exercise. For an in-depth discussion, see previously published reviews and guidelines (19–23).

Overall, it is recommended that all youth participate in 60 min of moderate-intensity (e.g., brisk walking and dancing) to vigorous-intensity (e.g., running and jumping rope) aerobic activity daily, including resistance and flexibility training (24). Although uncommon in the pediatric population, youth should be medically evaluated for comorbid conditions or diabetes complications that may restrict participation in an exercise program. As hyperglycemia can occur before, during, and after physical activity, it is important to ensure the elevated glucose level is not related to insulin deficiency, as that can lead to worsening hyperglycemia with exercise and ketosis risk. Intense activity should be postponed with marked hyperglycemia (glucose ≥350 mg/dL [≥19.4 mmol/L]), moderate to large urine ketones, and/or β-hydroxybutyrate (B-OHB) >1.5 mmol/L. Caution may be needed when B-OHB levels are ≥0.6 mmol/L (12,19).

Prevention and treatment of hypoglycemia associated with physical activity includes decreasing prandial insulin for the meal or snack before exercise and/or increasing food intake. Youth on insulin pumps without automated insulin delivery (AID) can lower basal rates by ∼10–50% or more or suspend for 1–2 h during exercise (25). Decreasing basal rates or long-acting insulin doses by ∼20% after exercise may reduce delayed exercise-induced hypoglycemia (26). Accessible rapid-acting carbohydrates and frequent blood glucose monitoring before, during, and after exercise, with or without continuous glucose monitoring (CGM), maximize safety with exercise. Using AID systems may improve time in range (TIR) (70–180 mg/dL) during exercise, and youth can use brand-specific settings that are more conservative or increase the glycemic goal to prevent hypoglycemia (27).

Blood glucose goals prior to physical activity and exercise are 126–180 mg/dL (7.0–10.0 mmol/L) but should be individualized based on the type, intensity, and duration of activity (19,21). The accuracy of CGM systems varies depending on the type of exercise (28–30). Consider additional carbohydrate intake during and/or after exercise, depending on duration and intensity of physical activity, to prevent hypoglycemia. For low- to moderate-intensity aerobic activities (30–60 min), and if the youth is fasting, 10–15 g of carbohydrate may prevent hypoglycemia (21). After insulin boluses (relative hyperinsulinemia), consider 0.5–1.0 g of carbohydrates/kg per hour of exercise (∼30–60 g), similar to carbohydrate requirements for optimizing performance in athletes without type 1 diabetes (31,32).

For children and adolescents with type 1 diabetes and obesity, physical activity and exercise are key components of diabetes care. Obesity is equally common in youth with or without type 1 diabetes. Having obesity is associated with a higher frequency of cardiovascular risk factors, and it disproportionately affects youth from racial and ethnic minoritized groups (e.g., Black and Latino youth) (9,33–36). Therefore, diabetes health care professionals should monitor weight status and encourage a healthy eating pattern, physical activity, and healthy weight as key components of pediatric type 1 diabetes care.

School and Child Care

As a large portion of a youth's day is spent in school and/or daycare, training of school or daycare personnel to provide care in accordance with the child's individualized diabetes medical management plan is essential for optimal diabetes management and safe access to all school- or daycare–sponsored opportunities (11,37,38). In addition, federal and state laws require schools, daycare facilities, and other entities to provide needed diabetes care to enable the child to safely access the school or daycare environment. Refer to the ADA position statements "Diabetes Care in the School Setting" (11) and "Care of Young Children With Diabetes in the Childcare and Community Setting" (38) and the ADA's Safe at School website (diabetes.org/resources/know-your-rights/safe-at-school-state-laws) for additional details.

Psychosocial Care

Recommendations

14.11 At diagnosis and during routine follow-up care, screen youth with type 1 diabetes for psychosocial concerns (e.g., diabetes distress, depressive symptoms, and disordered eating), family factors, and behavioral health concerns that could impact diabetes management with age-appropriate standardized and validated tools. Refer to a qualified behavioral health professional, preferably experienced in childhood diabetes, when indicated. B

14.12 Behavioral health professionals should be considered integral members of the pediatric diabetes interprofessional team. E

14.13 Encourage developmentally appropriate family involvement in diabetes management tasks for children and adolescents, recognizing that premature or unsupportive transfer of diabetes care responsibility to the youth can contribute to diabetes distress, lower engagement in diabetes self-management behaviors, and deterioration in glycemia. A

14.14 Health care professionals should screen for food security, housing stability, health literacy, financial barriers, and social or community support and apply that information to treatment decisions. E

14.15 Health care professionals should consider asking youth and their parents

or caregivers about social adjustment (peer relationships) and school performance to determine whether further intervention is needed. **B**

14.16 Offer adolescents time by themselves with their health care professional(s) at a developmentally appropriate age. **E**

14.17 Starting at puberty, preconception counseling should be incorporated into routine diabetes care for all individuals 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, social determinants of health, and diabetes distress in the youth and the parents or caregivers during routine diabetes visits (39–41). It is important to consider the impact of diabetes on quality of life as well as the development of behavioral health problems related to diabetes distress, symptoms of depression, symptoms of anxiety, fear of hypoglycemia (and hyperglycemia), disordered eating behaviors, and eating disorders (39,42).

Consider screening youth for diabetes distress, generally starting at 7 or 8 years of age (42), using validated tools for youth and their parents or caregivers (43). The U.S. Preventive Services Task Force recommends screening for depression in youth aged 12–18 years (44). Additional times to consider screening for depression include when youth are not meeting treatment goals or when there are significant changes in medical status or life circumstances. The U.S. Preventive Services Task Force also recommends screening for anxiety in youth aged 8–18 years (45). Parents or caregivers and youth at risk for hypoglycemia or fear of hypoglycemia, especially if they have experienced severe and/or frequent hypoglycemic events, should be screened for fear of hypoglycemia; youth as young as 6 years old can provide reliable self-reports for fear of hypoglycemia (46). Lastly, health care professionals should consider screening for disordered eating behaviors when signs and symptoms (e.g., unexplained weight loss, hyperglycemia, and DKA) and/or behavioral and emotional indicators (e.g., secrecy around eating and excessive concern about weight) are present using available screening tools (47). Youth with type 1 diabetes have an increased risk of disordered eating behavior as well as clinical eating disorders, with serious short-term and long-term negative effects on diabetes outcomes and health in general. It is important to recognize the unique and dangerous disordered eating behavior of insulin omission for weight management in type 1 diabetes (48).

Given the complexity of psychosocial concerns in the management of type 1 diabetes in youth, collaboration between the diabetes health care team and a behavioral health professional, ideally with expertise in diabetes, is recommended. Early detection of diabetes distress, depression, anxiety, fear of hypoglycemia, and disordered eating can facilitate effective treatment options and help minimize adverse effects on diabetes management and disease outcomes (39,42). When psychological symptoms are identified, referral to a behavioral health professional, ideally with experience in pediatric diabetes, may be warranted. Such professionals can provide individualized, evidence-based behavioral health care services, including cognitive-behavioral, mindfulness-based, and other interventions (49), to improve psychosocial functioning in youth with type 1 diabetes (50–52).

The complexities of diabetes management require ongoing parental involvement in care throughout childhood and adolescence. Developmentally appropriate, supportive family teamwork between the growing youth and parent(s) can help maintain engagement in self-management behaviors and reduce deterioration in glycemia (53,54). It is appropriate to inquire about diabetes-specific family relationships, including family teamwork and conflict, during visits; health care professionals can both help families negotiate a plan and refer to an appropriate behavioral health professional for more in-depth support (55). Such professionals can conduct further assessment and deliver evidence-based behavioral interventions to support developmentally appropriate, collaborative family involvement in diabetes self-management (50,52). Monitoring of social adjustment (peer relationships) and school performance can facilitate both well-being and academic achievement (56,57). Diabetes management and glycemic levels may be related to academic progress and students' functioning in the school setting, which highlights the need for appropriate accommodations and access to diabetes-related support in school (58).

Shared decision-making with youth regarding the adoption of management plan components and self-management behaviors can improve diabetes self-efficacy, participation in diabetes care, and glycemic outcomes (9,59). For example, well-designed decision aids can engage youth in comprehensive, unbiased conversations with their diabetes care team about treatment options (60). Other examples include creating self-care contracts (61) and technology-integrated care that uses blood glucose records shared with the care team to facilitate shared decision-making (62). Importantly, health care professionals working with youth who are not yet able to provide legal consent must balance clinical oversight with promoting developmentally appropriate independence. Recommendations include providing education tailored to the developmental stage, encouraging gradual responsibility with self-care, guiding parental involvement as responsibilities change, teaching self-advocacy to prepare for transitions in care, and incorporating psychosocial support at all stages (57,63). 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 (64).

Beginning at the onset of puberty or at diagnosis of diabetes, all individuals with childbearing potential should receive education about the effective use of contraception to prevent unplanned pregnancy, as risks of fetal malformations are associated with elevated A1C. Preconception counseling using developmentally appropriate educational and behavioral strategies enables individuals of childbearing potential to make well-informed decisions (65). Preconception counseling resources tailored for adolescents are available at no cost through the ADA (66). Refer to the ADA position statement "Psychosocial Care for People With Diabetes" for further details (42).

The presence of a behavioral health professional on pediatric interprofessional teams highlights the importance

of attending to the psychosocial issues of diabetes. These psychosocial factors are significantly related to self-management difficulties, elevated A1C, reduced quality of life, and higher rates of acute and chronic diabetes complications.

Glycemic Monitoring, Insulin Delivery, and Goals

Recommendations

14.18 All youth with type 1 diabetes should monitor glucose levels multiple times daily (up to 10 times/day by blood glucose meter or CGM), including prior to meals and snacks, at bedtime, and as needed for safety in specific situations such as physical activity, driving, or the presence of symptoms of hypoglycemia. **B**

14.19 Real-time CGM **A** or intermittently scanned CGM **C** should be offered for diabetes management at diagnosis or as soon as possible in youth with diabetes on multiple daily injections or insulin pump therapy who are capable of using the device safely (either by themselves or with caregivers). The choice of device should be made based on the individual's and family's circumstances, desires, and needs.

14.20 Automated insulin delivery (AID) systems should be offered for diabetes management to youth with type 1 diabetes who are capable of using the device safely (either by themselves or with caregivers). The choice of device should be made based on the individual's and family's circumstances, desires, and needs. **A**

14.21 Insulin pump therapy alone should be offered for diabetes management to youth on multiple daily injections with type 1 diabetes who are capable of using the device safely (either by themselves or with caregivers) if unable to use AID systems. The choice of device should be made based on the individual's and family's circumstances, desires, and needs. **A**

14.22 Students must be supported at school in the use of diabetes technology, including CGM, insulin pumps, connected insulin pens, and AID systems, as prescribed by their diabetes care team. **E**

14.23 A1C goals must be individualized and reassessed over time. An A1C of <7% (<53 mmol/mol) is appropriate for many children and adolescents. **B**

14.24 Less stringent A1C goals (such as <7.5% [<58 mmol/mol]) may be appropriate for youth who cannot articulate symptoms of hypoglycemia; have hypoglycemia unawareness; lack advanced insulin delivery technology and/or CGM; cannot check blood glucose regularly; or have nonglycemic factors that increase A1C (e.g., high glycators). **B**

14.25 Even less stringent A1C goals (such as <8% [<64 mmol/mol]) may be appropriate for individuals with a history of severe hypoglycemia or limited life expectancy or where the harms of treatment are greater than the benefits. **B**

14.26 Health care professionals may reasonably suggest more stringent A1C goals (such as <6.5% [<48 mmol/mol]) for selected individuals if they can be achieved without significant hypoglycemia, excessive weight gain, negative impacts on well-being, or undue burden of care or in those who have nonglycemic factors that decrease A1C (e.g., lower erythrocyte life span). Lower goals may also be appropriate during the honeymoon phase. **B**

14.27 CGM metrics derived from CGM use over the most recent 14 days (or longer for youth with more glycemic variability), including time in range (70–180 mg/dL [3.9–10.0 mmol/L]), time below range (<70 mg/dL [<3.9 mmol/L] and <54 mg/dL [<3.0 mmol/L]), and time above range (>180 mg/dL [>10.0 mmol/L] and >250 mg/dL [>13.9 mmol/L]), are recommended to be used in conjunction with A1C whenever possible. **E**

Current standards for diabetes management reflect the need to minimize hyperglycemia as safely as possible. 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 plans, insulin pumps, frequent blood glucose monitoring, CGM, AID systems, goal setting, and improved education has been associated with more children and adolescents reaching the blood glucose goals recommended by the ADA (67,68), particularly in families in which the parents or caregivers as well as the child with diabetes participate jointly to perform the required diabetes-related tasks.

Lower A1C in adolescence and young adulthood is associated with a lower risk and rate of microvascular and macrovascular complications (69–71) and demonstrates the effects of metabolic memory (72–75).

In addition, type 1 diabetes can be associated with adverse effects on cognition during childhood and adolescence (6,76), and neurocognitive imaging differences related to hyperglycemia in children provide another motivation for achieving glycemic goals (6). Several factors, including young age, severe hypoglycemia at <6 years of age, DKA, and chronic hyperglycemia (76,77), contribute to adverse effects on brain development and function. However, meticulous use of therapeutic modalities such as rapid- and long-acting insulin analogs, technological advances (e.g., CGM, sensor-augmented pump therapy, and AID systems), and intensive self-management education now make it more feasible to achieve glycemic goals while reducing the incidence of severe hypoglycemia (78–99). Please refer to Section 7, "Diabetes Technology," for more information on technology to support people with diabetes.

Recent data with newer devices and insulins indicate that the risk of hypoglycemia with lower A1C is less than it was before (100–108). In addition, achieving lower A1C levels is likely facilitated by setting lower A1C goals (109). Lower goals may be possible during the honeymoon phase of type 1 diabetes. 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. However, registry data indicate that lower A1C goals can be achieved in children, including those aged <6 years, without increased risk of severe hypoglycemia (101). Recent data have demonstrated that the use of real-time CGM lowered A1C and increased TIR in adolescents and young adults and was associated with a lower risk of hypoglycemia (110). Please refer to Section 6, "Glycemic Goals and Hypoglycemia," for more information on glycemic assessment.

A strong relationship exists between the frequency of blood glucose monitoring and glycemic management (97–99, 111,112). Glucose levels for all children and adolescents with type 1 diabetes should be monitored multiple times daily by blood glucose monitoring and/or CGM. Recent data on children and adults suggest that use of CGM soon after type 1 diabetes diagnosis is associated with improved A1C (84,85,113). In the U.S., real-time CGM is approved for nonadjunctive use in children aged 2 years and older, and intermittently scanned CGM is approved for nonadjunctive use in children aged 4 years and older. Parents, caregivers, and youth should be offered initial and ongoing education and support for CGM use. Behavioral support may further improve ongoing CGM use (114). Metrics derived from CGM include percent TIR, time below target range, and time above target range (115). While studies indicate a relationship between TIR and A1C (116,117), it is still uncertain what the ideal goal TIR should be for children, and further studies are needed. Please refer to Section 7, "Diabetes Technology," for more information on the use of blood glucose meters, CGM, and insulin pumps. More information on insulin injection technique can be found in Section 9, "Pharmacologic Approaches to Glycemic Treatment."

Key Concepts in Setting Glycemic Goals

- Glycemic 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 plans.

Autoimmune Conditions

Recommendation

14.28 Assess for additional autoimmune conditions soon after the diagnosis of type 1 diabetes and if clinically relevant. **B**

Because of the increased frequency of other autoimmune diseases in type 1 diabetes, screening for thyroid dysfunction and celiac disease should be considered (118–122). Periodic screening in asymptomatic individuals has been recommended, but the optimal frequency of screening is unclear.

Although much less common than thyroid dysfunction and celiac disease, other autoimmune conditions, such as Addison 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. In addition, relatives of youth with type 1 diabetes should be offered testing for islet autoantibodies through research studies (e.g., TrialNet) and national programs for early diagnosis of preclinical type 1 diabetes (stages 1 and 2).

Thyroid Disease

Recommendations

14.29 Consider testing children with type 1 diabetes for antithyroid peroxidase and antithyroglobulin antibodies soon after diagnosis. **B**

14.30 Measure thyroid-stimulating hormone concentrations at diagnosis when clinically stable or soon after optimizing glycemia. If normal, suggest rechecking every 1–2 years or sooner if the youth has positive thyroid antibodies or develops symptoms or signs suggestive of thyroid dysfunction, thyromegaly, an abnormal growth rate, or unexplained glycemic variability. **B**

Autoimmune thyroid disease is the most common autoimmune disorder associated with diabetes, occurring in 17–30% of individuals with type 1 diabetes (119,123,124). At the time of diagnosis, ~25% of children with type 1 diabetes have thyroid autoantibodies (125), the presence of which is predictive of thyroid dysfunction—most commonly hypothyroidism, although hyperthyroidism occurs in ~0.5% of people with type 1 diabetes (126,127). For thyroid autoantibodies, a study from Sweden indicated that antithyroid peroxidase antibodies were more predictive than antithyroglobulin antibodies in multivariate analysis (128). 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 repeated soon after a period of metabolic stability and achievement of glycemic goals. Subclinical hypothyroidism may be associated with an increased risk of symptomatic hypoglycemia and dyslipidemia (129,130) and a reduced linear growth rate. Hyperthyroidism alters glucose metabolism and usually causes deterioration of glycemia.

Celiac Disease

Recommendations

14.31 Screen youth with type 1 diabetes for celiac disease by measuring IgA tissue transglutaminase (tTG) antibodies, with documentation of normal total serum IgA levels, soon after the diagnosis of diabetes, or IgG tTG and deamidated gliadin antibodies if IgA is deficient. **B**

14.32 Repeat screening for celiac disease within 2 years of diabetes diagnosis and then again after 5 years and consider more frequent screening in youth who have symptoms or a first-degree relative with celiac disease. **B**

14.33 Individuals with confirmed celiac disease should be placed on a gluten-free diet for treatment and to avoid complications. Youth and their caregivers should also have a consultation with a registered dietitian nutritionist experienced in managing both diabetes and celiac disease. **B**

Celiac disease is an immune-mediated disorder that occurs with increased frequency in people with type 1 diabetes (1.6–16.4% of individuals compared with 0.3–1% in the general population) (118,121,122, 131–134). Screening people with type 1 diabetes for celiac disease is further justified by its association with osteoporosis, iron deficiency, growth failure, and potential increased risk of retinopathy and albuminuria (135–137).

Screening for celiac disease includes measuring serum levels of IgA and tissue transglutaminase (tTG) IgA antibodies, or, with IgA deficiency, screening can include measuring tTG IgG antibodies or deamidated gliadin peptide IgG 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 (132) or if clinical symptoms indicate, such as poor growth or increased hypoglycemia (135).

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 tTG antibody should be considered at other times in individuals with symptoms suggestive of celiac disease (132). Monitoring for symptoms should include an assessment of linear growth and weight gain (135). A small-bowel biopsy in antibody-positive children is recommended to confirm the diagnosis (138). 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., >10 times the upper limit of normal) provided that further testing is performed (verification of endomysial antibody positivity on a separate blood sample). Whether this approach may be appropriate for asymptomatic children in high-risk groups remains an open question, though evidence is emerging (139). It is also advisable to check for celiac disease–associated HLA types in individuals who are diagnosed without a small intestinal biopsy. In symptomatic children with type 1 diabetes and confirmed celiac disease, gluten-free diets reduce symptoms and rates of hypoglycemia (140). The challenging eating plan 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 establishing a diagnosis of celiac disease and endorsing significant eating plan changes.

Management of Cardiovascular Risk Factors

Hypertension Screening

Recommendation

14.34 Blood pressure should be measured at every routine visit. In youth with high blood pressure (blood pressure ≥90th percentile for age, sex, and height or, in adolescents aged ≥13 years, blood pressure ≥120/80 mmHg) on three separate measurements, ambulatory blood pressure monitoring should be strongly considered. **B**

Hypertension Treatment

Recommendations

14.35 Treatment of elevated blood pressure (defined as 90th to <95th percentile for age, sex, and height or, in adolescents aged ≥13 years, 120–129/<80 mmHg) is lifestyle modification focused on healthy nutrition, physical activity, sleep, and, if appropriate, weight management. **C**

14.36 After excluding other causes, in addition to lifestyle modification, ACE inhibitors or angiotensin receptor blockers should be started for treatment of confirmed hypertension (defined as blood pressure consistently ≥95th percentile for age, sex, and height or, in adolescents aged ≥13 years, ≥130/80 mmHg). Due to the potential teratogenic effects, individuals of childbearing age should receive reproductive counseling, and ACE inhibitors and angiotensin receptor blockers should be avoided in individuals of childbearing age who are not using reliable contraception. **B**

14.37 The goal of treatment is blood pressure <90th percentile for age, sex, and height or, in adolescents aged ≥13 years, <130/80 mmHg. **C**

Blood pressure measurements should be performed using the appropriate size cuff with the youth seated and relaxed. Elevated blood pressure should be confirmed on at least three separate days, and ambulatory blood pressure monitoring should be considered. Evaluation should proceed as clinically indicated (141,142). 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) (143).

Dyslipidemia Screening

Recommendations

14.38 Initial lipid profile should be performed soon after diagnosis, preferably after glycemia has improved and age is ≥2 years. If initial LDL cholesterol is ≤100 mg/dL (≤2.6 mmol/L), subsequent testing should be performed at 9–11 years of age. **B** Initial testing may be done with a nonfasting lipid level with confirmatory testing with a fasting lipid panel.

14.39 If LDL cholesterol values are within the accepted risk level (<100 mg/dL [<2.6 mmol/L]), a lipid profile repeated every 3 years is reasonable. **E**

Dyslipidemia Treatment

Recommendations

14.40 If lipids are abnormal, initial therapy should consist of optimizing glycemia and MNT to limit the amount of calories from fat to 25–30% and saturated fat to <7%, limit cholesterol to <200 mg/day, avoid *trans* fats, and aim for ∼10% calories from monounsaturated fats. **A**

14.41 Consider age-approved statins, in addition to MNT and lifestyle changes, for youth with type 1 diabetes who have LDL cholesterol ≥130 mg/dL (≥3.4 mmol/L). **E** Individuals of childbearing age should receive reproductive counseling, and lipid-lowering medications should be avoided in most individuals of childbearing age who are not using reliable contraception. **B**

14.42 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 risk factors (144–146), and the prevalence of cardiovascular disease (CVD) risk factors increase with age (146) and among racial and ethnic minoritized groups (33), with girls having a higher risk burden than boys (145).

Pathophysiology. The atherosclerotic process begins in childhood, and although atherosclerotic cardiovascular disease 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 (147–149). Studies of carotid intima media thickness have yielded inconsistent results (142,143).

Screening. Diabetes predisposes the individual to the development of accelerated arteriosclerosis. Lipid evaluation for these individuals contributes to risk assessment and identifies an important proportion of those with dyslipidemia. Therefore, initial screening should be done soon after diagnosis. If the initial screen is normal, subsequent screening may be done at 9–11 years of age, which is a stable time

for lipid assessment in children (150). Children with a primary lipid disorder (e.g., familial hyperlipidemia) should be referred to a lipid specialist. Non-HDL cholesterol level has been identified as a significant predictor of the presence of atherosclerosis—as powerful as any other lipoprotein cholesterol measure in children and adolescents. For both children and adults, non-HDL cholesterol level seems to be more predictive of persistent dyslipidemia and, therefore, atherosclerosis and future events than total cholesterol, LDL cholesterol, or HDL cholesterol level alone. A major advantage (151) of non-HDL cholesterol is that it can be accurately calculated in a nonfasting state and therefore is practical to obtain in clinical practice as a screening test (152). Youth with type 1 diabetes have a high prevalence of lipid abnormalities (144,151). Even if normal, screening should be repeated within 3 years, as A1C and other cardiovascular risk factors can change dramatically during adolescence (153).

Treatment. Pediatric lipid guidelines provide some guidance relevant to children with type 1 diabetes and secondary dyslipidemia (142,154,155); however, there are few studies on modifying lipid levels in children with type 1 diabetes. A 6-month trial of nutritional counseling produced a significant improvement in lipid levels (156); likewise, a lifestyle intervention trial with 6 months of exercise in adolescents demonstrated improvement in lipid levels (157). Data from the SEARCH for Diabetes in Youth (SEARCH) study show that improved glucose over a 2-year period is associated with a more favorable lipid profile; however, improved glycemia alone will not normalize lipids in youth with type 1 diabetes and dyslipidemia (158).

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 (159,160). Initial therapy should include a nutrition plan that restricts saturated fat to 7% of total calories and dietary cholesterol to 200 mg/day (150). Data from randomized clinical trials in children as young as 7 months of age indicate that this nutrition plan is safe and does not interfere with normal growth and development.

Long-term safety and cardiovascular outcome efficacy of statin therapy have been established for children with familial hypercholesterolemia (161). At the time of this writing, rosuvastatin is indicated for children as young as 6 years old (162). Statins should be avoided in individuals of childbearing age who are not using reliable contraception (see Section 15, "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 (142).

Microvascular Complications

Nephropathy Screening

Recommendation

14.43 Annual screening for albuminuria with a random (morning sample preferred to avoid effects of exercise) spot urine sample for albumin-to-creatinine ratio should be considered at puberty or at age >10 years, whichever is earlier, once the youth has had diabetes for 5 years. **B**

Nephropathy Treatment

Recommendation

14.44 An ACE inhibitor or an angiotensin receptor blocker, titrated to normalization of albumin excretion, may be considered when elevated urinary albumin-to-creatinine ratio (>30 mg/g) is documented (two of three urine samples obtained over a 6-month interval following efforts to improve glycemia and normalize blood pressure). **E** Due to the potential teratogenic effects, individuals of childbearing age should receive reproductive counseling, and ACE inhibitors and angiotensin receptor blockers should be avoided in individuals of childbearing age who are not using reliable contraception. **B**

Data from 7,549 participants <20 years of age in the T1D Exchange clinic registry emphasize the importance of meeting glycemic and blood pressure goals, particularly as diabetes duration increases, 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 (163). An estimation of glomerular filtration rate (GFR), calculated with GFR-estimating equations using serum creatinine, height, age, and sex (164), 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 (164,165). The AdDIT study in adolescents with type 1 diabetes demonstrated the safety of ACE inhibitor treatment, but the treatment did not change the albumin-to-creatinine ratio over the course of the study (142).

Retinopathy

Recommendations

14.45 An initial dilated and comprehensive eye examination is recommended once youth have had type 1 diabetes for 3–5 years, provided they are aged ≥11 years or puberty has started, whichever is earlier. **B**

14.46 After the initial examination, repeat dilated and comprehensive eye examination every 2 years. Less frequent examinations, every 4 years, may be acceptable on the advice of an eye care professional and based on risk factor assessment, including a history of A1C <8% (<64 mmol/mol). **B**

14.47 Programs that use retinal photography (with remote reading or use of a validated assessment tool) to improve access to diabetic retinopathy screening can be appropriate screening strategies for diabetic retinopathy. Such programs need to provide pathways for timely referral for a comprehensive eye examination when indicated. **B**

Retinopathy (like albuminuria) most commonly occurs after the onset of puberty and after 5–10 years of diabetes duration (166). It is currently recognized that there is a low risk of development of vision-threatening retinal lesions prior to 12 years of age (167,168). A 2019 publication based on the follow-up of the DCCT adolescent cohort supports a lower frequency of eye examinations than previously recommended, particularly in adolescents with A1C closer to the goal range (169,170). Autonomous artificial intelligence screening for diabetic retinopathy has been shown to increase access to this routine

health maintenance (171). Referrals should be made to eye care professionals with expertise in diabetic retinopathy and experience in counseling pediatric individuals and families on the importance of prevention, early detection, and intervention.

Neuropathy

Recommendation

14.48 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. The examination should include inspection, assessment of foot pulses, pinprick, and 10-g monofilament sensation tests, testing of vibration sensation using a 128-Hz tuning fork, and ankle reflex tests. **B**

Diabetic neuropathy rarely occurs in prepubertal children or after only 1–2 years of diabetes (166), although data suggest a prevalence of distal peripheral neuropathy of 7% in 1,734 youth with type 1 diabetes and association with the presence of CVD risk factors (172,173). 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 (173). Foot inspection can be performed at each visit to educate youth regarding the importance of foot care (see Section 12, "Retinopathy, Neuropathy, and Foot Care").

TYPE 2 DIABETES

For information on risk-based screening for type 2 diabetes and prediabetes in youth, please refer to Section 2, "Diagnosis and Classification of Diabetes." For additional support for these recommendations, see the ADA position statement "Evaluation and Management of Youth-Onset Type 2 Diabetes" (3).

The prevalence of type 2 diabetes in youth has continued to increase over the past 20 years (4). The CDC 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 (174,175).

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 (3,176). Long-term follow-up data from the Treatment Options for Type 2 Diabetes in Adolescents and Youth (TODAY) study reported most individuals with type 2 diabetes diagnosed as youth had microvascular complications by young adulthood (177). Type 2 diabetes disproportionately impacts youth from historically marginalized communities and can occur in complex psychosocial and cultural environments, which may make it difficult to implement and sustain healthy lifestyle changes and self-management behaviors (9,178–181). Additional risk factors associated with type 2 diabetes in youth include obesity and excess adiposity (182), family history of diabetes possibly mediated by shared genetics, lifestyle, and environmental factors (183), female sex, maternal gestational diabetes mellitus (184), and adverse social determinants of health (176).

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 and safety and maximal academic opportunities.

Screening and Diagnosis

Recommendations

14.49 Risk-based screening for prediabetes and/or type 2 diabetes should be considered after the onset of puberty or ≥10 years of age, whichever occurs earlier, in youth with overweight (BMI ≥85th percentile) or obesity (BMI ≥95th percentile) and who have one or more additional risk factors for diabetes (see **Table 2.5** for evidence grading of other risk factors).

14.50 If screening is normal, repeat screening at a minimum of 2-year intervals **E** or more frequently if BMI is increasing. **C**

14.51 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**

14.52 Children and adolescents with overweight or obesity in whom the diagnosis of type 2 diabetes is being considered should have a panel of pancreatic autoantibodies tested to exclude the possibility of autoimmune type 1 diabetes. **B**

In recent years, incidence and prevalence of type 2 diabetes in adolescents have increased dramatically, especially in historically marginalized communities (185). A few 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 (186), while fasting glucose alone may overdiagnose diabetes in children (187,188). In addition, 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 (189). An analysis of National Health and Nutrition Examination Survey (NHANES) data suggests using A1C for screening of high-risk youth (190). The 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, the ADA continues to recommend A1C for diagnosis of type 2 diabetes in this population (186).

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 (34), and diabetes-associated autoantibodies and ketosis may be present in pediatric individuals with clinical features of type 2 diabetes (including obesity and acanthosis nigricans) (187). The presence of islet autoantibodies has been associated with faster progression to insulin deficiency (187). At the onset of diabetes, DKA occurs in ∼11% of youth aged 10–19 years with type 2 diabetes (191). Although uncommon, type 2 diabetes has been observed in prepubertal children under the age of 10 years, thus it should be part of the differential in children with suggestive symptoms (192). Finally, obesity contributes to the development of type 1 diabetes in some individuals (193), which further

blurs the lines between diabetes types. We must acknowledge that people with type 1 diabetes can also experience weight gain and insulin resistance. However, accurate diagnosis is critical, as treatment plans, educational approaches, nutrition advice, and outcomes differ markedly between individuals with predominantly insulin resistance and absolute insulinopenia phenotypes. The significant diagnostic difficulties posed by maturity-onset diabetes of the young are discussed in Section 2, "Diagnosis and Classification of Diabetes." In addition, there are rare and atypical diabetes cases that represent a challenge for clinicians and researchers.

Management

Lifestyle Management

Recommendations

14.53 All youth with type 2 diabetes and their families should receive comprehensive DSMES that is specific to youth with type 2 diabetes and is culturally appropriate. **B**

14.54 Youth with overweight or obesity and 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 at least a 7–10% decrease in excess weight. **B**

14.55 Given the necessity of long-term weight management for youth with type 2 diabetes, lifestyle intervention should be based on a chronic care model and offered in the context of diabetes care. **E**

14.56 Youth with prediabetes and type 2 diabetes, like all children and adolescents, should be encouraged to participate in at least 60 min of moderate to vigorous physical activity daily (with muscle and bone strength training at least 3 days/week) **B** and to decrease sedentary recreational screen time. **C**

14.57 Nutrition for youth with prediabetes and type 2 diabetes, like for all children and adolescents, should focus on key nutrition principles (i.e., eat more nonstarchy vegetables, whole fruits, legumes, whole grains, nuts and seeds, and low-fat dairy products and eat less meat, sugar-sweetened beverages, sweets, refined grains, and processed or ultraprocessed foods). **B**

Glycemic Goals

Recommendations

14.58 Real-time CGM or intermittently scanned CGM should be offered for diabetes management in youth with type 2 diabetes on multiple daily injections or insulin pumps who are capable of using the device safely (either by themselves or with a caregiver). The choice of device should be made based on an individual's and family's circumstances, desires, and needs. **E**

14.59 Glycemic status should be assessed at least every 3 months. **E**

14.60 Consider setting an A1C goal of <6.5% (<48 mmol/mol) for most children and adolescents with type 2 diabetes who have a low risk of hypoglycemia. For those at higher risk of hypoglycemia, A1C goals should be individualized as clinically appropriate. **C**

Pharmacologic Management

Recommendations

14.61 Initiate pharmacologic therapy, in addition to behavioral counseling for healthful nutrition and physical activity changes, at diagnosis of type 2 diabetes. **A**

14.62 In individuals with incidentally diagnosed or metabolically stable diabetes (A1C <8.5% [<69 mmol/mol] and asymptomatic), metformin is the initial pharmacologic treatment of choice if kidney function is normal. **A**

14.63 Youth with marked hyperglycemia (blood glucose ≥250 mg/dL [≥13.9 mmol/L], A1C ≥8.5% [≥69 mmol/mol]) without acidosis at diagnosis who are symptomatic with polyuria, polydipsia, nocturia, and/or weight loss should be treated initially with long-acting insulin while metformin is initiated and titrated. **B**

14.64 Initiate subcutaneous or intravenous insulin treatment in individuals with ketoacidosis to rapidly correct the hyperglycemia and the metabolic derangement. Once acidosis is resolved, metformin should be initiated while subcutaneous insulin therapy is continued. **A**

14.65 In individuals presenting with severe hyperglycemia (blood glucose ≥600 mg/dL [≥33.3 mmol/L]), consider assessment for hyperglycemic hyperosmolar state. **A**

14.66 If glycemic goals are no longer met with metformin (with or without long-acting insulin), glucagon-like peptide 1 (GLP-1) receptor agonist therapy and/or empagliflozin should be considered in children 10 years of age or older. **A**

14.67 When choosing glucose-lowering or other medications for youth with overweight or obesity and type 2 diabetes, consider medication-taking behavior and the medications' effect on weight. **E**

14.68 For youth not meeting glycemic goals, consider maximizing noninsulin therapies (metformin, a GLP-1 receptor agonist, and empagliflozin) before initiating and/or the intensifying insulin therapy plan. **E**

14.69 In individuals initially treated with insulin and metformin and/or other glucose-lowering medications who are meeting glucose goals based on blood glucose monitoring or CGM, insulin can be tapered over 2–6 weeks by decreasing the insulin dose 10–30% every few days. **B**

Treatment of youth-onset type 2 diabetes should include lifestyle management, DSMES, and pharmacologic treatment. Initial treatment of youth with obesity and diabetes must consider that diabetes type is often uncertain in the first few weeks of treatment due to overlap in presentation and that a substantial percentage of youth with type 2 diabetes will present with clinically significant ketoacidosis (194). Therefore, initial therapy should address the hyperglycemia and associated metabolic derangements irrespective of ultimate diabetes type, with adjustment of therapy once metabolic compensation has been established and subsequent information, such as islet autoantibody results, becomes available. **Figure 14.1** provides an approach to the initial treatment of new-onset diabetes in youth with overweight or obesity with clinical suspicion of type 2 diabetes.

Glycemic goals should be individualized, taking into consideration the long-term health benefits of more stringent goals and risk for adverse effects, such as hypoglycemia. A lower A1C goal of <6.5% in youth with type 2 diabetes compared with <7% recommended in type 1 diabetes is justified by a lower risk of hypoglycemia and higher risk of

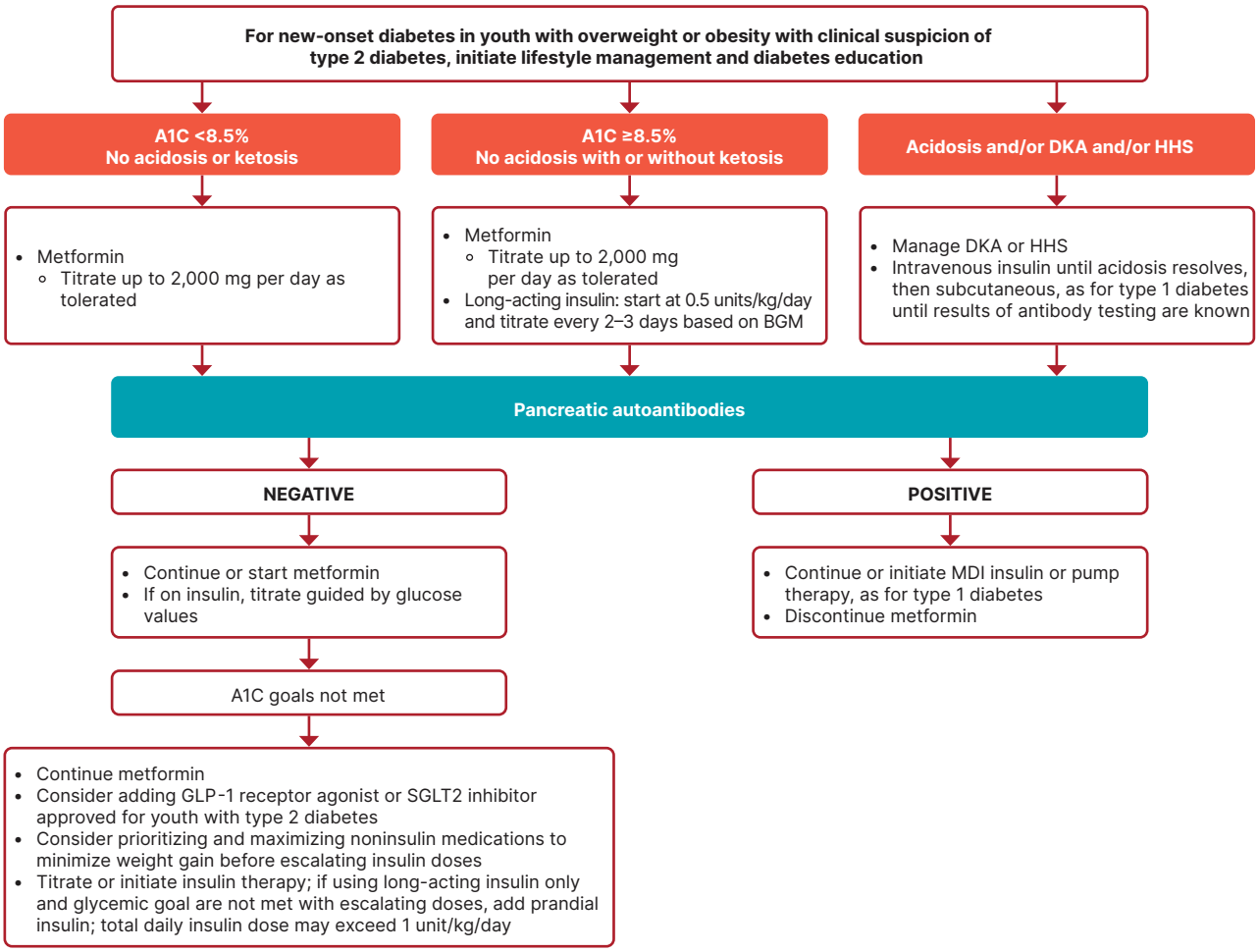

Figure 14.1—Management of new-onset diabetes in youth with overweight or obesity with clinical suspicion of type 2 diabetes. A1C 8.5% = 69 mmol/mol. BGM, blood glucose monitoring; CGM, continuous glucose monitoring; DKA, diabetic ketoacidosis; GLP-1, glucagon-like peptide 1; HHS, hyperosmolar hyperglycemic state; MDI, multiple daily injections; SGLT2, sodium–glucose cotransporter 2. Adapted from the ADA position statement "Evaluation and Management of Youth-Onset Type 2 Diabetes" (3).

complications in youth with type 2 diabetes (177,195–199).

Self-management in pediatric diabetes involves both the youth and their parents or adult caregivers. Individuals and their families should receive education and support for healthful nutrition and physical activity, such as a balanced meal plan, achieving and maintaining a healthy weight, and regular physical activity. Physical activity should include aerobic, muscle-strengthening, and bone-strengthening activities (24). A family-centered approach to nutrition and lifestyle modification is essential in children and adolescents with type 2 diabetes, and nutrition recommendations should be culturally appropriate and sensitive to family resources (see Section 5, "Facilitating Positive Health Behaviors and Well-being to Improve Health Outcomes"). Given the complex social and environmental context surrounding youth with type 2 diabetes, individual-level lifestyle interventions may not be sufficient to address the complex interplay of family dynamics, behavioral health, community readiness, and the broader environmental system (3).

An interprofessional diabetes team, including a physician, diabetes care and education specialist (CDCES), registered dietitian nutritionist, and behavioral health specialist or social worker, is essential. In addition to achieving glycemic goals and self-management education (200–202), initial treatment must include management of comorbidities such as obesity, dyslipidemia, hypertension, and microvascular complications.

Current pharmacologic treatment options for youth-onset type 2 diabetes are limited to four approved drug classes: insulin, metformin, glucagon-like peptide 1 (GLP-1) receptor agonists, and sodium–glucose cotransporter 2 inhibitors. Presentation with ketoacidosis or marked ketosis requires a period of insulin therapy until fasting and postprandial glycemia have been restored to normal or near-normal levels. Insulin pump therapy may be considered as an option for those on long-term multiple daily injections who are able to safely manage the device. Initial treatment should also be with insulin when the distinction between type 1 diabetes and type 2 diabetes is unclear and in individuals who have random blood glucose concentrations ≥250 mg/dL (≥13.9 mmol/L) and/or A1C ≥8.5% (≥69 mmol/mol) (203). Metformin therapy should be added after resolution of ketosis or ketoacidosis.

When initial insulin treatment is not required, initiation of metformin is recommended as first-line therapy. The TODAY study found that metformin alone provided durable glycemic management (A1C

≤8% [≤64 mmol/mol] for 6 months) in approximately half of the subjects (204). The Restoring Insulin Secretion (RISE) Consortium study did not demonstrate differences in measures of glucose or β-cell function preservation between metformin and insulin, but there was more weight gain with insulin (205).

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 levels (204).

Randomized controlled trials in youth have shown that GLP-1 receptor agonists are safe and effective for decreasing A1C (206–210) and promoting weight loss at higher doses approved for obesity (211). Use of GLP-1 receptor agonists can increase the frequency of gastrointestinal side effects and should not be used in individuals with a family history of medullary thyroid cancer.

In addition to GLP-1 receptor agonists, sodium–glucose cotransporter-2 inhibitors are well-studied drugs in adults with type 2 diabetes, and empagliflozin is now approved for use in youth with type 2 diabetes. In a recent multicenter double-blind, placebo-controlled trial, 158 children with type 2 diabetes aged between 10 and 17 years were randomized to 10 mg empagliflozin, 5 mg linagliptin, or placebo. Participants in the empagliflozin group who did not have A1C below 7.0% by week 12 underwent a second double-blinded randomization at week 14 to either remain on 10 mg of empagliflozin or increase their dose to 25 mg. In the empagliflozin pooled group compared with the placebo group, there was a significant reduction in A1C of 0.84% (P = 0.012). There were no episodes of severe hypoglycemia during the study (212).

Blood glucose monitoring plans should be individualized, taking into consideration the pharmacologic treatment of the person. Although data on CGM in youth with type 2 diabetes are sparse (213,214), CGM could be considered in individuals requiring frequent blood glucose monitoring for diabetes management.

Metabolic Surgery

Recommendations

14.70 Metabolic surgery may be considered for the treatment of adolescents with type 2 diabetes who have class 2 obesity or higher (BMI >35 kg/m^2 or >120% of 95th percentile for age and sex, whichever is lower) and who have elevated A1C and/or serious comorbidities despite lifestyle and pharmacologic intervention. **A**

14.71 Metabolic surgery should be performed only by an experienced surgeon working as part of a well-organized and engaged interprofessional team, including a surgeon, endocrinologist, registered dietitian nutritionist, behavioral health specialist, and nurse. **A**

The results of weight loss and lifestyle interventions for obesity in children and adolescents have been disappointing, and treatment options as adjuncts to lifestyle therapy are limited. Recent U.S. Food and Drug Administration–approved medications for youth ages 12 years and older include phentermine and topiramate extended-release capsules and GLP-1 receptor agonists (211,215–217). Over the last decade, weight loss surgery has been increasingly performed in adolescents with obesity. Small retrospective analyses and a prospective multicenter, nonrandomized study suggest that bariatric or metabolic surgery have benefits in adolescents with obesity and type 2 diabetes like those observed in adults. Early follow-up studies indicate that adolescents experience similar degrees of weight loss compared with adults and even higher rates of type 2 diabetes and hypertension remission (218). A secondary data analysis from the Teen-Longitudinal Assessment of Bariatric Surgery (Teen-LABS) and TODAY studies suggests surgical treatment of adolescents with severe obesity and type 2 diabetes is associated with improved glycemia compared with the agents used in the TODAY study (219); however, no randomized trials have compared the effectiveness and safety of surgery with those of conventional treatment options in adolescents and particularly with the vertical sleeve gastrectomy, which is the most widely performed metabolic surgery in adolescents (220). The guidelines used as an indication for metabolic surgery in adolescents generally include class 2 obesity or higher (BMI >35 kg/m^2 or >120% of 95th percentile for age and sex, whichever is lower, with comorbidities) or BMI >40 kg/m^2 with or without comorbidities (221–227). A number of groups, including the Pediatric Bariatric Study Group and Teen-LABS study, have demonstrated the effectiveness of metabolic surgery in adolescents (221–225). However, long-term data on the rates of complications, reoperations, nutritional deficiencies, and diabetes recurrence are still needed.

Prevention and Management of Diabetes Complications

Hypertension

Recommendations

14.72 Blood pressure should be measured at every clinic visit. In youth with high blood pressure (blood pressure ≥ 90th percentile for age, sex, and height or, in adolescents aged ≥13 years, ≥120/80 mmHg) on three separate measurements, ambulatory blood pressure monitoring should be strongly considered. **B**

14.73 After excluding secondary hypertension, treatment of elevated blood pressure (defined as 90th to <95th percentile for age, sex, and height or, in adolescents aged ≥13 years, 120–129/<80 mmHg) is lifestyle modification focused on healthy nutrition, physical activity, sleep, and, if appropriate, weight management. **C**

14.74 In addition to lifestyle modification, ACE inhibitors or angiotensin receptor blockers should be started for treatment of confirmed hypertension (defined as blood pressure consistently ≥95th percentile for age, sex, and height or, in adolescents aged ≥13 years, ≥130/80 mmHg). Due to the potential teratogenic effects, individuals of childbearing age should receive reproductive counseling, and ACE inhibitors and angiotensin receptor blockers should be avoided in individuals of childbearing age who are not using reliable contraception. **B**

14.75 The goal of treatment is blood pressure <90th percentile for age, sex, and height or, in adolescents aged ≥13 years, <130/80 mmHg. **C**

Nephropathy

Recommendations

14.76 Urine albumin-to-creatinine ratio should be obtained at the time of diagnosis and annually thereafter. An elevated urine albumin-to-creatinine ratio (>30 mg/g creatinine) should be confirmed on two of three samples. **B**

14.77 Estimated glomerular filtration rate (GFR) should be determined at the time of diagnosis and annually thereafter. E

14.78 In youth with diabetes and hypertension, either an ACE inhibitor or an angiotensin receptor blocker is recommended for those with modestly elevated urinary albumin-to-creatinine ratio (30–299 mg/g creatinine) and should be considered for those with urinary albumin-to-creatinine ratio >300 mg/g creatinine and/or estimated GFR <60 mL/min/1.73 m^2. E Due to the potential teratogenic effects, individuals of childbearing age should receive reproductive counseling, and ACE inhibitors and angiotensin receptor blockers should be avoided in individuals of childbearing age who are not using reliable contraception. B

14.79 For youth with nephropathy, continue monitoring (yearly and/or as indicated by urinary albumin-to-creatinine ratio and estimated GFR) to detect disease progression. E

14.80 Referral to nephrology is recommended in case of uncertainty of etiology, worsening urinary albumin-to-creatinine ratio, or decrease in estimated GFR. E

Neuropathy

Recommendations

14.81 Youth with type 2 diabetes should be screened for the presence of neuropathy by foot examination at diagnosis and annually. The examination should include inspection, assessment of foot pulses, pinprick and 10-g monofilament sensation tests, testing of vibration sensation using a 128-Hz tuning fork, and ankle reflex tests. C

14.82 Prevention of neuropathy should focus on achieving glycemic goals. C

Retinopathy

Recommendations

14.83 Screening for retinopathy should be performed by dilated fundoscopy at or soon after diagnosis and annually thereafter. C

14.84 Optimizing glycemia is recommended to decrease the risk or slow the progression of retinopathy. B

14.85 Less frequent examination (every 2 years) may be considered if achieving glycemic goals and a normal eye exam. C

14.86 Programs that use retinal photography (with remote reading or use of a validated assessment tool) to improve access to diabetic retinopathy screening can be appropriate screening strategies for diabetic retinopathy. Such programs need to provide pathways for timely referral for a comprehensive eye examination when indicated. E

Metabolic Dysfunction–Associated Steatotic Liver Disease Recommendations

Recommendations

14.87 Evaluation of youth with type 2 diabetes for metabolic dysfunction–associated steatotic liver disease (by measuring AST and ALT) should be done at diagnosis and annually thereafter. B

14.88 Referral to gastroenterology should be considered for persistently elevated or worsening transaminases. B

Obstructive Sleep Apnea

Recommendation

14.89 Screening for symptoms of sleep apnea should be done at each visit, and referral to a pediatric sleep specialist for evaluation and a polysomnogram, if indicated, is recommended. Obstructive sleep apnea should be treated when documented. B

Polycystic Ovary Syndrome

Recommendations

14.90 Evaluate for polycystic ovary syndrome in female adolescents with type 2 diabetes, including laboratory studies, when indicated. B

14.91 Metformin, in addition to lifestyle modification, is likely to improve the menstrual cyclicity and hyperandrogenism in female individuals with type 2 diabetes. E

Cardiovascular Disease

Recommendation

14.92 Intensive lifestyle interventions focusing on weight loss, dyslipidemia, hypertension, and dysglycemia are important to prevent overt macrovascular disease in early adulthood. E

Dyslipidemia

Recommendations

14.93 Lipid screening should be performed initially after optimizing glycemia and annually thereafter. B

14.94 Optimal goals are LDL cholesterol <100 mg/dL (<2.6 mmol/L), HDL cholesterol >35 mg/dL (>0.91 mmol/L), and triglycerides <150 mg/dL (<1.7 mmol/L). E

14.95 If lipids are abnormal, initial therapy should consist of optimizing glycemia and medical nutritional therapy to limit the amount of calories from fat to 25–30% and saturated fat to <7%, limit cholesterol to <200 mg/day, avoid *trans* fats, and aim for ~10% calories from monounsaturated fats for elevated LDL. For elevated triglycerides, MNT should also focus on decreasing carbohydrate intake and increasing dietary n-3 fatty acids in addition to the above changes. A

14.96 If LDL cholesterol remains >130 mg/dL (>3.4 mmol/L) after 6 months of dietary intervention, initiate therapy with statin, with a goal of LDL <100 mg/dL (<2.6 mmol/L). Due to the potential teratogenic effects, individuals of childbearing age should receive reproductive counseling, and statins should be avoided in individuals of childbearing age who are not using reliable contraception. B

14.97 If triglycerides are >400 mg/dL (>4.7 mmol/L) fasting or >1,000 mg/dL (>11.6 mmol/L) nonfasting, optimize glycemia and begin fibrate, with a goal of <400 mg/dL (<4.7 mmol/L) fasting to reduce risk for pancreatitis. C

Cardiac Function Testing

Recommendation

14.98 Routine screening for heart disease with electrocardiogram, echocardiogram, or stress testing is not recommended in asymptomatic youth with type 2 diabetes. B

Comorbidities may already be present at the time of diagnosis of type 2 diabetes in youth (176,228). Therefore, blood pressure measurement, a fasting lipid

panel, assessment of random urine albumin-to-creatinine ratio, foot examination for neuropathy, and a dilated eye examination should be performed at diagnosis. Additional medical conditions 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 position statement "Evaluation and Management of Youth-Onset Type 2 Diabetes" (3) provides guidance on the prevention, screening, and treatment of type 2 diabetes and its comorbidities in children and adolescents.

Youth-onset type 2 diabetes is associated with significant microvascular and macrovascular risk burden and a substantial increase in the risk of cardiovascular morbidity and mortality at an earlier age than in those diagnosed later in life (177, 229). The higher complication risk in earlier-onset type 2 diabetes is likely related to prolonged lifetime exposure to hyperglycemia and other atherogenic risk factors, including insulin resistance, dyslipidemia, hypertension, and chronic inflammation. There is a low risk of hypoglycemia in youth with type 2 diabetes, even if they are being treated with insulin (230), and there are high rates of complications (196–198,230). These diabetes comorbidities also appear to be higher than those in youth with type 1 diabetes despite shorter diabetes duration and lower A1C (228). In addition, the progression of vascular abnormalities appears to be more pronounced in youth-onset type 2 diabetes than with type 1 diabetes of similar duration, including ischemic heart disease and stroke (229).

In youth with type 2 diabetes and polycystic ovary syndrome, oral contraceptives are appropriate agents.

Psychosocial Factors

Recommendations

14.99 Health care professionals should screen for food insecurity, housing stability, health literacy, financial barriers, and social or community support and apply that information to treatment decisions. **E**

14.100 Use age-appropriate standardized and validated tools to screen for diabetes distress, depressive symptoms, and behavioral health concerns in youth with type 2 diabetes, with attention to symptoms of depression and disordered eating, and refer to a qualified behavioral health professional when indicated. **B**

14.101 Starting at puberty, preconception counseling should be incorporated into routine diabetes clinic visits for all individuals of childbearing potential because of the adverse pregnancy outcomes in this population. **A**

Most youth with type 2 diabetes come from historically marginalized communities, have low socioeconomic status, and often experience multiple psychosocial stressors (9,40,42,231). Consideration of the sociocultural context and efforts to personalize diabetes management are of critical importance to minimize barriers to care, enhance participation, and maximize response to treatment. Screening for food insecurity, housing stability, and other barriers related to the social determinants of health should be part of routine pediatric diabetes care (232). Please see Section 1, "Improving Care and Promoting Health in Populations," for further information on how to screen and address social determinants of health–related barriers.

Evidence about psychosocial concerns in youth with type 2 diabetes is limited (233–236), but given the sociocultural context for many youth, combined with the medical burden and obesity associated with type 2 diabetes, continuous monitoring of behavioral health is recommended. Symptoms of depression and disordered eating are common and associated with higher A1C (41,233,237,238). Early detection of psychological and behavioral concerns can facilitate effective treatment options to improve psychosocial well-being and support diabetes (42). When psychological symptoms are identified, referral to a behavioral health professional, ideally with experience in pediatric diabetes, may be warranted. Although far less research has been done on psychological and behavioral interventions for youth with type 2 diabetes than for youth with type 1 diabetes, behavioral professionals can provide behavioral health care services to support youth with type 2 diabetes (50–52). Many of the medications prescribed for diabetes and psychiatric disorders are associated with weight gain and can increase concerns about eating, body shape, and weight (239,240).

The TODAY study documented high rates of maternal complications during pregnancy and low rates of preconception counseling and contraception use in youth with type 2 diabetes (241). Preconception counseling tailored for adolescents with diabetes (including type 2 diabetes) has sustained behavioral benefits (65).

SUBSTANCE USE IN PEDIATRIC DIABETES

Tobacco, Electronic Cigarettes, Alcohol, and Cannabis

Recommendations

14.102 Adolescents and young adults should be screened for tobacco or nicotine, electronic cigarettes, substance use, and alcohol use at diagnosis and regularly thereafter. **C**

14.103 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**

14.104 Electronic cigarette use or vaping should be discouraged. **A**

14.105 Advise all youth with diabetes not to use cannabis recreationally in any form. **E**

The adverse health effects of smoking and use of tobacco products 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 (242). In youth with diabetes, it is important to avoid additional CVD risk factors. Smoking increases the risk of the onset of albuminuria; therefore, smoking avoidance is important to prevent both microvascular and macrovascular complications (150). Discouraging use of tobacco products, including electronic cigarettes (243, 244), is an important part of routine diabetes care. Individuals with diabetes should be advised to avoid vaping and using electronic cigarettes, either as a way to stop smoking tobacco or as a recreational drug. In younger children, it is important to assess exposure to cigarette smoke in the home because of the adverse effects of secondhand smoke and to discourage youth from ever smoking.

As alcohol use has implications for glycemic management and safety in youth and young adults with diabetes, efforts are warranted to reduce alcohol use and

increase education about the risks of alcohol use and strategies to minimize risks. A psychoeducational intervention for adolescents with chronic medical conditions, including type 1 diabetes, has demonstrated benefits for knowledge, perceived benefits, and reduced use (245). See also Section 5, "Facilitating Positive Health Behaviors and Well-being to Improve Health Outcomes."

Finally, increased legalization and multiple formulations of cannabis products have resulted in increased use of these products among youth and young adults. In 2022, 30.7% of 12th graders reported using cannabis in the past year and 6.3% reported using it daily over the past 30 days (246). Cannabis users with type 1 diabetes are at increased risk for hyperglycemic ketosis due to cannabis hyperemesis syndrome (severe nausea, abdominal pain, and vomiting) (247). For youth with type 1 diabetes presenting with a hyperglycemic emergency, health care professionals should consider cannabis hyperemesis syndrome in individuals with pH $\geq$7.4 and bicarbonate $>$15 mmol/L in the presence of ketosis (247). Routine diabetes care should discourage the use of recreational cannabis in all forms. See Section 5, "Facilitating Positive Health Behaviors and Well-being to Improve Health Outcomes," for more information about smoking cessation, tobacco, electronic cigarettes, and cannabis in people with diabetes.

TRANSITION FROM PEDIATRIC TO ADULT CARE

Recommendations

14.106 Diabetes care teams should implement transition preparation programs for youth beginning in early adolescence and, at the latest, at least 1 year before the anticipated transfer from pediatric to adult health care. **E**

14.107 Interprofessional adult and pediatric health care teams should provide support and resources for adolescents, young adults, and their families prior to and during the transfer process from pediatric to adult health care. **C**

14.108 Pediatric diabetes specialists should partner with youth with diabetes and their caregivers to engage in shared decision-making for the timing of transfer to an adult diabetes specialist. There is no age-specific cutoff for youth with diabetes to transfer to an adult diabetes specialist. **E**

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 professionals, however, often occurs abruptly as the older teen enters the next developmental stage, referred to as emerging adulthood (248), which is a critical period for young people who have diabetes. During this period of major life transitions, youth may begin to move out of their parents' or caregivers' homes and become increasingly 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 stability; increased occurrence of acute complications; psychosocial, emotional, and behavioral challenges; and the emergence of chronic complications (249,250). The transfer period from pediatric to adult care is prone to fragmentation in health care delivery, which may adversely impact health care quality, cost, and outcomes (251). Worsening diabetes health outcomes during the transition to adult care and early adulthood have been documented (252,253).

Comprehensive and coordinated planning that begins in early adolescence is necessary to facilitate a seamless transition from pediatric to adult health care (249, 254). Research on effective interventions to promote successful transition to adult care is limited, although there are promising developments that may improve attendance at follow-up appointments and lower hospitalizations (255,256). Use of transition coordinators, technology to support communication with young adults, and other interventions may be useful in addressing the identified needs and preferences of young adults for transition (257) and in supporting successful establishment in adult care settings (258–261). Given the behavioral, psychosocial, and developmental factors that relate to this transition, diabetes care teams addressing transition should include physicians, certified diabetes care and education specialists, nurses, behavioral health professionals, registered dietitian nutritionists, and social workers (50,262). Resources to enhance social and peer support during the transition process may also be valuable (263). 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" (249). Ultimately, there is no age cutoff for youth with diabetes to transfer to adult diabetes care. The decision to transfer should be a collaborative process in which the youth with diabetes, their caregivers, and pediatric diabetes specialists discuss their readiness, preferences, and concerns to ensure that the transfer aligns with their needs and circumstances (256).

The Endocrine Society, in collaboration with the ADA and other organizations, has developed transition tools for clinicians and youth and families (254).

References

1. Centers for Disease Control and Prevention. U.S. COVID-19 Vaccine Product Information. 2024. 2024. Accessed 31 August 2024. Available from https://www.cdc.gov/vaccines/hcp/index.html
2. Chiang JL, Maahs DM, Garvey KC, et al. Type 1 diabetes in children and adolescents: a position statement by the American Diabetes Association. Diabetes Care 2018;41:2026–2044
3. Arslanian S, Bacha F, Grey M, Marcus MD, White NH, Zeitler P. Evaluation and management of youth-onset type 2 diabetes: a position statement by the American Diabetes Association. Diabetes Care 2018;41:2648–2668
4. Lawrence JM, Divers J, Isom S, et al.; SEARCH for Diabetes in Youth Study Group. Trends in prevalence of type 1 and type 2 diabetes in children and adolescents in the US, 2001-2017. JAMA 2021;326:717–727
5. Leslie RD, Evans-Molina C, Freund-Brown J, et al. Adult-onset type 1 diabetes: current understanding and challenges. Diabetes Care 2021; 44:2449–2456
6. Barnea-Goraly N, Raman M, Mazaika P, et al.; Diabetes Research in Children Network (DirecNet). Alterations in white matter structure in young children with type 1 diabetes. Diabetes Care 2014; 37:332–340
7. Cameron FJ, Scratch SE, Nadebaum C, et al.; DKA Brain Injury Study Group. Neurological consequences of diabetic ketoacidosis at initial presentation of type 1 diabetes in a prospective cohort study of children. Diabetes Care 2014;37: 1554–1562
8. Markowitz JT, Garvey KC, Laffel LMB. Developmental changes in the roles of patients and families in type 1 diabetes management. Curr Diabetes Rev 2015;11:231–238
9. Liu LL, Lawrence JM, Davis C, et al.; SEARCH for Diabetes in Youth Study Group. Prevalence of overweight and obesity in youth with diabetes in USA: the SEARCH for Diabetes in Youth study. Pediatr Diabetes 2010;11:4–11

10. Driscoll KA, Volkening LK, Haro H, et al. Are children with type 1 diabetes safe at school? Examining parent perceptions. Pediatr Diabetes 2015;16:613–620
11. Cogen F, Rodriguez H, March CA, et al. Diabetes care in the school setting: a statement of the American Diabetes Association. Diabetes Care 2024;47:2050–2061
12. Mehta SN, Volkening LK, Anderson BJ, et al.; Family Management of Childhood Diabetes Study Steering Committee. Dietary behaviors predict glycemic control in youth with type 1 diabetes. Diabetes Care 2008;31:1318–1320
13. Bell KJ, Smart CE, Steil GM, Brand-Miller JC, King B, Wolpert HA. Impact of fat, protein, and glycemic index on postprandial glucose control in type 1 diabetes: implications for intensive diabetes management in the continuous glucose monitoring era. Diabetes Care 2015;38:1008–1015
14. Smith TA, Marlow AA, King BR, Smart CE. Insulin strategies for dietary fat and protein in type 1 diabetes: a systematic review. Diabet Med 2021;38:e14641
15. Paterson MA, Smart CEM, Lopez PE, et al. Increasing the protein quantity in a meal results in dose-dependent effects on postprandial glucose levels in individuals with type 1 diabetes mellitus. Diabet Med 2017;34:851–854
16. Paterson MA, King BR, Smart CEM, Smith T, Rafferty J, Lopez PE. Impact of dietary protein on postprandial glycaemic control and insulin requirements in type 1 diabetes: a systematic review. Diabet Med 2019;36:1585–1599
17. Smith TA, Blowes AA, King BR, Howley PP, Smart CE. Families' reports of problematic foods, management strategies and continuous glucose monitoring in type 1 diabetes: a cross-sectional study. Nutr Diet 2021;78:449–457
18. Steiman De Visser H, Fast I, Brunton N, et al. Cardiorespiratory fitness and physical activity in pediatric diabetes: a systemic review and meta-analysis. JAMA Netw Open 2024;7:e240235
19. Riddell MC, Gallen IW, Smart CE, et al. Exercise management in type 1 diabetes: a consensus statement. Lancet Diabetes Endocrinol 2017;5:377–390
20. Colberg SR, Sigal RJ, Yardley JE, et al. Physical activity/exercise and diabetes: a position statement of the American Diabetes Association. Diabetes Care 2016;39:2065–2079
21. Moser O, Riddell MC, Eckstein ML, et al. Glucose management for exercise using continuous glucose monitoring (CGM) and intermittently scanned CGM (isCGM) systems in type 1 diabetes: position statement of the European Association for the Study of Diabetes (EASD) and of the International Society for Pediatric and Adolescent Diabetes (ISPAD) endorsed by JDRF and supported by the American Diabetes Association (ADA). Diabetologia 2020;63:2501–2520
22. Shorey S, Ng ED, Law EC, Wong JCM, Loke KY, Tam WWS. Physical activity and nutrition interventions for type 1 diabetes: a meta-analysis. Pediatrics 2022;150:e2022056540
23. Zaharieva DP, Morrison D, Paldus B, Lal RA, Buckingham BA, O'Neal DN. Practical aspects and exercise safety benefits of automated insulin delivery systems in type 1 diabetes. Diabetes Spectr 2023;36:127–136
24. U.S. Department of Health and Human Services. Physical Activity Guidelines for Americans. Accessed 31 August 2024. Available from https://health.gov/our-work/nutrition-physical-activity/physical-activity-guidelines
25. Sherr JL, Bergford S, Gal RL, et al. Exploring factors that influence postexercise glycemia in youth with type 1 diabetes in the real world: the Type 1 Diabetes Exercise Initiative Pediatric (T1DEXIP) study. Diabetes Care 2024;47:849–857
26. Riddell MC, Gal RL, Bergford S, et al. The acute effects of real-world physical activity on glycemia in adolescents with type 1 diabetes: the Type 1 Diabetes Exercise Initiative Pediatric (T1DEXIP) study. Diabetes Care 2024;47:132–139
27. Eckstein ML, Weilguni B, Tauschmann M, et al. Time in range for closed-loop systems versus standard of care during physical exercise in people with type 1 diabetes: a systematic review and meta-analysis. J Clin Med 2021;10:2445
28. Da Prato G, Pasquini S, Rinaldi E, et al. Accuracy of CGM systems during continuous and interval exercise in adults with type 1 diabetes. J Diabetes Sci Technol 2022;16:1436–1443
29. Moser O, Mader JK, Tschakert G, et al. Accuracy of continuous glucose monitoring (CGM) during continuous and high-intensity interval exercise in patients with type 1 diabetes mellitus. Nutrients 2016;8:489
30. Bally L, Zueger T, Pasi N, Carlos C, Paganini D, Stettler C. Accuracy of continuous glucose monitoring during differing exercise conditions. Diabetes Res Clin Pract 2016;112:1–5
31. Ajčević M, Candido R, Assaloni R, Accardo A, Francescato MP. Personalized approach for the management of exercise-related glycemic imbalances in type 1 diabetes: comparison with reference method. J Diabetes Sci Technol 2021;15:1153–1160
32. Baker LB, Rollo I, Stein KW, Jeukendrup AE. Acute effects of carbohydrate supplementation on intermittent sports performance. Nutrients 2015;7:5733–5763
33. Redondo MJ, Libman I, Cheng P, et al.; Pediatric Diabetes Consortium. Racial/ethnic minority youth with recent-onset type 1 diabetes have poor prognostic factors. Diabetes Care 2018;41:1017–1024
34. DuBose SN, Hermann JM, Tamborlane WV, et al.; Type 1 Diabetes Exchange Clinic Network and Diabetes Prospective Follow-up Registry. Obesity in youth with type 1 diabetes in Germany, Austria, and the United States. J Pediatr 2015;167:627–632
35. Corbin KD, Driscoll KA, Pratley RE, Smith SR, Maahs DM, Mayer-Davis EJ; Advancing Care for Type 1 Diabetes and Obesity Network (ACT1ON). Obesity in type 1 diabetes: pathophysiology, clinical impact, and mechanisms. Endocr Rev 2018;39:629–663
36. Redondo MJ, Foster NC, Libman IM, et al. Prevalence of cardiovascular risk factors in youth with type 1 diabetes and elevated body mass index. Acta Diabetol 2016;53:271–277
37. Lawlor MT, Evert AB, Hanson JH, et al.; American Association of Diabetes Educators. Management of children with diabetes in the school setting. Diabetes Educ 2018;44:51–56
38. March C, Sherman J, Bannuru RR, et al. Care of young children with diabetes in the childcare and community setting: a statement of the American Diabetes Association. Diabetes Care 2023;46:2102–2111
39. Hilliard ME, De Wit M, Wasserman RM, et al. Screening and support for emotional burdens of youth with type 1 diabetes: strategies for diabetes care providers. Pediatr Diabetes 2018;19:534–543
40. Hill-Briggs F, Adler NE, Berkowitz SA, et al. Social determinants of health and diabetes: a scientific review. Diabetes Care 2020;44:258–279
41. Monaghan M, Mara CA, Kichler JC, et al. Multisite examination of depression screening scores and correlates among adolescents and young adults with type 2 diabetes. Can J Diabetes 2021;45:411–416
42. Young-Hyman D, de Groot M, Hill-Briggs F, Gonzalez JS, Hood K, Peyrot M. Psychosocial care for people with diabetes: a position statement of the American Diabetes Association. Diabetes Care 2016;39:2126–2140
43. Evans MA, Weil LEG, Shapiro JB, et al. Psychometric properties of the parent and child problem areas in diabetes measures. J Pediatr Psychol 2019;44:703–713
44. Mangione CM, Barry MJ, Nicholson WK, et al.; US Preventive Services Task Force. Screening for depression and suicide risk in children and adolescents: US Preventive Services Task Force Recommendation Statement. JAMA 2022;328:1534–1542
45. Mangione CM, Barry MJ, Nicholson WK, et al.; US Preventive Services Task Force. Screening for anxiety in children and adolescents: US Preventive Services Task Force Recommendation Statement. JAMA 2022;328:1438–1444
46. Gonder-Frederick L, Nyer M, Shepard JA, Vajda K, Clarke W. Assessing fear of hypoglycemia in children with type 1 diabetes and their parents. Diabetes Manag (Lond) 2011;1:627–639
47. Pursey KM, Hart M, Jenkins L, McEvoy M, Smart CE. Screening and identification of disordered eating in people with type 1 diabetes: a systematic review. J Diabetes Complications 2020;34:107522
48. Wisting L, Frøisland DH, Skrivarhaug T, Dahl-Jørgensen K, Rø O. Disturbed eating behavior and omission of insulin in adolescents receiving intensified insulin treatment: a nationwide population-based study. Diabetes Care 2013;36:3382–3387
49. Inverso H, Moore HR, Lupini F, et al. Mindfulness-based interventions: focus on pediatric type 1 and type 2 diabetes. Curr Diab Rep 2022;22:493–500
50. Kichler JC, Harris MA, Weissberg-Benchell J. Contemporary roles of the pediatric psychologist in diabetes care. Curr Diabetes Rev 2015;11:210–221
51. Winkley K, Upsher R, Stahl D, et al. Psychological interventions to improve self-management of type 1 and type 2 diabetes: a systematic review. Health Technol Assess 2020;24:1–232
52. Hilliard ME, Powell PW, Anderson BJ. Evidence-based behavioral interventions to promote diabetes management in children, adolescents, and families. Am Psychol 2016;71:590–601
53. Katz ML, Volkening LK, Butler DA, Anderson BJ, Laffel LM. Family-based psychoeducation and Care Ambassador intervention to improve glycemic control in youth with type 1 diabetes: a randomized trial. Pediatr Diabetes 2014;15:142–150
54. Laffel LMB, Vangsness L, Connell A, Goebel-Fabbri A, Butler D, Anderson BJ. Impact of ambulatory, family-focused teamwork intervention

on glycemic control in youth with type 1 diabetes. J Pediatr 2003;142:409–416
55. Hickling A, Dingle GA, Barrett HL, Cobham VE. Systematic review: diabetes family conflict in young people with type 1 diabetes. J Pediatr Psychol 2021;46:1091–1109
56. Van Vleet M, Helgeson VS. Friend and peer relationships among youth with type 1 diabetes. In *Behavioral diabetes: Social ecological perspectives for pediatric and adult populations*. Cham, Switzerland, Springer Nature Switzerland AG, 2020, pp. 121–138.
57. Chiang JL, Kirkman MS, Laffel LMB, Peters AL; Type 1 Diabetes Sourcebook Authors. Type 1 diabetes through the life span: a position statement of the American Diabetes Association. Diabetes Care 2014;37:2034–2054
58. Kucera M, Sullivan AL. The educational implications of type I diabetes mellitus: a review of research and recommendations for school psychological practice. Psychol Schools 2011;48: 587–603
59. Kuther TL. Medical decision-making and minors: issues of consent and assent. Adolescence 2003;38:343–358
60. Wysocki T, James L, Milkes A, et al. Electronically verified use of internet-based, multimedia decision aids by adolescents with type 1 diabetes and their caregivers. MDM Policy Pract 2018;3:2381468318769857
61. Hannon TS, Moore CM, Cheng ER, et al. Codesigned shared decision-making diabetes management plan tool for adolescents with type 1 diabetes mellitus and their parents: prototype development and pilot test. J Participat Med 2018;10:e8
62. Hannon TS, Yazel-Smith LG, Hatton AS, et al. Advancing diabetes management in adolescents: comparative effectiveness of mobile self-monitoring blood glucose technology and family-centered goal setting. Pediatr Diabetes 2018;19:776–781
63. Pugh A, Ritholz MD, Beverly EA. Similarities and differences in diabetes diagnosis stories among adults with type 1 or type 2 diabetes in Appalachian Ohio. Clin Diabetes 2024;42:408–418
64. Coleman DL, Rosoff PM. The legal authority of mature minors to consent to general medical treatment. Pediatrics 2013;131:786–793
65. Charron-Prochownik D, Sereika SM, Becker D, et al. Long-term effects of the booster-enhanced READY-Girls preconception counseling program on intentions and behaviors for family planning in teens with diabetes. Diabetes Care 2013;36:3870–3874
66. American Diabetes Association. Reproductive Health for Teen Girls with Diabetes. Accessed 31 August 2024. Available from https://diabetes.org/health-wellness/sexual-health/reproductive-health-teen-girls-diabetes
67. Gerhardsson P, Schwandt A, Witsch M, et al.; SWEET Study Group. The SWEET Project 10-year benchmarking in 19 countries worldwide is associated with improved hba1c and increased use of diabetes technology in youth with type 1 diabetes. Diabetes Technol Ther 2021;23:491–499
68. Miller KM, Beck RW, Foster NC, Maahs DM. HbA1c levels in type 1 diabetes from early childhood to older adults: a deeper dive into the influence of technology and socioeconomic status on HbA1c in the T1D Exchange clinic registry findings. Diabetes Technol Ther 2020;22: 645–650
69. Diabetes Control and Complications Trial Research Group. Effect of intensive diabetes treatment on the development and progression of long-term complications in adolescents with insulin-dependent diabetes mellitus: Diabetes Control and Complications Trial. J Pediatr 1994; 125:177–188
70. White NH, Cleary PA, Dahms W, Goldstein D, Malone J, Tamborlane WV; Diabetes Control and Complications Trial (DCCT)/Epidemiology of Diabetes Interventions and Complications (EDIC) Research Group. Beneficial effects of intensive therapy of diabetes during adolescence: outcomes after the conclusion of the Diabetes Control and Complications Trial (DCCT). J Pediatr 2001;139: 804–812
71. Carlsen S, Skrivarhaug T, Thue G, et al. Glycemic control and complications in patients with type 1 diabetes—a registry-based longitudinal study of adolescents and young adults. Pediatr Diabetes 2017;18:188–195
72. Genuth SM, Backlund J-YC, Bayless M, et al.; DCCT/EDIC Research Group. Effects of prior intensive versus conventional therapy and history of glycemia on cardiac function in type 1 diabetes in the DCCT/EDIC. Diabetes 2013;62:3561–3569
73. Writing Team for the Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Research Group. Sustained effect of intensive treatment of type 1 diabetes mellitus on development and progression of diabetic nephropathy: the Epidemiology of Diabetes Interventions and Complications (EDIC) study. JAMA 2003;290:2159–2167
74. Gubitosi-Klug RA, Sun W, Cleary PA, et al.; Writing Team for the DCCT/EDIC Research Group. Effects of prior intensive insulin therapy and risk factors on patient-reported visual function outcomes in the Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) cohort. JAMA Ophthalmol 2016;134:137–145
75. Orchard TJ, Nathan DM, Zinman B, et al.; Writing Group for the DCCT/EDIC Research Group. Association between 7 years of intensive treatment of type 1 diabetes and long-term mortality. JAMA 2015;313:45–53
76. Mauras N, Buckingham B, White NH, et al.; Diabetes Research in Children Network (DirecNet). Impact of type 1 diabetes in the developing brain in children: a longitudinal study. Diabetes Care 2021;44:983–992
77. Pourabbasi A, Tehrani-Doost M, Qavam SE, Arzaghi SM, Larijani B. Association of diabetes mellitus and structural changes in the central nervous system in children and adolescents: a systematic review. J Diabetes Metab Disord 2017; 16:10
78. Brown SA, Kovatchev BP, Raghinaru D, et al.; iDCL Trial Research Group. Six-month randomized, multicenter trial of closed-loop control in type 1 diabetes. N Engl J Med 2019;381:1707–1717
79. Bergenstal RM, Nimri R, Beck RW, et al. A comparison of two hybrid closed-loop systems in adolescents and young adults with type 1 diabetes (FLAIR): a multicentre, randomised, crossover trial. Lancet 2021;397:208–219
80. Breton MD, Kanapka LG, Beck RW, et al. A randomized trial of closed-loop control in children with type 1 diabetes. N Engl J Med 2020;383: 836–845
81. Dorando E, Haak T, Pieper D. Continuous glucose monitoring for glycemic control in children and adolescents diagnosed with diabetes type 1: a systematic review and meta-analysis. Exp Clin Endocrinol Diabetes 2022;130: 61–72
82. Brown SA, Forlenza GP, Bode BW, et al.; Omnipod 5 Research Group. Multicenter trial of a tubeless, on-body automated insulin delivery system with customizable glycemic targets in pediatric and adult participants with type 1 diabetes. Diabetes Care 2021;44:1630–1640
83. Carlson AL, Sherr JL, Shulman DI, et al.; MiniMed AHCL Study Group. Safety and glycemic outcomes during the MiniMed advanced hybrid closed-loop system pivotal trial in adolescents and adults with type 1 diabetes. Diabetes Technol Ther 2022;24:178–189
84. Prahalad P, Ding VY, Zaharieva DP, et al. Teamwork, targets, technology, and tight control in newly diagnosed type 1 diabetes: the Pilot 4T study. J Clin Endocrinol Metab 2022;107: 998–1008
85. Champakanath A, Akturk HK, Alonso GT, Snell-Bergeon JK, Shah VN. Continuous glucose monitoring initiation within first year of type 1 diabetes diagnosis is associated with improved glycemic outcomes: 7-year follow-up study. Diabetes Care 2022;45:750–753
86. Johnson SR, Holmes-Walker DJ, Chee M, et al. Universal subsidized continuous glucose monitoring funding for young people with type 1 diabetes: uptake and outcomes over 2 years, a population-based study. Diabetes Care 2022;45: 391–397
87. Rose S, Styles SE, Wiltshire EJ, et al. Use of intermittently scanned continuous glucose monitoring in young people with high-risk type 1 diabetes-extension phase outcomes following a 6-month randomized control trial. Diabet Med 2022;39:e14756
88. Beato-Víbora PI, Gallego-Gamero F, Ambrojo-López A, Gil-Poch E, Martín-Romo I, Arroyo-Díez FJ. Rapid improvement in time in range after the implementation of an advanced hybrid closed-loop system in adolescents and adults with type 1 diabetes. Diabetes Technol Ther 2021;23:609–615
89. Breton MD, Kovatchev BP. One year real-world use of the Control-IQ advanced hybrid closed-loop technology. Diabetes Technol Ther 2021;23:601–608
90. Forlenza GP, Ekhlaspour L, DiMeglio LA, et al. Glycemic outcomes of children 2-6 years of age with type 1 diabetes during the pediatric MiniMed 670G system trial. Pediatr Diabetes 2022; 23:324–329
91. Messer LH, Berget C, Pyle L, et al. Real-world use of a new hybrid closed loop improves glycemic control in youth with type 1 diabetes. Diabetes Technol Ther 2021;23:837–843
92. Varimo T, Pulkkinen M, Hakonen E, Hero M, Miettinen PJ, Tuomaala A. First year on commercial hybrid closed-loop system—experience on 111 children and adolescents with type 1 diabetes. Pediatr Diabetes 2021;22:909–915
93. Ware J, Allen JM, Boughton CK, et al.; KidsAP Consortium. Randomized trial of closed-loop control in very young children with type 1 diabetes. N Engl J Med 2022;386:209–219
94. Isganaitis E, Raghinaru D, Ambler-Osborn L, et al.; iDCL Trial Research Group. Closed-loop insulin therapy improves glycemic control in

adolescents and young adults: outcomes from the international diabetes closed-loop trial. Diabetes Technol Ther 2021;23:342–349
95. Sherr JL, Bode BW, Forlenza GP, et al.; Omnipod 5 in Preschoolers Study Group. Safety and glycemic outcomes with a tubeless automated insulin delivery system in very young children with type 1 diabetes: a single-arm multicenter clinical trial. Diabetes Care 2022;45:1907–1910
96. Marigliano M, Eckert AJ, Guness PK, et al.; SWEET Study Group. Association of the use of diabetes technology with HbA1c and BMI-SDS in an international cohort of children and adolescents with type 1 diabetes: the SWEET project experience. Pediatr Diabetes 2021;22:1120–1128
97. Bergenstal RM, Garg S, Weinzimer SA, et al. Safety of a hybrid closed-loop insulin delivery system in patients with type 1 diabetes. JAMA 2016;316:1407–1408
98. Thabit H, Tauschmann M, Allen JM, et al. Home use of an artificial beta cell in type 1 diabetes. N Engl J Med 2015;373:2129–2140
99. Kovatchev B, Cheng P, Anderson SM, et al.; Control to Range Study Group. Feasibility of Long-term closed-loop control: a multicenter 6-month trial of 24/7 automated insulin delivery. Diabetes Technol Ther 2017;19:18–24
100. Cooper MN, O'Connell SM, Davis EA, Jones TW. A population-based study of risk factors for severe hypoglycaemia in a contemporary cohort of childhood-onset type 1 diabetes. Diabetologia 2013;56:2164–2170
101. Haynes A, Hermann JM, Miller KM, et al.; T1D Exchange. Severe hypoglycemia rates are not associated with HbA1c: a cross-sectional analysis of 3 contemporary pediatric diabetes registry databases. Pediatr Diabetes 2017;18:643–650
102. Haynes A, Hermann JM, Clapin H, et al. Decreasing trends in mean HbA1c are not associated with increasing rates of severe hypoglycemia in children: a longitudinal analysis of two contemporary population-based pediatric type 1 diabetes registries from Australia and Germany/Austria between 1995 and 2016. Dia-betes Care 2019;42:1630–1636
103. Fredheim S, Johansen A, Thorsen SU, et al.; Danish Society for Diabetes in Childhood and Adolescence. Nationwide reduction in the frequency of severe hypoglycemia by half. Acta Diabetol 2015;52:591–599
104. Birkebaek NH, Drivvoll AK, Aakeson K, et al. Incidence of severe hypoglycemia in children with type 1 diabetes in the Nordic countries in the period 2008-2012: association with hemoglobin A 1c and treatment modality. BMJ Open Diabetes Res Care 2017;5:e000377
105. Ly TT, Nicholas JA, Retterath A, Lim EM, Davis EA, Jones TW. Effect of sensor-augmented insulin pump therapy and automated insulin suspension vs standard insulin pump therapy on hypoglycemia in patients with type 1 diabetes: a randomized clinical trial. JAMA 2013;310:1240–1247
106. Karges B, Kapellen T, Wagner VM, et al.; DPV Initiative. Glycated hemoglobin A1c as a risk factor for severe hypoglycemia in pediatric type 1 diabetes. Pediatr Diabetes 2017;18:51–58
107. Karges B, Rosenbauer J, Kapellen T, et al. Hemoglobin A1c levels and risk of severe hypoglycemia in children and young adults with type 1 diabetes from Germany and Austria: a trend analysis in a cohort of 37,539 patients between 1995 and 2012. PLoS Med 2014;11:e1001742
108. Johnson SR, Cooper MN, Jones TW, Davis EA. Long-term outcome of insulin pump therapy in children with type 1 diabetes assessed in a large population-based case-control study. Diabetologia 2013;56:2392–2400
109. Swift PGF, Skinner TC, De Beaufort CE, et al.; Hvidoere Study Group on Childhood Diabetes. Target setting in intensive insulin management is associated with metabolic control: the Hvidoere childhood diabetes study group centre differences study 2005. Pediatr Diabetes 2010 2009;11:271–278
110. Laffel LM, Kanapka LG, Beck RW, et al.; CGM Intervention in Teens and Young Adults with T1D (CITY) Study Group. Effect of continuous glucose monitoring on glycemic control in adolescents and young adults with type 1 diabetes: a randomized clinical trial. JAMA 2020;323:2388–2396
111. Levine BS, Anderson BJ, Butler DA, Antisdel JE, Brackett J, Laffel LM. Predictors of glycemic control and short-term adverse outcomes in youth with type 1 diabetes. J Pediatr 2001;139:197–203
112. Miller KM, Beck RW, Bergenstal RM, et al.; T1D Exchange Clinic Network. Evidence of a strong association between frequency of self-monitoring of blood glucose and hemoglobin A1c levels in T1D exchange clinic registry participants. Diabetes Care 2013;36:2009–2014
113. Patton SR, Noser AE, Youngkin EM, Majidi S, Clements MA. Early initiation of diabetes devices relates to improved glycemic control in children with recent-onset type 1 diabetes mellitus. Diabetes Technol Ther 2019;21:379–384
114. Strategies to Enhance New CGM Use in Early Childhood (SENCE) Study Group. A randomized clinical trial assessing continuous glucose monitoring (CGM) use with standardized education with or without a family behavioral intervention compared with fingerstick blood glucose monitoring in very young children with type 1 diabetes. Diabetes Care 2021;44:464–472
115. Battelino T, Danne T, Bergenstal RM, et al. Clinical targets for continuous glucose monitoring data interpretation: recommendations from the international consensus on time in range. Diabetes Care 2019;42:1593–1603
116. Vigersky RA, McMahon C. The relationship of hemoglobin A1C to time-in-range in patients with diabetes. Diabetes Technol Ther 2019;21:81–85
117. Petersson J, Åkesson K, Sundberg F, Särnblad S. Translating glycated hemoglobin A1c into time spent in glucose target range: a multicenter study. Pediatr Diabetes 2019;20:339–344
118. Warncke K, Fröhlich-Reiterer EE, Thon A, Hofer SE, Wiemann D, Holl RW; DPV Initiative of the German Working Group for Pediatric Diabetology; German BMBF Competence Network for Diabetes Mellitus. Polyendocrinopathy in children, adolescents, and young adults with type 1 diabetes: a multicenter analysis of 28,671 patients from the German/Austrian DPV. Diabetes Care 2010;33:2010–2012
119. Nederstigt C, Uitbeijerse BS, Janssen LGM, Corssmit EPM, de Koning EJP, Dekkers OM. Associated auto-immune disease in type 1 diabetes patients: a systematic review and meta-analysis. Eur J Endocrinol 2019;180:135–144
120. Kozhakhmetova A, Wyatt RC, Caygill C, et al. A quarter of patients with type 1 diabetes have co-existing non-islet autoimmunity: the findings of a UK population-based family study. Clin Exp Immunol 2018;192:251–258
121. Hughes JW, Riddlesworth TD, DiMeglio LA, Miller KM, Rickels MR, McGill JB; T1D Exchange Clinic Network. Autoimmune diseases in children and adults with type 1 diabetes from the T1D Exchange clinic registry. J Clin Endocrinol Metab 2016;101:4931–4937
122. Kahaly GJ, Hansen MP. Type 1 diabetes associated autoimmunity. Autoimmun Rev 2016;15:644–648
123. Roldán MB, Alonso M, Barrio R. Thyroid autoimmunity in children and adolescents with type 1 diabetes mellitus. Diabetes Nutr Metab 1999;12:27–31
124. Shun CB, Donaghue KC, Phelan H, Twigg SM, Craig ME. Thyroid autoimmunity in type 1 diabetes: systematic review and meta-analysis. Diabet Med 2014;31:126–135
125. Triolo TM, Armstrong TK, McFann K, et al. Additional autoimmune disease found in 33% of patients at type 1 diabetes onset. Diabetes Care 2011;34:1211–1213
126. Kordonouri O, Deiss D, Danne T, Dorow A, Bassir C, Grüters-Kieslich A. Predictivity of thyroid autoantibodies for the development of thyroid disorders in children and adolescents with type 1 diabetes. Diabet Med 2002;19:518–521
127. Dost A, Rohrer TR, Fröhlich-Reiterer E, et al.; DPV Initiative and the German Competence Network Diabetes Mellitus. Hyperthyroidism in 276 children and adolescents with type 1 diabetes from Germany and Austria. Horm Res Paediatr 2015;84:190–198
128. Jonsdottir B, Larsson C, Carlsson A, et al.; Better Diabetes Diagnosis Study Group. Thyroid and islet autoantibodies predict autoimmune thyroid disease at type 1 diabetes diagnosis. J Clin Endocrinol Metab 2017;102:1277–1285
129. Mohn A, Di Michele S, Di Luzio R, Tumini S, Chiarelli F. The effect of subclinical hypothyroidism on metabolic control in children and adolescents with type 1 diabetes mellitus. Diabet Med 2002;19:70–73
130. Denzer C, Karges B, Näke A, et al.; DPV Initiative and the BMBF-Competence Network Diabetes Mellitus. Subclinical hypothyroidism and dyslipidemia in children and adolescents with type 1 diabetes mellitus. Eur J Endocrinol 2013;168:601–608
131. Holmes GKT. Screening for coeliac disease in type 1 diabetes. Arch Dis Child 2002;87:495–498
132. Pham-Short A, Donaghue KC, Ambler G, Phelan H, Twigg S, Craig ME. Screening for celiac disease in type 1 diabetes: a systematic review. Pediatrics 2015;136:e170–e176
133. Cerutti F, Bruno G, Chiarelli F, Lorini R, Meschi F, Sacchetti C; Diabetes Study Group of Italian Society of Pediatric Endocrinology and Diabetology. Younger age at onset and sex predict celiac disease in children and adolescents with type 1 diabetes: an Italian multicenter study. Diabetes Care 2004;27:1294–1298
134. Taczanowska A, Schwandt A, Amed S, et al. Celiac disease in children with type 1 diabetes varies around the world: an international, cross-sectional study of 57 375 patients from the SWEET registry. J Diabetes 2021;13:448–457
135. Simmons JH, Foster NC, Riddlesworth TD, et al.; T1D Exchange Clinic Network. Sex- and age-dependent effects of celiac disease on

growth and weight gain in children with type 1 diabetes: analysis of the Type 1 Diabetes Exchange Clinic Registry. Pediatr Diabetes 2018; 19:741–748
136. Margoni D, Chouliaras G, Duscas G, et al. Bone health in children with celiac disease assessed by dual x-ray absorptiometry: effect of gluten-free diet and predictive value of serum biochemical indices. J Pediatr Gastroenterol Nutr 2012;54:680–684
137. Mollazadegan K, Kugelberg M, Montgomery SM, Sanders DS, Ludvigsson J, Ludvigsson JF. A population-based study of the risk of diabetic retinopathy in patients with type 1 diabetes and celiac disease. Diabetes Care 2013;36:316–321
138. Rubio-Tapia A, Hill ID, Kelly CP, Calderwood AH, Murray JA. ACG clinical guidelines: diagnosis and management of celiac disease. Am J Gastroenterol 2013;108:656–676
139. Paul SP, Sandhu BK, Spray CH, Basude D, Ramani P. Evidence supporting serology-based pathway for diagnosing celiac disease in asymptomatic children from high-risk groups. J Pediatr Gastroenterol Nutr 2018;66:641–644
140. Abid N, McGlone O, Cardwell C, McCallion W, Carson D. Clinical and metabolic effects of gluten free diet in children with type 1 diabetes and coeliac disease. Pediatr Diabetes 2011;12: 322–325
141. Flynn JT, Kaelber DC, Baker-Smith CM, et al.; Subcommittee on Screening and Management of High Blood Pressure in Children. Clinical practice guideline for screening and management of high blood pressure in children and adolescents. Pediatrics 2017;140:e20171904
142. Marcovecchio ML, Chiesa ST, Bond S, et al.; AdDIT Study Group. ACE inhibitors and statins in adolescents with type 1 diabetes. N Engl J Med 2017;377:1733–1745
143. de Ferranti SD, de Boer IH, Fonseca V, et al. Type 1 diabetes mellitus and cardiovascular disease: a scientific statement from the American Heart Association and American Diabetes Association. Diabetes Care 2014;37:2843–2863
144. Rodriguez BL, Fujimoto WY, Mayer-Davis EJ, et al.; SEARCH for Diabetes in Youth Study. Prevalence of cardiovascular disease risk factors in U.S. children and adolescents with diabetes: the SEARCH for diabetes in youth study. Diabetes Care 2006;29:1891–1896
145. Margeirsdottir HD, Larsen JR, Brunborg C, Overby NC, Dahl-Jørgensen K; Norwegian Study Group for Childhood Diabetes. High prevalence of cardiovascular risk factors in children and adolescents with type 1 diabetes: a population-based study. Diabetologia 2008;51:554–561
146. Schwab KO, Doerfer J, Hecker W, et al.; DPV Initiative of the German Working Group for Pediatric Diabetology. Spectrum and prevalence of atherogenic risk factors in 27,358 children, adolescents, and young adults with type 1 diabetes. Diabetes Care 2006;29:218–225.
147. Singh TP, Groehn H, Kazmers A. Vascular function and carotid intimal-medial thickness in children with insulin-dependent diabetes mellitus. J Am Coll Cardiol 2003;41:661–665
148. Haller MJ, Stein J, Shuster J, et al. Peripheral artery tonometry demonstrates altered endothelial function in children with type 1 diabetes. Pediatr Diabetes 2007;8:193–198
149. Urbina EM, Wadwa RP, Davis C, et al. Prevalence of increased arterial stiffness in children with type 1 diabetes mellitus differs by measurement site and sex: the SEARCH for Diabetes in Youth Study. J Pediatr 2010;156: 731–737.e1
150. Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents; National Heart, Lung, and Blood Institute. Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary report. Pediatrics 2011;128:S213–256
151. Kershnar AK, Daniels SR, Imperatore G, et al. Lipid abnormalities are prevalent in youth with type 1 and type 2 diabetes: the SEARCH for Diabetes in Youth Study. J Pediatr 2006;149: 314–319
152. Blaha MJ, Blumenthal RS, Brinton EA, Jacobson TA; National Lipid Association Taskforce on Non-HDL Cholesterol. The importance of non-HDL cholesterol reporting in lipid management. J Clin Lipidol 2008;2:267–273
153. Maahs DM, Hermann JM, DuBose SN, et al.; T1D Exchange Clinic Network. Contrasting the clinical care and outcomes of 2,622 children with type 1 diabetes less than 6 years of age in the United States T1D Exchange and German/Austrian DPV registries. Diabetologia 2014;57: 1578–1585
154. Daniels SR, Greer FR; Committee on Nutrition. Lipid screening and cardiovascular health in childhood. Pediatrics 2008;122:198–208
155. de Ferranti SD, Steinberger J, Ameduri R, et al. Cardiovascular risk reduction in high-risk pediatric patients: a scientific statement from the American Heart Association. Circulation 2019;139: e603–e634
156. Cadario F, Prodam F, Pasqualicchio S, et al. Lipid profile and nutritional intake in children and adolescents with type 1 diabetes improve after a structured dietician training to a Mediterranean-style diet. J Endocrinol Invest 2012;35:160–168
157. Salem MA, AboElAsrar MA, Elbarbary NS, ElHilaly RA, Refaat YM. Is exercise a therapeutic tool for improvement of cardiovascular risk factors in adolescents with type 1 diabetes mellitus? A randomised controlled trial. Diabetol Metab Syndr 2010;2:47
158. Maahs DM, Dabelea D, D'Agostino RB, Jr, et al. Glucose control predicts 2-year change in lipid profile in youth with type 1 diabetes. J Pediatr 2013;162:101–107.e1
159. Kavey R-EW, Allada V, Daniels SR, et al. Cardiovascular risk reduction in high-risk pediatric patients. Circulation 2006;114:2710–2738
160. McCrindle BW, Urbina EM, Dennison BA, et al. Drug therapy of high-risk lipid abnormalities in children and adolescents: a scientific statement from the American Heart Association Atherosclerosis, Hypertension, and Obesity in Youth Committee, Council of Cardiovascular Disease in the Young, with the Council on Cardiovascular Nursing. Circulation 2007;115:1948–1967
161. Luirink IK, Wiegman A, Kusters DM, et al. 20-Year follow-up of statins in children with familial hypercholesterolemia. N Engl J Med 2019; 381:1547–1556
162. AstraZeneca Canada Inc. Rosuvastatin product monograph. 2011. Accessed 31 August 2024. Available from https://www.astrazeneca.ca/content/dam/az-ca/downloads/productinformation/crestor-product-monograph-en.pdf
163. Daniels M, DuBose SN, Maahs DM, et al.; T1D Exchange Clinic Network. Factors associated with microalbuminuria in 7,549 children and adolescents with type 1 diabetes in the T1D Exchange clinic registry. Diabetes Care 2013;36:2639–2645
164. Schwartz GJ, Work DF. Measurement and estimation of GFR in children and adolescents. Clin J Am Soc Nephrol 2009;4:1832–1843
165. Inker LA, Schmid CH, Tighiouart H, et al.; CKD-EPI Investigators. Estimating glomerular filtration rate from serum creatinine and cystatin C. N Engl J Med 2012;367:20–29
166. Cho YH, Craig ME, Hing S, et al. Microvascular complications assessment in adolescents with 2- to 5-yr duration of type 1 diabetes from 1990 to 2006. Pediatr Diabetes 2011;12:682–689
167. Scanlon PH, Stratton IM, Bachmann MO, Jones C, Leese GP; Four Nations Diabetic Retinopathy Screening Study Group. Risk of diabetic retinopathy at first screen in children at 12 and 13 years of age. Diabet Med 2016;33: 1655–1658
168. Beauchamp G, Boyle CT, Tamborlane WV, et al. Treatable diabetic retinopathy is extremely rare among pediatric T1D Exchange clinic registry participants. Diabetes Care 2016;39:e218–e219
169. Nathan DM, Bebu I, Hainsworth D, et al.; DCCT/EDIC Research Group. Frequency of evidence-based screening for retinopathy in type 1 diabetes. N Engl J Med 2017;376:1507–1516
170. Gubitosi-Klug RA, Bebu I, White NH, et al.; Diabetes Control and Complications Trial (DCCT)/Epidemiology of Diabetes Interventions and Complications (EDIC) Research Group. Screening eye exams in youth with type 1 diabetes under 18 years of age: once may be enough? Pediatr Diabetes 2019;20:743–749
171. Wolf RM, Channa R, Liu TYA, et al. Autonomous artificial intelligence increases screening and follow-up for diabetic retinopathy in youth: the ACCESS randomized control trial. Nat Commun 2024;15:421
172. Jaiswal M, Divers J, Dabelea D, et al. Prevalence of and risk factors for diabetic peripheral neuropathy in youth with type 1 and type 2 diabetes: SEARCH for Diabetes in Youth Study. Diabetes Care 2017;40:1226–1232
173. Pop-Busui R, Boulton AJM, Feldman EL, et al. Diabetic neuropathy: a position statement by the American Diabetes Association. Diabetes Care 2017;40:136–154
174. Imperatore G, Boyle JP, Thompson TJ, et al.; SEARCH for Diabetes in Youth Study Group. Projections of type 1 and type 2 diabetes burden in the U.S. population aged <20 years through 2050. Diabetes Care 2012;35:2515–2520
175. Pettitt DJ, Talton J, Dabelea D, et al.; SEARCH for Diabetes in Youth Study Group. Prevalence of diabetes in U.S. youth in 2009: the SEARCH for diabetes in youth study. Diabetes Care 2014;37:402–408
176. Copeland KC, Zeitler P, Geffner M, et al. Characteristics of adolescents and youth with recent-onset type 2 diabetes: the TODAY cohort at baseline. J Clin Endocrinol Metab 2011;96: 159–167
177. Bjornstad P, Drews KL, Caprio S, et al.; TODAY Study Group. Long-term complications in youth-onset type 2 diabetes. N Engl J Med 2021; 385:416–426
178. Arslanian SA. Metabolic differences between Caucasian and African-American children and the

relationship to type 2 diabetes mellitus. J Pediatr Endocrinol Metab 2002;15(Suppl 1):509–517
179. Naughton MJ. Health-related quality of life of children and adolescents with type 1 or type 2 diabetes mellitus: SEARCH for Diabetes in Youth Study. Arch Pediatr Adolesc Med 2008;162:649–657
180. Wadden TA, Webb VL, Moran CH, Bailer BA. Lifestyle modification for obesity: new developments in diet, physical activity, and behavior therapy. Circulation 2012;125:1157–1170
181. Whalen DJ, Belden AC, Tillman R, Barch DM, Luby JL. Early adversity, psychopathology, and latent class profiles of global physical health from preschool through early adolescence. Psychosom Med 2016;78:1008–1018
182. Cioana M, Deng J, Nadarajah A, et al. The Prevalence of obesity among children with type 2 diabetes: a systematic review and meta-analysis. JAMA Netw Open 2022;5:e2247186
183. Srinivasan S, Chen L, Todd J, et al. The first genome-wide association study for type 2 diabetes in youth: the Progress in Diabetes Genetics in Youth (ProDiGY) Consortium. Diabetes 2021;70:996–1005
184. Perng W, Oken E, Dabelea D. Developmental overnutrition and obesity and type 2 diabetes in offspring. Diabetologia 2019;62:1779–1788
185. Tönnies T, Brinks R, Isom S, et al. Projections of type 1 and type 2 diabetes burden in the U.S. population aged <20 years through 2060: the SEARCH for Diabetes in Youth Study. Diabetes Care 2023;46:313–320
186. Buse JB, Kaufman FR, Linder B, Hirst K, El Ghormli L, Willi S; HEALTHY Study Group. Diabetes screening with hemoglobin A1c versus fasting plasma glucose in a multiethnic middle-school cohort. Diabetes Care 2013;36:429–435
187. Klingensmith GJ, Pyle L, Arslanian S, et al.; TODAY Study. The presence of GAD and IA-2 antibodies in youth with a type 2 diabetes phenotype. Diabetes Care 2010;33:1970–1975
188. Hannon TS, Arslanian SA. The changing face of diabetes in youth: lessons learned from studies of type 2 diabetes. Ann N Y Acad Sci 2015;1353:113–137
189. Kapadia C, Zeitler P; Drugs and Therapeutics Committee of the Pediatric Endocrine Society. Hemoglobin A1c measurement for the diagnosis of type 2 diabetes in children. Int J Pediatr Endocrinol 2012;2012:31
190. Wallace AS, Wang D, Shin J-I, Selvin E. Screening and diagnosis of prediabetes and diabetes in US children and adolescents. Pediatrics 2020;146:e20200265
191. Dabelea D, Rewers A, Stafford JM, et al.; SEARCH for Diabetes in Youth Study Group. Trends in the prevalence of ketoacidosis at diabetes diagnosis: the SEARCH for diabetes in youth study. Pediatrics 2014;133:e938–e945
192. Hutchins J, Barajas RA, Hale D, Escaname E, Lynch J. Type 2 diabetes in a 5-year-old and single center experience of type 2 diabetes in youth under 10. Pediatr Diabetes 2017;18:674–677
193. Ferrara CT, Geyer SM, Liu Y-F, et al.; Type 1 Diabetes TrialNet Study Group. Excess BMI in childhood: a modifiable risk factor for type 1 diabetes development? Diabetes Care 2017;40:698–701
194. Kubota-Mishra E, Huang X, Minard CG, et al.; RADIANT Study Group. High prevalence of A-β+ ketosis-prone diabetes in children with type 2 diabetes and diabetic ketoacidosis at diagnosis: evidence from the Rare and Atypical Diabetes Network (RADIANT). Pediatr Diabetes 2024;2024
195. TODAY Study Group. Safety and tolerability of the treatment of youth-onset type 2 diabetes: the TODAY experience. Diabetes Care 2013;36:1765–1771
196. TODAY Study Group. Retinopathy in youth with type 2 diabetes participating in the TODAY clinical trial. Diabetes Care 2013;36:1772–1774
197. TODAY Study Group. Lipid and inflammatory cardiovascular risk worsens over 3 years in youth with type 2 diabetes: the TODAY clinical trial. Diabetes Care 2013;36:1758–1764
198. TODAY Study Group. Rapid rise in hypertension and nephropathy in youth with type 2 diabetes: the TODAY clinical trial. Diabetes Care 2013;36:1735–1741
199. Zeitler P, Hirst K, Copeland KC, et al.; TODAY Study Group. HbA1c after a short period of monotherapy with metformin identifies durable glycemic control among adolescents with type 2 diabetes. Diabetes Care 2015;38:2285–2292
200. Grey M, Schreiner B, Pyle L. Development of a diabetes education program for youth with type 2 diabetes. Diabetes Educ 2009;35:108–116
201. American Diabetes Association. Be healthy today; be healthy for life. Accessed 31 August 2024. Available from http://main.diabetes.org/dorg/PDFs/Type-2-Diabetes-in-Youth/Type-2-Diabetes-in-Youth.pdf
202. Atkinson A, Radjenovic D. Meeting quality standards for self-management education in pediatric type 2 diabetes. Diabetes Spectrum 2007;20:40–46
203. Copeland KC, Silverstein J, Moore KR, et al.; American Academy of Pediatrics. Management of newly diagnosed type 2 diabetes mellitus (T2DM) in children and adolescents. Pediatrics 2013;131:364–382
204. Zeitler P, Hirst K, Pyle L, et al. A clinical trial to maintain glycemic control in youth with type 2 diabetes. N Engl J Med 2012;366:2247–2256
205. RISE Consortium. Impact of insulin and metformin versus metformin alone on β-cell function in youth with impaired glucose tolerance or recently diagnosed type 2 diabetes. Diabetes Care 2018;41:1717–1725
206. Tamborlane WV, Barrientos-Pérez M, Fainberg U, et al.; Ellipse Trial Investigators. Liraglutide in children and adolescents with type 2 diabetes. N Engl J Med 2019;381:637–646
207. U.S. Food and Drug Administration. FDA approves treatment for pediatric patients with type 2 diabetes. 2021. Accessed 31 August 2024. Available from https://content.govdelivery.com/accounts/USFDA/bulletins/2e98d66
208. U.S. Food and Drug Administration. FDA approves new treatment for pediatric patients with type 2 diabetes. 2019. Accessed 31 August 2024. Available from https://www.fda.gov/news-events/press-announcements/fda-approves-new-treatment-pediatric-patients-type-2-diabetes
209. Tamborlane WV, Bishai R, Geller D, et al. Once-weekly exenatide in youth with type 2 diabetes. Diabetes Care 2022;45:1833–1840
210. Arslanian SA, Hannon T, Zeitler P, et al.; AWARD-PEDS Investigators. Once-weekly dulaglutide for the treatment of youths with type 2 diabetes. N Engl J Med 2022;387:433–443
211. Kelly AS, Auerbach P, Barrientos-Perez M, et al.; NN8022-4180 Trial Investigators. A randomized, controlled trial of liraglutide for adolescents with obesity. N Engl J Med 2020;382:2117–2128
212. Laffel LM, Danne T, Klingensmith GJ, et al. Efficacy and safety of the SGLT2 inhibitor empagliflozin versus placebo and the DPP-4 inhibitor linagliptin versus placebo in young people with type 2 diabetes (DINAMO): a multicentre, randomised, double-blind, parallel group, phase 3 trial. Lancet Diabetes Endocrinol 2023;11:169–181
213. Chan CL. Use of continuous glucose monitoring in youth-onset type 2 diabetes. Curr Diab Rep 2017;17:66
214. Chesser H, Srinivasan S, Puckett C, Gitelman SE, Wong JC. Real-time continuous glucose monitoring in adolescents and young adults with type 2 diabetes can improve quality of life. J Diabetes Sci Technol 2024;18:911–919
215. Weghuber D, Kelly AS, Arslanian S. Once-weekly semaglutide in adolescents with obesity. reply. N Engl J Med 2023;388:1146
216. U.S. Food and Drug Administration. FDA approves weight management drug for patients aged 12 and older. 2021. Accessed 31 Aug 2024. Available from https://www.fda.gov/drugs/drug-safety-and-availability/fda-approves-weight-management-drug-patients-aged-12-and-older
217. U.S. Food and Drug Administration. FDA approves treatment for chronic weight management in pediatric patients aged 12 years and older. 2022. Accessed 27 Aug 2024. Available from https://www.fda.gov/drugs/news-events-human-drugs/fda-approves-treatment-chronic-weight-management-pediatric-patients-aged-12-years-and-older
218. Beamish AJ, Ryan Harper E, Järvholm K, Janson A, Olbers T. Long-term outcomes following adolescent metabolic and bariatric surgery. J Clin Endocrinol Metab 2023;108:2184–2192
219. Inge TH, Zeller M, Harmon C, et al. Teen-Longitudinal Assessment of Bariatric Surgery: methodological features of the first prospective multicenter study of adolescent bariatric surgery. J Pediatr Surg 2007;42:1969–1971
220. Rubino F, Nathan DM, Eckel RH, et al.; Delegates of the 2nd Diabetes Surgery Summit. Metabolic surgery in the treatment algorithm for type 2 diabetes: a joint statement by international diabetes organizations. Diabetes Care 2016;39:861–877
221. Torbahn G, Brauchmann J, Axon E, et al. Surgery for the treatment of obesity in children and adolescents. Cochrane Database Syst Rev 2022;9:Cd011740
222. Michalsky MP, Inge TH, Simmons M, et al.; Teen-LABS Consortium. Cardiovascular risk factors in severely obese adolescents: the Teen Longitudinal Assessment of Bariatric Surgery (Teen-LABS) study. JAMA Pediatr 2015;169:438–444
223. Zeinoddini A, Heidari R, Talebpour M. Laparoscopic gastric plication in morbidly obese adolescents: a prospective study. Surg Obes Relat Dis 2014;10:1135–1139
224. Göthberg G, Gronowitz E, Flodmark C-E, et al. Laparoscopic Roux-en-Y gastric bypass in adolescents with morbid obesity–surgical aspects and clinical outcome. Semin Pediatr Surg 2014;23:11–16
225. Inge TH, Prigeon RL, Elder DA, et al. Insulin sensitivity and β-cell function improve after

gastric bypass in severely obese adolescents. J Pediatr 2015;167:1042–1048.e1
226. Styne DM, Arslanian SA, Connor EL, et al. Pediatric obesity-assessment, treatment, and prevention: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab 2017;102:709–757
227. Hampl SE, Hassink SG, Skinner AC, et al. Executive summary: clinical practice guideline for the evaluation and treatment of children and adolescents with obesity. Pediatrics 2023;151:e2022060641
228. Dabelea D, Stafford JM, Mayer-Davis EJ, et al.; SEARCH for Diabetes in Youth Research Group. Association of type 1 diabetes vs type 2 diabetes diagnosed during childhood and adolescence with complications during teenage years and young adulthood. JAMA 2017;317:825–835
229. Song SH, Hardisty CA. Early onset type 2 diabetes mellitus: a harbinger for complications in later years-clinical observation from a secondary care cohort. QJM 2009;102:799–806
230. Shah AS, Zeitler PS, Wong J, et al. ISPAD clinical practice consensus guidelines 2022: type 2 diabetes in children and adolescents. Pediatr Diabetes 2022;23:872–902
231. Bacha F, Cheng P, Gal RL, et al. Racial and ethnic disparities in comorbidities in youth with type 2 diabetes in the Pediatric Diabetes Consortium (PDC). Diabetes Care 2021;44:2245–2251
232. Odugbesan O, Wright T, Jones N-HY, et al.; T1D Exchange Quality Improvement Collaborative. Increasing social determinants of health screening rates among six endocrinology centers across the United States: results from the T1D Exchange quality improvement collaborative. Clin Diabetes 2024;42:49–55
233. Lawrence JM, Standiford DA, Loots B, et al.; SEARCH for Diabetes in Youth Study. Prevalence and correlates of depressed mood among youth with diabetes: the SEARCH for Diabetes in Youth Study. Pediatrics 2006;117:1348–1358
234. Levitt Katz LE, Swami S, Abraham M, et al. Neuropsychiatric disorders at the presentation of type 2 diabetes mellitus in children. Pediatr Diabetes 2005;6:84–89
235. Lewis-Fernández R, Rotheram-Borus MJ, Betts VT, et al. Rethinking funding priorities in mental health research. Br J Psychiatry 2016;208:507–509
236. Reinehr T. Type 2 diabetes mellitus in children and adolescents. World J Diabetes 2013;4:270–281
237. Pinhas-Hamiel O, Hamiel U, Levy-Shraga Y. Eating disorders in adolescents with type 1 diabetes: challenges in diagnosis and treatment. World J Diabetes 2015;6:517–526
238. McVoy M, Hardin H, Fulchiero E, et al. Mental health comorbidity and youth onset type 2 diabetes: a systematic review of the literature. Int J Psychiatry Med 2023;58:37–55
239. Shelton RC. Depression, antidepressants, and weight gain in children. Obesity (Silver Spring) 2016;24:2450
240. Baeza I, Vigo L, de la Serna E, et al. The effects of antipsychotics on weight gain, weight-related hormones and homocysteine in children and adolescents: a 1-year follow-up study. Eur Child Adolesc Psychiatry 2017;26:35–46
241. TODAY Study Group. Pregnancy outcomes in young women with youth-onset type 2 diabetes followed in the TODAY study. Diabetes Care 2021;45:1038–1045
242. Kim G, Divers J, Fino NF, et al. Trends in prevalence of cardiovascular risk factors from 2002 to 2012 among youth early in the course of type 1 and type 2 diabetes. The SEARCH for Diabetes in Youth Study. Pediatr Diabetes 2019;20:693–701
243. Foxon F, Selya AS. Electronic cigarettes, nicotine use trends and use initiation ages among US adolescents from 1999 to 2018. Addiction 2020;115:2369–2378
244. Veliz PT, McCabe SE, Evans-Polce RJ, Boyd CJ. Assessing how the history of e-cigarette and cigarette use are associated with the developmental course of marijuana use in a sample of United States adolescents. Drug Alcohol Depend 2020;216:108308
245. Weitzman ER, Wisk LE, Minegishi M, et al. Effects of a patient-centered intervention to reduce alcohol use among youth with chronic medical conditions. J Adolesc Health 2022;71:S24–s33
246. Institute for Social Research. Monitoring the future national survey results on drug use, 1975–2022: secondary school students. Monitoring the Future Monograph Series. Ann Arbor, MI, Institute for Social Research, University of Michigan. 2023. Accessed 31 August 2024. Available from https://monitoringthefuture.org/wp-content/uploads/2022/12/mtf2022.pdf
247. Akturk HK, Snell-Bergeon J, Kinney GL, Champakanath A, Monte A, Shah VN. Differentiating diabetic ketoacidosis and hyperglycemic ketosis due to cannabis hyperemesis syndrome in adults with type 1 diabetes. Diabetes Care 2022;45:481–483
248. Arnett JJ. Emerging adulthood. A theory of development from the late teens through the twenties. Am Psychol 2000;55:469–480
249. Peters A, Laffel L; American Diabetes Association Transitions Working Group. Diabetes care for emerging adults: recommendations for transition from pediatric to adult diabetes care systems. Diabetes Care 2011;34:2477–2485
250. Agarwal S, Raymond JK, Isom S, et al. Transfer from paediatric to adult care for young adults with type 2 diabetes: the SEARCH for Diabetes in Youth Study. Diabet Med 2018;35:504–512
251. Mays JA, Jackson KL, Derby TA, et al. An evaluation of recurrent diabetic ketoacidosis, fragmentation of care, and mortality across Chicago, Illinois. Diabetes Care 2016;39:1671–1676
252. Lotstein DS, Seid M, Klingensmith G, et al.; SEARCH for Diabetes in Youth Study Group. Transition from pediatric to adult care for youth diagnosed with type 1 diabetes in adolescence. Pediatrics 2013;131:e1062–e1070
253. Lyons SK, Becker DJ, Helgeson VS. Transfer from pediatric to adult health care: effects on diabetes outcomes. Pediatr Diabetes 2014;15:10–17
254. Endocrine Society. Transitions of care. Accessed 21 August 2024. Available from https://www.endocrine.org/improving-practice/transitions#t1d
255. D'Amico RP, Pian TM, Buschur EO. Transition from pediatric to adult care for individuals with type 1 diabetes: opportunities and challenges. Endocr Pract 2023;29:279–285
256. Lal RA, Maahs DM, Dosiou C, Aye T, Basina M. The guided transfer of care improves adult clinic show rate. Endocr Pract 2020;26:508–513
257. Xie LF, Housni A, Nakhla M, et al. Adaptation of an adult web application for type 1 diabetes self-management to youth using the behavior change wheel to tailor the needs of health care transition: qualitative interview study. JMIR Diabetes 2023;8:e42564
258. Butalia S, Crawford SG, McGuire KA, Dyjur DK, Mercer JR, Pacaud D. Improved transition to adult care in youth with type 1 diabetes: a pragmatic clinical trial. Diabetologia 2021;64:758–766
259. Spaic T, Robinson T, Goldbloom E, et al.; JDRF Canadian Clinical Trial CCTN1102 Study Group. Closing the gap: results of the multicenter canadian randomized controlled trial of structured transition in young adults with type 1 diabetes. Diabetes Care 2019;42:1018–1026
260. White M, O'Connell MA, Cameron FJ. Clinic attendance and disengagement of young adults with type 1 diabetes after transition of care from paediatric to adult services (TrACeD): a randomised, open-label, controlled trial. Lancet Child Adolesc Health 2017;1:274–283
261. Sequeira PA, Pyatak EA, Weigensberg MJ, et al. Let's Empower and Prepare (LEAP): evaluation of a structured transition program for young adults with type 1 diabetes. Diabetes Care 2015;38:1412–1419
262. Monaghan M, Baumann K. Type 1 diabetes: addressing the transition from pediatric to adult-oriented health care. Res Rep Endocr Disord 2016;6:31–40
263. Carreon SA, Duran B, Tang TS, et al. Here for you: a review of social support research in young adults with diabetes. Diabetes Spectr 2021;34:363–370