

Overview of Diabetes in Children and Adolescents

A Fact Sheet from the National Diabetes Education Program



Type 1 diabetes in U.S. children and adolescents may be increasing¹ and many more new cases of type 2 diabetes are being reported in young people. Standards of care for managing children with diabetes issued by the American Diabetes Association in January 2005 provide more guidance than previously given. To update primary care providers and their staff members on this rapidly changing area of diabetes care, the National Diabetes Education Program (NDEP) has developed this overview of the current literature.

What Is Diabetes?

Diabetes mellitus is a group of diseases characterized by high levels of blood glucose resulting from defects in insulin production, insulin action, or both. Diabetes can be associated with serious complications and premature death, but people with diabetes can take steps to control the disease and lower the risk of complications.

Type 1 Diabetes

Type 1 diabetes is an autoimmune disease in which the immune system destroys the insulin-producing beta cells of the pancreas that regulate blood glucose. Type 1 diabetes has an acute onset, with children and adolescents usually able to pinpoint when symptoms began. Onset can occur at any age, but it most often occurs in children and young adults.

Since the pancreas can no longer produce insulin, people with type 1 diabetes require daily injections of insulin for life. Children with type 1 diabetes are at risk for long-term complications (damage to cardiovascular system, kidneys, eyes, nerves, blood vessels, gums, and teeth).

Type 1 diabetes accounts for 5 to 10 percent of all diagnosed cases of diabetes, but is the leading cause of diabetes in children. A diabetes management plan for young people includes insulin therapy, self-monitoring of blood glucose, healthy eating, and physical activity. The plan is designed to ensure proper growth and prevention of hypoglycemia. New management strategies are helping children with type 1 diabetes live long and healthy lives.

- **Symptoms.** The symptoms of type 1 diabetes usually develop over a short period of time. They include increased thirst and urination, constant hunger, weight loss, and blurred vision. Children also may feel very tired. If not diagnosed and treated with insulin, the individual with type 1 diabetes can lapse into a life-threatening diabetic coma, known as diabetic ketoacidosis or DKA. Often, children will present with vomiting, a sign of DKA, and mistakenly be diagnosed as having gastroenteritis. New-onset diabetes can be differentiated from a GI infection by the frequent urination that accompanies continued vomiting as opposed to decreased urination due to dehydration if the vomiting is caused by a GI "bug."
- **Risk Factors.** A combination of genetic and environmental factors put people at increased risk for type 1 diabetes. Researchers are working to identify these factors and to stop the autoimmune process that destroys the pancreas.
- **Co-morbidities.** Autoimmune diseases such as celiac disease and autoimmune thyroiditis are associated with type 1 diabetes.

Type 2 Diabetes

The first stage in the development of type 2 diabetes is often insulin resistance causing an inadequate response to insulin and requiring increasing amounts of insulin to control blood glucose. Initially, the pancreas responds by producing more insulin, but after several years, insulin production may decrease and diabetes develops. Type 2 diabetes used to occur mainly in adults who were overweight and ages 40 and older. Now, as more children and adolescents in the United States become overweight and inactive, type 2 diabetes is occurring more often in young people. Type 2 diabetes is more common in certain racial and ethnic groups such as African Americans, American Indians, Hispanic/Latino Americans, and some Asian and Pacific Islander Americans. The increased incidence of type 2 diabetes in youth is a "first consequence" of the obesity epidemic among young people, a significant and growing public health problem.² Overweight children are at increased risk for developing type 2 diabetes during childhood, adolescence, and later in life.

- **Symptoms.** Type 2 diabetes usually develops slowly and insidiously in children. Symptoms may be similar to those of type 1 diabetes. A child or teen can feel very tired, thirsty, or nauseated and have to urinate often. Other symptoms may include weight loss, blurred vision, frequent infections, and slow healing of wounds or sores. Some children or adolescents with type 2 diabetes may show no symptoms at all when they are diagnosed, and others may present with vaginal yeast infection or burning on urination due to yeast infection. Therefore, it is important for health care providers to identify and test children or teens who are at high risk for the disease.
- **Signs of Diabetes.** Physical signs of insulin resistance include acanthosis nigricans, where the skin around the neck or in the armpits appears dark, thick, and feels velvety. High blood pressure and dyslipidemia also are associated with insulin resistance.
- **Risk Factors.** Being overweight, having a family member who has type 2 diabetes, being a member of a high risk ethnic group, having signs of insulin resistance, being older than 10 years of age, and experiencing puberty are risk factors for the disease.
- **Co-morbidities.** Children with type 2 diabetes also are at risk for the long-term complications of diabetes and the co-morbidities associated with insulin resistance (lipid abnormalities and hypertension).

The cornerstone of diabetes management for children with type 2 is healthy eating, with portion control, and increased physical activity. To control their diabetes, children with type 2 diabetes also may need to take oral anti-diabetes medication, insulin, or both. Ongoing efforts to prevent and treat type 2 diabetes in children will require the involvement of health care providers, school personnel, community institutions, and government agencies working together.

Gestational Diabetes

Gestational diabetes mellitus (GDM) is a form of diabetes that is diagnosed in about 7 percent of *all* pregnancies, at a rate of about 200,000 per year. It is more common among obese women, women with a family history of diabetes, and among African American, Hispanic/Latino American, and American Indian women. During pregnancy, GDM must be treated to normalize maternal blood glucose levels and avoid complications in the infant.

GDM imparts a lifetime risk for type 2 diabetes although the risk is highest 5 to 10 years after delivery. In women with a history of GDM, even 10 years postpartum, the risk of developing diabetes is 70 percent higher than in a comparable group of women without GDM. The children of women with a history of GDM also are at increased risk for obesity and diabetes compared to other children.

Overweight women with a history of GDM can take steps to reduce their risk for diabetes by losing at least 5 to 7 percent of their body weight and increasing their physical activity.

The Diabetes Prevention Program clinical trial and other studies have shown that type 2 diabetes can be delayed or prevented in women with a history of GDM through sustained weight loss and lifestyle changes, and possibly, the use of medications. Timely diagnosis and treatment of type 2 diabetes,

should it develop despite efforts at prevention, can prevent or delay the onset of diabetes complications.

(See "[Resources](#)" for information on gestational diabetes.)

"Hybrid" or "Mixed" Diabetes

While for the most part it is easy to determine if a child or teenager has type 1 or type 2 diabetes, some children have elements of both kinds of diabetes. This phenomenon may be called "hybrid" or "mixed"* diabetes. It is not surprising that some children have elements of both type 1 and type 2 diabetes, given the fact that more children are becoming overweight. Youth with "hybrid" diabetes are likely to have both:

- insulin resistance that is associated with obesity and type 2 diabetes, and
 - antibodies against the pancreatic islet cells that are associated with autoimmunity and type 1 diabetes.
- Signs and symptoms. The signs and symptoms are the same as those for type 1 and type 2 diabetes.
 - Management. At the time of diagnosis, the clinician should attempt to determine which type of diabetes is present. Measuring antibodies against islet cells and assessing insulin production by measuring C-peptide levels help make the distinction. C-peptide levels are best determined about a year after diagnosis. The presence of hybrid diabetes may affect how the child or teen is treated. Insulin injections are likely to be needed (as for type 1), and oral diabetes medications may be used to improve insulin resistance (as for type 2). It is important to counsel the child or teen about healthy eating habits and the need for daily physical activity so he or she can reach a healthy weight.

** Some people also may use the misleading term "double" diabetes. Patients should be assured that this does not mean that they have a greater risk for complications or "extra" disease compared to those with type 1 or type 2 diabetes.*

Maturity-onset Diabetes of the Young

Maturity-onset diabetes of the young (MODY) is a rare form of diabetes in children that is caused by a single gene defect that results in faulty insulin secretion. MODY is defined by its early onset (usually before age 25), absence of ketosis, and autosomal dominant inheritance.³ Thus each child of a parent with MODY has a 50 percent chance of inheriting the same type of diabetes. MODY is thought to account for 2 to 5 percent of all cases of diabetes and often goes unrecognized.³ Treatment of MODY varies. Some children respond to diet therapy, exercise, and/or oral anti-diabetes medications that enhance insulin release. Others may require insulin therapy.

Secondary Diabetes

Diabetes can occur in children with other diseases such as cystic fibrosis or those needing glucocorticoid drugs. These causes may account for 1 to 5 percent of all diagnosed cases of diabetes.

Statistics

Diabetes is one of the most common chronic diseases in school-aged children. In the United States, about 176,500 people under 20 years of age have diabetes. About 1 in every 400 to 600 children, has type 1 diabetes.⁴ Each year, more than 13,000 children are diagnosed with type 1 diabetes.⁵ The incidence of type 1 is about 7 per 100,000 per year in children ages 4 and under; 15 per 100,000 per year in children 5 to 9 years, and about 22 per 100,000 per year in those 10 to 14 years of age.⁶ About 75 percent of all newly diagnosed cases of type 1 diabetes occur in individuals younger than 18 years of age.

Currently, because 10 to 15 percent of children and teens are overweight – about double the number of two decades ago – increasing numbers of young people have type 2 diabetes.⁷ In several clinic-based studies, the percentage of children with newly diagnosed diabetes classified as type 2 has increased from less than 5 percent before 1994 to 30 to 50 percent in subsequent years.^{8,9} Although no ethnic group is untouched by the problem, the disease disproportionately affects American Indian, African American, Mexican American, and Pacific Islander youth.^{8,10} An example of this

overrepresentation is seen among Pima Indians where the prevalence of type 2 diabetes among 15- to 19-year-olds is 5 percent.⁸

According to the Centers for Disease Control and Prevention (CDC), "at risk for overweight" is defined as being in the 85th to 94th percentile and "overweight" is defined as at or above the 95th percentile on the CDC's Body Mass Index (BMI)-for-age growth charts. These charts can be found at <http://www.cdc.gov/nccdphp/dnpa/bmi/index.htm>.

Identifying Children with Diabetes

The rate of beta cell destruction in type 1 diabetes is quite variable--rapid in some individuals (mainly infants and children) and slow in others (mainly adults). Children and adolescents may present with ketoacidosis as the first indication of the disease. Others may have modest fasting hyperglycemia that rapidly changes to severe hyperglycemia and/or ketoacidosis in the presence of infection or other stress.¹¹

Most children and adolescents diagnosed with type 2 diabetes are overweight or obese, insulin resistant, and have a family history of type 2 diabetes. They also may have physical signs of insulin resistance such as acanthosis nigricans. Diabetes complications such as microalbuminuria and the presence of cardiovascular risk factors such as abnormal cholesterol and high blood pressure have been observed among teenage Pima Indians⁸ and in other pediatric populations in the United States.^{12,13}

Undiagnosed type 2 diabetes in children and adolescents may place these young people at early risk for cardiovascular disease; however, no data are available to define the scope of this problem. In adults, up to one-third of individuals who have type 2 diabetes are undiagnosed and at risk for microvascular and macrovascular complications of diabetes.¹⁴ It is important, therefore, for health care providers to consider testing for diabetes in high risk or symptomatic children.

The American Academy of Pediatrics and the American Diabetes Association have developed the following testing criteria and diabetes risk factors that health care providers can use to help identify type 2 diabetes in children before the onset of complications.¹⁵

Testing Criteria

1. Overweight or at risk for overweight, defined as BMI > 85th percentile for age and sex; weight for height >85th percentile; or weight >120 percent of ideal for height
PLUS
2. Any two of the following risk factors:
 - Family history of type 2 diabetes in first- or second-degree relative
 - American Indian, African American, Hispanic/Latino, Asian American, or Pacific Islander heritage
 - Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, polycystic ovarian syndrome)

Age to begin testing--10 years old or at onset of puberty if puberty occurs earlier

Frequency of testing--every 2 years

Test to use--fasting plasma glucose

Treatment Strategies

The basic elements of type 1 diabetes management are insulin administration, nutrition management, physical activity, blood glucose testing, and the avoidance of hypoglycemia. Algorithms are used for insulin dosing based on blood glucose level and food intake.

Children receiving fixed insulin doses of intermediate- and rapid-acting insulins must have food given at the time of peak action of the insulin. Children receiving a long-acting insulin analogue or using an insulin pump receive a rapid-acting insulin analogue just before a meal, with the amount of pre-meal insulin based on carbohydrate content of the meal using an insulin:carbohydrate ratio and a sliding

scale for hyperglycemia. Further adjustment of insulin or food intake may be made based on anticipation of special circumstances such as increased exercise. Children on these regimens are expected to check their blood glucose levels routinely before meals and at bedtime.

Management of type 2 diabetes involves nutrition management, increased physical activity, and blood glucose testing. If this is not sufficient to normalize blood glucose levels, oral anti-diabetes medication and/or insulin therapy are used as well. The only oral agent approved for use in children and adolescents is metformin. All aspects of the regimen are individualized. (See [Tip Sheets for Kids with Type 2 Diabetes](#))

There is no single recipe to manage diabetes that fits all children. Blood glucose targets, frequency of blood glucose testing, type, dose and frequency of insulin, use of insulin injections or a pump, and details of nutrition management, all may vary among individuals. The family and diabetes care team determine the regimen that best suits each child's individual characteristics and circumstances.

Blood Glucose Goals

To control diabetes and prevent complications, blood glucose levels must be managed as close to a "normal" range as is safely possible (70 to 100 mg/dl before eating). Families should work with their health care team to set target blood glucose levels appropriate for the child.

The American Diabetes Association has developed recommendations for blood glucose goals for young people with type 1 diabetes. Although there are no national recommendations for children with type 2 diabetes, it may be reasonable to use the values in the following table as a guide.

Optimal plasma blood glucose and A1C goals for type 1 diabetes by age group are:¹⁶

Values by Age (Years)	Plasma Blood Glucose Goal Range (mg/dl)		A1C Percent	Rationale
	Before Meals	Bedtime/Overnight		
Toddlers and preschoolers under age 6	100–180	110–200	≤8.5 but ≥7.5	• High risk and vulnerability to hypoglycemia
School age, ages 6 to 12	90–180	100–180	<8	• Risks of hypoglycemia and relatively low risk of complications prior to puberty
Adolescents and young adults, ages 13 to 19	90–130	90–150	<7.5*	• Risk of hypoglycemia • Developmental and psychological issues
Key concepts in setting glycemic goals:				
<ul style="list-style-type: none"> • Goals should be individualized and lower goals may be reasonable based on benefit: risk assessment. 				
<ul style="list-style-type: none"> • Blood glucose goals should be higher than those listed above in children with frequent hypoglycemia or hypoglycemia unawareness. 				
<ul style="list-style-type: none"> • Postprandial blood glucose values should be measured when there is a disparity between preprandial blood glucose values and A1C levels. 				

* A lower goal (<7.0) is reasonable if it can be achieved without excessive hypoglycemia.

Hypoglycemia

Diabetes treatment can sometimes cause blood glucose levels to drop too low, with resultant **hypoglycemia**. Taking too much insulin, missing a meal or snack, or exercising too much may cause hypoglycemia. A child can become irritable, shaky, and confused. When blood glucose levels fall very low, loss of consciousness or seizures may develop.

When hypoglycemia is recognized, the child should drink or eat a concentrated sugar to raise the blood glucose value to greater than 80 mg/dl. Once the blood glucose is over 80, the child can eat food containing protein to maintain blood glucose levels in the normal range. The concentrated sugar will increase blood glucose levels and cause resolution of symptoms quickly, avoiding over-treatment of "lows." If the child is unable to eat or drink, a glucose gel may be administered to the buccal mucosa of the cheek or glucagon may be injected.

Glycemic goals may need to be modified to take into account the fact that most children younger than 6 or 7 years of age have a form of "hypoglycemic unawareness." They lack the cognitive capacity to recognize and respond to hypoglycemic symptoms and may be at greater risk for hypoglycemia.¹⁶

Hyperglycemia

Causes of hyperglycemia include forgetting to take medications on time, eating too much, and getting too little exercise. Being ill also can raise blood glucose levels. Over time, hyperglycemia can cause damage to the eyes, kidneys, nerves, blood vessels, gums, and teeth.

Intercurrent illnesses are more frequent in young children. Sick-day management rules, including assessment for ketosis with every illness, must be established for children with type 1 diabetes. Families need to be taught what to do for vomiting and for ketosis to prevent severe hyperglycemia and ketoacidosis.¹⁷

Monitoring Complications and Reducing CVD Risk

The following recommendations are based on the American Diabetes Association's standards of Medical Care.¹⁶

Retinopathy. Although retinopathy most commonly occurs after the onset of puberty and after 5–10 years of diabetes duration, it has been reported in prepubertal children and with diabetes duration of only 1–2 years. Referrals should be made to eye care professionals with expertise in diabetic retinopathy, an understanding of the risk for retinopathy in the pediatric population, as well as experience in counseling the pediatric patient and family on the importance of early prevention/intervention. The first ophthalmologic examination should be obtained once the child is 10 years of age or older and has had diabetes for 3–5 years. After the initial examination, annual routine follow-up is generally recommended. Less frequent examinations may be acceptable on the advice of an eye care professional.

Nephropathy. To reduce the risk and/or slow the progression of nephropathy, optimize glucose and blood pressure control. Annual screening for microalbuminuria should be initiated once the child is 10 years of age and has had diabetes for 5 years. Screening may be done with a random spot urine sample analyzed for microalbumin-to-creatinine ratio. Confirmed, persistently elevated microalbumin levels should be treated with an ACE inhibitor, titrated to normalization of microalbumin excretion if possible.

Neuropathy. Although it is unclear whether foot examinations are important in children and adolescents, annual foot examinations are painless, inexpensive, and provide an opportunity for education about foot care. The risk for foot complications is increased in people who have had diabetes over 10 years.¹⁸

Lipids. In children older than 2 years of age with a family history of total cholesterol over 240 mg/dl, or a CVD event before age 55, or if family history is unknown, perform a lipid profile after diagnosis of diabetes and when glucose control has been established. If family history is not a concern, then perform a lipid profile at puberty. Based on data obtained from studies in adults, having diabetes is equivalent to having had a heart attack, making diabetes a key risk factor for future cardiovascular disease.

Pubertal children should have a lipid profile at the time of diagnosis after glucose control has been established. If lipid values fall within the accepted risk levels (LDL less than 100 mg/dl), repeat lipid profile every 5 years.

The goal for LDL-cholesterol in children and adolescents with diabetes is less than 100 mg/dl (2.60 mmol/l). If the LDL-cholesterol is greater than 100 mg/dl, the child should be treated with an exercise plan and a Step 2 American Heart Association diet. If, after 6 months of diet and exercise, the LDL-C level remains above 160 mg/dl, pharmacologic agents should be given. If the LDL-C is between 130 and 160 mg/dl, pharmacologic therapy should be considered. Statins are the agents of

choice. Weight loss, increased physical activity, and improvement in glycemic control often result in improvements in lipid levels.

Blood pressure. Careful control of hypertension in children is critical. Hypertension in childhood is defined as an average systolic or diastolic blood pressure $\geq 95^{\text{th}}$ percentile for age, sex, and height measured on at least three separate days. Normal blood pressure levels for age, sex, and height, appropriate methods for measurement, and treatment recommendations are available online at: www.nhlbi.nih.gov/health/prof/heart/hbp/hbp_ped.pdf.¹⁹

ACE inhibitors are the agents of choice in children with microalbuminuria. They have beneficial effects on slowing progression or preventing diabetic nephropathy.

Visiting the Health Care Team

Because most newly diagnosed cases of type 1 diabetes occur in individuals younger than 18 years of age, and more children and teens are now getting type 2 diabetes, care of this group requires integration of diabetes management with the complicated physical and emotional growth needs of children, adolescents, and their families, as well as with their emerging autonomy and independence.

Diabetes care for children should be provided by a team that can deal with these special medical, educational, nutritional, and behavioral issues. The team usually consists of a physician, diabetes educator, dietitian, social worker or psychologist, along with the patient and family. Children should be seen by the team at diagnosis and in follow-up, as agreed upon by the primary care provider and the diabetes team. The following schedule of care is based on the American Diabetes Association's Standards of Medical Care, published in 2005.¹⁶

At Diagnosis:

- Establish the goals of care and required treatment.
- Check lipids in children with a significant family history*
- Begin diabetes self-management education about healthy eating habits, daily physical activity, and insulin/medication administration, and self-monitoring of blood glucose levels if appropriate. A solid educational base is needed so that the individual and family can become increasingly independent in self-management of diabetes. Diabetes educators play an important role in this aspect of management.
- Provide nutritional therapy by an individual experienced with the nutritional needs of the growing child and the behavioral issues that have an impact on adolescent diets.
- Conduct a psychosocial assessment to identify emotional and behavioral disorders.

* In children with no significant family history, check lipids at puberty and if normal, repeat profile every 5 years (see section on lipids for more information).

Each Quarterly Visit

Most young people with diabetes are seen by the health care team every 3 months. At each visit, the following should be monitored or examined:

- A1C, an indicator of average blood glucose control
- Growth (height and weight)
- BMI
- Blood pressure
- Injection sites
- Self-testing blood glucose records
- Psychosocial assessment

Annually:

- Evaluate nutrition therapy
- Provide ophthalmologic examination (less often on the advice of an eye care professional)*
- Check for microalbuminuria (once the child is 10 years old and has had diabetes for 5 years)
- Perform thyroid function test (for children with type 1 diabetes)
- Administer influenza vaccination
- Examine feet.

*The first ophthalmologic examination should be obtained once the child is age 10 or older and has had diabetes for 3 to 5 years.

Helping Children Manage Diabetes

The health care provider team, in partnership with the young person with diabetes and caregivers, can develop a personal diabetes plan for the child that puts a daily schedule in place to keep diabetes under control. The plan shows the child how to follow a healthy meal plan, get regular physical activity, check blood glucose levels, take insulin or oral medication as prescribed, and manage hyperglycemia and hypoglycemia.

Follow a healthy meal plan

Young people with diabetes need to follow a meal plan developed by a registered dietitian, diabetes educator, or physician. For children with type 1 diabetes, the meal plan must ensure proper nutrition for growth. For children with type 2, the meal plan should outline appropriate changes in eating habits that lead to better energy balance and reduce or prevent obesity. A meal plan also helps keep blood glucose levels in the target range.

Children or adolescents and their families can learn how different types of food -- especially carbohydrates such as breads, pasta, and rice -- can affect blood glucose levels. Portion sizes, the right amount of calories for the child's age, and ideas for healthy food choices at meal and snack time also should be discussed including reduction in soda and juice consumption. Family support for following the meal plan and setting up regular meal times is a key to success, especially if the child or teen is taking insulin. See NDEP's "[Eat Healthy Foods](#)" Tip Sheet for Kids with type 2 Diabetes.

For more information about healthy eating for children, visit the [American Dietetic Association](#), an NDEP partner. Their "Healthy Habits for Healthy Kids" guide for parents is available in [English](#) and [Spanish](#), and includes [tips for a balanced diet](#). The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) also offers [diet tips](#) for people with diabetes.

Get regular physical activity

Children with diabetes need regular physical activity, ideally a total of 60 minutes each day. Physical activity helps to lower blood glucose levels, especially in children and adolescents with type 2 diabetes. Physical activity is also a good way to help children control their weight. In children with type 1 diabetes, the most common problem encountered during physical activity is hypoglycemia. If possible, a child or a teen should check blood glucose levels before beginning a game or a sport. If blood glucose levels are too low, the child should not be physically active until the low blood glucose level has been treated. See NDEP's "[Be Active](#)" Tip Sheet for Kids with type 2 Diabetes.

For more information on helping your child be physically active, visit the Weight-Control Information Network (WIN) of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). WIN offers a number of [publications](#) that address healthy eating and physical activity. The Centers for Disease Control and Prevention's (CDC) [Verb](#) campaign encourages youth to be physically active. "[Diabetes and Physical Activity at School](#)" provides additional information.

Check blood glucose levels regularly

Young people with diabetes should know the acceptable range for their blood glucose. Children, particularly those using insulin should check blood glucose values regularly with a blood glucose meter, preferably one with a built-in memory. A health care team member can teach a child how to use a blood glucose meter properly and how often to use it. Children should keep a journal or other records of blood glucose results to discuss with their health care team. This information helps providers make any needed changes to the child's or teen's personal diabetes plan.

Take all diabetes medication as prescribed

Parents, caregivers, school nurses, and others can help a child or teen learn how to take medications as prescribed. For type 1 diabetes, a child or teen takes insulin at prescribed times each day via multiple injections or an insulin pump. Some young people with type 2 diabetes need oral medication or insulin or both. In any case, it is important to stress that all medication should be balanced with

food and activity every day. [“Managing Insulin Requirements at School”](#) provides additional information.

Special Issues

Diabetes presents unique issues for young people with the disease. Simple things, such as going to a birthday party, playing sports, or staying overnight with friends, need careful planning. Checking blood glucose, making correct food choices, and taking insulin or oral medication can make school-age children feel "different" from their classmates and this can be particularly bothersome for teens.

For any child or teen with diabetes, learning to cope with the disease is a big task. Dealing with a chronic illness such as diabetes may cause emotional and behavioral challenges, sometimes leading to depression. Talking to a social worker or psychologist may help young people and their families learn to adjust to the lifestyle changes needed to stay healthy.

Family Support

Managing diabetes in children and adolescents is most effective when the entire family gets involved. Diabetes education should involve family members. Families can be encouraged to share concerns with physicians, diabetes educators, dietitians, and other health care providers to get their help in the day-to-day management of diabetes. Extended family members, teachers, school nurses, counselors, coaches, day care providers, and other resources in the community can provide information, support, guidance, and help with coping skills. These individuals also may be knowledgeable about resources for health education, financial services, social services, mental health counseling, transportation, and home visits.

Diabetes is stressful for both the children and their families. Parents should be alert for signs of depression or eating disorders and seek appropriate treatment. While all parents should talk to their children about avoiding tobacco, alcohol, and other drugs, this is particularly important for children with diabetes. Smoking and diabetes each independently increase the risk of cardiovascular disease and people with diabetes who smoke have a greatly increased risk of heart disease and circulatory problems. Binge drinking can cause hyperglycemia acutely, followed by an increased risk of hypoglycemia. The symptoms of intoxication are very similar to the symptoms of hypoglycemia, and thus, may result in delay of treatment of hypoglycemia with potentially disastrous consequences.

Transition to Independence

Children with diabetes—depending on their age and level of maturity—will learn to take over much of their care. Most school-age children can recognize symptoms of hypoglycemia and monitor blood glucose levels. They also participate in nutrition decisions. They often can give their own insulin injections but may not be able to draw up the dose accurately in a syringe until a developmental age of 11 to 12 years.

Adolescents often have the motor and cognitive skills to perform all diabetes-related tasks and determine insulin doses based on blood glucose levels and food intake. This is a time, however, when peer acceptance is important, risk-taking behaviors common, and rebellion against authority is part of teens' search for independence. Thus, adolescents must be supervised in their diabetes tasks and allowed gradual independence with the understanding that the independence will be continued only if they adhere to the diabetes regimen and succeed in maintaining reasonable metabolic control. During mid-adolescence, the family and health care team should stress to teens the importance of checking blood glucose levels prior to driving a car to avoid hypoglycemia while driving.

Diabetes at School

The NDEP has developed a guide to educate and inform school personnel about diabetes, how it is managed, and how each member of the school staff can help meet the needs of students with the disease. School principals, administrators, nurses, teachers, coaches, bus drivers, health care, and lunchroom staff all play a role in helping students with diabetes succeed.

Several Federal and some state laws provide protections to children with disabilities, including diabetes. These laws help ensure that all students with diabetes are educated in a medically safe

environment and have the same access to educational opportunities as their peers—in public and some private schools. Students with diabetes are entitled to accommodations and modifications necessary for them to stay healthy at school. Accommodations may need to be made in the classroom, with physical education, on field trips, and/or for after-school activities.

Written plans outlining each student's diabetes management help students, their families, school staff, and the student's health care providers know what is expected of them. These expectations should be laid out in written documents, such as a:

Diabetes Medical Management Plan, developed by the student's personal health care team and family

Quick Reference Emergency Plan, which describes how to recognize hypoglycemia and hyperglycemia and what to do as soon as signs or symptoms of these conditions are observed

Education plans, such as the Section 504 Plan or Individualized Education Program (IEP)

Care Plan or Individual Health Plan generated by the school nurse that provides instructions to faculty and staff.

The school nurse is the most appropriate person to coordinate care for students with diabetes. Each student with diabetes should have a written plan, developed by the school nurse, incorporating physician orders, parent requests, and tailored to the specific developmental, physical, cognitive, and skill ability of the child. The nurse will conduct a nursing assessment of the student and develop a nursing care plan, taking into consideration the child's cognitive, emotional, and physical status as well as the medical orders contained in the Diabetes Medical Management Plan. A team approach to developing the care plan, involving the student, parent, health care provider, key school personnel, and school nurse, is the most effective way to ensure safe and effective diabetes management during the school day.

The nursing care plan would also identify school employees assigned to provide care to an individual student, under the direction of the school nurse, when allowed by state nurse practice acts. The school nurse is responsible for training, monitoring, and supervising these school personnel. The school nurse will promote and encourage independence and self-care consistent with the student's ability, skill, maturity, and developmental level.

For more information on managing diabetes in the school setting, see [Helping the Student with Diabetes Succeed: A Guide for School Personnel](#).

Camps and Support Groups

Local peer groups and camps for children and teens with diabetes can provide positive role models and group activities. Peer encouragement often helps children perform diabetes-related tasks that they had been afraid to do previously and encourages independence in diabetes management. Talking with other children who have diabetes helps young people feel less isolated and less alone in having to deal with the demands of diabetes. They have the opportunity to discuss issues they share in common that others in their peer group can't understand, and they can share solutions to problems that they have encountered. Often, these programs challenge children physically and teach them how to deal with increased exercise, reinforcing the fact that diabetes should not limit them in their ability to perform strenuous physical activity.

Prevention Strategies for Type 2 Diabetes

For children and teens at risk, health care providers can encourage, support, and educate the entire family to make lifestyle changes that may delay -- or lower the risk for -- the onset of type 2 diabetes. Such lifestyle changes include keeping at a healthy weight and staying active. New research findings will help determine effective ways to lower risk factors in high risk children. NDEP's ["Lower Your Risk" Tip Sheet](#) provides additional information for children at risk of developing type 2 diabetes.

Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) conducts and supports a wide range of research aimed at finding ways to prevent and treat diabetes and its health complications. The Centers for Disease Control and Prevention (CDC) compiles diabetes statistics and conducts studies to help prevent and treat diabetes in children.

DirecNet: The Diabetes Research in Children Network (DirecNet) is a network of clinical centers working to determine the potential use of glucose monitoring technology and its impact on the management of type 1 diabetes in children. <http://public.direc.net/>

TEDDY: The consortium to identify The Environmental Determinants of Diabetes in the Young (TEDDY) will organize international efforts to identify infectious agents, dietary factors, or other environmental factors that trigger type 1 diabetes in genetically susceptible individuals. <http://www.teddystudy>

TrialNet: Type 1 Diabetes TrialNet is a clinical trials network of 18 sites in the United States, Canada, Europe, and Australia to test new ways to prevent type 1 diabetes and to preserve beta cell function in people who already have type 1 diabetes. www.DiabetesTrialnet.org

SEARCH: The SEARCH for Diabetes in Youth study is co-funded by CDC and NIDDK to determine the incidence and prevalence of diabetes in children in six areas of the U.S. and help clarify trends in the development of diabetes in youth. www.searchfordiabetes.org/

TODAY Trial: The TODAY (Treatment Options for type 2 Diabetes in Adolescents and Youth) study, which seeks to identify the best treatment of type 2 diabetes in children and teens, has begun in 13 medical centers and affiliated sites around the country. <http://www.niddk.nih.gov/patient/today/today.htm>

STOPP-T2D: The STOPP-T2D (Studies to Treat or Prevent Pediatric Type 2 Diabetes) study will test a program to lower risk factors for type 2 diabetes in middle school students. The seven-site study group is currently pilot testing potential interventions aimed at promoting physical activity and healthy food choices.

Resources

For more information about diabetes, target goals for blood glucose levels, educational materials, and support programs for people with diabetes and their families and friends, contact the following organizations.

1. National Diabetes Education Program (NDEP)

Toll-free: 1-800-438-5383

Website: www.ndep.nih.gov

The goal of this program is to reduce illness and death associated with diabetes and its complications. NDEP offers a number of state-of-the-science resources through its website and publications including a resource directory and a bibliography of recent articles in the pediatric field.

2. National Diabetes Information Clearinghouse

Toll-free: 1-800-860-8747

www.niddk.nih.gov/health/diabetes/diabetes.htm

3. Centers for Disease Control and Prevention

Toll-free: 1-800-311-3435

www.cdc.gov/diabetes

4. American Association of Diabetes Educators

Toll-free: 800-TEAM-UP4 (1-800-832-6874)

www.aadenet.org

5. American Diabetes Association

Toll-free: 1-800-DIABETES (1-800-342-2383)

www.diabetes.org

6. Juvenile Diabetes Research Foundation International

Toll-free: 1-800-223-1138

www.jdf.org

References

1. Lipman TH, Chang Y, Murphy KM. The epidemiology of type 1 diabetes in children in Philadelphia 1990-1994: evidence of an epidemic. *Diabetes Care* 2002; **25**(11):1969-75.
2. Fagot-Campagna A, Burrows NR, Williamson DF. The public health epidemiology of type 2 diabetes in children and adolescents: a case study of American Indian adolescents in the Southwestern United States. *Clin Chim Acta* 1999; **286**(1-2):81-95.
3. Nobre EL, Lopes LO, Miranda A, Pragosa M, de Castro JJ. Mature onset diabetes of the young (MODY). *Acta Med Port* 2002; **15**(6):435-9.
4. National Institute of Diabetes and Digestive and Kidney Diseases. National Diabetes Statistics fact sheet: general information and national estimates on diabetes in the United States, 2005. Bethesda, MD: U.S. Department of Health and Human Services, National Institute of Health, 2005.
5. Libman I, Songer T, LaPorte R. How many people in the U.S. have IDDM? *Diabetes Care* 1993; **16**(5):841-2.
6. Karvonen M, Viik-Kajander M, Moltchanova E, Libman I, LaPorte R, Tuomilehto J. Incidence of childhood type 1 diabetes worldwide. Diabetes Mondiale (DiaMond) Project Group. *Diabetes Care* 2000; **23**(10):1516-26.
7. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999-2000. *JAMA* 2002; **288**(14):1728-32.
8. Fagot-Campagna A, Pettitt DJ, Engelgau MM, et al. Type 2 diabetes among North American children and adolescents: an epidemiologic review and a public health perspective. *J Pediatr* 2000; **136**(5):664-72.
9. Kaufman FR. Type 2 diabetes mellitus in children and youth: a new epidemic. *J Pediatr Endocrinol Metab* 2002; **15 Suppl 2**:737-44.
10. Acton KJ, Burrows NR, Moore K, Querec MA, Geiss LS, Engelgau MM. Trends in diabetes prevalence among American Indian and Alaska Native children, adolescents, and young adults. 2002.
11. American Diabetes Association. Clinical Practice Recommendations -Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care* 2005; **28(Suppl. 1)**:S37-S42.
12. Deckelbaum RJ, Williams CL. Childhood obesity: the health issue. *Obes Res* 2001; **9 Suppl 4**:239S-243S.
13. Crawford PB, Story M, Wang MC, Ritchie LD, Sabry ZI. Ethnic issues in the epidemiology of childhood obesity. *Pediatr Clin North Am* 2001; **48**(4):855-78.
14. Harris MI, Klein R, Welborn TA, Knudman MW. Onset of NIDDM occurs at least 4-7 yr before clinical diagnosis. *Diabetes Care* 1992; **15**(7):815-9.
15. American Diabetes Association. Type 2 diabetes in children and adolescents. *Diabetes Care* 2000; **23**(3):381-9.
16. American Diabetes Association. Clinical Practice Recommendations -Standards of Medical Care in Diabetes. *Diabetes Care* 2005; **28(Suppl. 1)**:S4-36.
17. American Diabetes Association. Hyperglycemic crises in diabetes (Position statement). *Diabetes Care* 2004; **27 (Suppl.1)**(S94-S102).
18. American Diabetes Association. Type 2 diabetes in children and adolescents. *Pediatrics* 2000; **105**(3):671-680.
19. National Heart Lung and Blood Institute. Update on the Task Force Report (1987) on High Blood Pressure in Children and Adolescents: A Working Group Report from the National High Blood Pressure Program. Bethesda, MD: National Institutes of Health, 1996.



The U.S. Department of Health and Human Services' National Diabetes Education Program (NDEP) is jointly sponsored by the National Institutes of Health (NIH) and the Centers for Disease Control and Prevention (CDC) with the support of more than 200 partner organizations.

