Chapter 4: Diabetes in Children

4 Contact Hours

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Learning objectives
- Differentiate among the different types of diabetes.
- Discuss the incidence and prevalence of diabetes.
- Identify risk factors for the development of diabetes in children.
- Correlate the complications of diabetes with their causes.
- Identify how the diagnosis of diabetes in children is made.
- Explain pharmacological treatments for diabetes in children.

Introduction

Sam Hall is 46 years old and was diagnosed with type 2 diabetes a few years ago. Thanks to a treatment plan that involves oral medication, diet, and exercise, Sam is healthy and coping well with the diagnosis. Today, Sam sits in an exam room at his physician's office, waiting to see the doctor for a routine check-up. Suddenly, he hears a loud scream and sobbing. Startled, he leaves the exam room and looks out into the hallway to see what is happening. A young girl who appears to be about 13 years old is crying uncontrollably and shouts, "I can't be sick! I just can't be! I won't give myself shots for the rest of my life for this diabetes thing! I'd rather be dead!" As the nurse and the mother lead the girl into one of the other exam rooms, Sam shakes his head sadly. "I'm so lucky. I'm older and only have to swallow a pill. I don't know what I would have done if I had gotten diabetes when I was just a kid."

Differentiating among the different types of diabetes

Traditionally, when people hear the phrases "childhood diabetes" or "diabetes in children," they automatically think of type 1 diabetes, a condition characterized by the failure of the pancreas to produce insulin. In fact, until only a few years ago, it was actually believed that the existence of type 2 diabetes (formerly referred to as adult-onset diabetes) in children was indeed rare. Today, however, we know that people younger than 20 years of age are affected by type 2 diabetes. It is estimated that about 215,000 people younger than 20 had either type 1 diabetes or type 2 diabetes in 2010 in the United States.

Type 1 diabetes

There are three major types of diabetes. Type 1 diabetes, formerly known as insulin-dependent or juvenile-onset diabetes, is caused by the destruction or the suppression of the beta cells in the pancreas. This leads to a failure of the pancreas to release insulin, which is necessary for human survival.

Type 1 diabetes can affect people of all ages, but it is usually diagnosed in children or very young adults. Persons with type 1 diabetes are insulin-dependent. They and their families must learn to inject insulin, monitor blood glucose levels, and monitor their intake of carbohydrates.
Type 2 diabetes

The vast majority of diabetics are affected by type 2 diabetes. Type 2 diabetes, formerly referred to as non-insulin dependent diabetes or adult-onset diabetes, is characterized by insulin deficiency and insulin resistance. Diagnosis of type 2 diabetes is usually made in people over the age of 40, but it can also occur in children and young adults as well.

The symptoms of type 2 diabetes can be quite mild, and the disease can remain undetected for a number of years. The disease may not be diagnosed until abnormal results are noted in blood or urine glucose levels.

**Diabetes alert!** Type 2 diabetes is often linked with obesity. Obesity can cause blood glucose levels to increase and insulin resistance to occur.

Gestational diabetes (GDM)

GDM occurs during pregnancy and is characterized by high blood glucose levels that usually return to normal after delivery. GDM occurs in one out of 25 pregnancies throughout the world and is “associated with complications in the period immediately before and after birth.” The children of women who have GDM are at a greater risk for the development of type 2 diabetes later in life. Women who have GDM are also at greater risk for developing type 2 diabetes. It is estimated that these women have a 40-60 percent chance of developing type 2 diabetes within five to 10 years after child delivery.

In addition to these three major types of diabetes, there are variations known as “other specific types.” These include:

- Diabetes that is a result of a genetic defect.
- Diabetes that is due to a dysfunction of an endocrine gland.
- Diabetes that is due to exposure to some drugs or chemicals.

Incidence and prevalence of diabetes

The National Diabetes Information Clearinghouse (NDIC) has compiled National Diabetes Statistics, 2011 (the most current statistics available as of this writing). These statistics were obtained from a number of data systems, including the Centers for Disease Control and Prevention (CDC), the Indian Health Service’s (IHS’s) National Patient Information Reporting System, the U.S. Renal Data System of the National Institutes of Health (NIH), and the U.S. Census Bureau and published studies. According to this database:

- Diabetes affects 8.3 percent of the population of the United States, or about 25.8 million people.

- It is estimated that 7 million people have diabetes but have not yet been diagnosed.
- Diabetes is the leading cause of kidney failure, new cases of blindness, and non-traumatic lower limb amputations in adults in the United States.
- Diabetes is a significant cause of cardiovascular and cerebrovascular disease.
- Diabetes is the seventh leading cause of death in the United States.

Diabetes in people younger than 20 years of age

As of 2010, an estimated 215,000 people less than 20 years of age had diabetes, type 1 or type 2. This figure represents 0.26 percent of all young people in this age group.

A number of statistics on the incidence of diabetes in people younger than 20 years of age have been compiled thanks to SEARCH for Diabetes in Youth, a multicenter study funded by the CDC and the NIH. The purpose of the study was to investigate the incidence and prevalence of type 1 and type 2 diabetes in children and adolescents in the United States.

Some of the findings from this study include:

- During the years from 2002 through 2005, 15,600 young people were newly diagnosed annually with type 1 diabetes, and 3,600 were newly diagnosed annually with type 2 diabetes.
- The rate of new cases of type 1 diabetes among children less than 10 years of age was 19.7 per 100,000 each year and 0.4 per 100,000 for type 2 diabetes.

The rate of new cases among young people older than 10 years of age was 18.6 per 100,000 per year for type 1 diabetes and 8.5 per 100,000 for type 2 diabetes.

- The highest rate of new cases of type 1 diabetes among young people occurred in non-Hispanic white youths.
- The occurrence of type 2 diabetes was quite rare among children less than 10 years of age. Rates were higher among youths 10-19 years of age than in younger children. Rates were higher among minority populations than in non-Hispanic whites.

Boston Children’s Hospital posts the following statistics on incidence and prevalence on its website:

- Approximately one in every 600 children in the United States develops type 1 diabetes.
- Type 1 diabetes is one of the most common chronic diseases in children.
- Type 1 diabetes most often occurs during puberty; ages 10 to 12 in girls and ages 12 to 14 in boys. However, it is increasing in very young children less than 5 years of age.
- Type 1 diabetes tends to occur within families.

The development of diabetes

It is important for learners to know about the normal functioning of the body before they can comprehend the processes involved in the development of diabetes. The specific factors related to diabetes vary with the type of diabetes affecting the patient.

Development of type 1 diabetes

Type 1 diabetes is caused by destruction or suppression of the beta cells of the pancreas. It may also be caused by a primary defect in the functioning of the beta cells that causes insulin release failure and inadequate transport of glucose.

Type 1 diabetes can be subdivided into idiopathic and immune-mediated types.

- Idiopathic type 1 diabetics have a permanent deficiency of insulin without evidence of autoimmunity.
- Immune-mediated type 1 diabetics are affected by a deficit or defect that causes an autoimmune attack on the beta cells of the pancreas. This leads to a pancreatic inflammatory response called insulitis.

In the immune-mediated form of type 1 diabetes, antibodies may be present for some time before symptoms appear. By the time signs and
it is converted to energy. However, in type 2 diabetes, cells develop triggers the opening of portals to allow glucose to enter the cell, where insulin molecules bind to preceptors on the body’s cells. Insulin triggers the opening of portals to allow glucose to enter the cell, where it is converted to energy. However, in type 2 diabetes, cells develop

**Development of type 2 diabetes**

Type 2 diabetes is a chronic disease that is the result of impaired secretion of insulin, inappropriate hepatic glucose production, or peripheral insulin receptor insensitivity. Under normal conditions, insulin molecules bind to preceptors on the body’s cells. Insulin triggers the opening of portals to allow glucose to enter the cell, where it is converted to energy. However, in type 2 diabetes, cells develop a resistance to insulin that makes it harder for glucose to enter cells. Without adequate glucose, the cells do not receive enough energy, glucose builds up in the blood vessels, and all organs of the body experience some degree of damage.

**Development of other forms of diabetes**

So-called secondary forms of diabetes are those caused by conditions such as pancreatic disease, pregnancy, hormonal or genetic problems, and various drugs or chemicals. Common causes include:

- **Physical or emotional stress**: Stress may elevate the levels of stress hormones (cortisol, epinephrine, glucagon, and growth hormone), which elevate blood glucose levels and increase the demands placed on the pancreas.
- **Pregnancy**: Gestational diabetes is characterized by glucose intolerance, possibly due to placental hormones counteracting insulin.

**Risk factors for the development of diabetes in children**

Robert and Sandra have been happily married for 15 years. They have three children, one of whom is 12-year-old Scott. Lately, they have been a bit worried about Scott. He has been unusually tired and irritable and has been losing weight despite eating large amounts of food. Scott’s pediatrician suspects that Scott may have type 1 diabetes. He asks Robert and Sandra about any family history of the disease. Both parents deny any history. But Robert, who was raised by his mother and stepfather, wonders about the health history of his biological father, who died when Robert was just a toddler. Robert calls his mother who relays that his father did indeed have diabetes “since he was very young.”

There are a number of risk factors for both type 1 and type 2 diabetes. Family history is one such factor. It is important that parents know and understand the implications of risk factors for the development of diabetes.

**Risk factors for type 1 diabetes**

The exact cause of type 1 diabetes is not known. However, research indicates that in the majority of people with type 1 diabetes, the child’s own immune system actually destroys the beta insulin-producing cells of the pancreas. Thus, the pancreas of a type 1 diabetic produces very little or no insulin, which, under normal conditions, facilitates the transport of glucose into the cells of the body. Thus glucose builds up in the bloodstream leading to various, sometimes life-threatening, complications.

As research shows, genetics and family history play a part in the development of most if not all diseases and disorders. Type 1 diabetes is no exception. Family history of type 1 diabetes, especially that of a parent or sibling, increases the risk of developing the disease.

Genetic testing for certain genes may also become more common in the future. It is believed that the presence of particular genes increases the risk for diabetes 1. As of this writing, genetic testing for type 1 diabetes is generally done as part of a clinical trial.

Genetics and family history are agreed-upon risk factors. There are a number of other possible risk factors for the development of type 1 diabetes. Exposure to viruses such as the Epstein-Barr virus, coxsackievirus, mumps virus, and cytomegalovirus may spark autoimmune destruction of islet cells. It is also possible that the viruses themselves infect the islet cells.

Adequate levels of vitamin D may help to protect against the development of type 1 diabetes. Conversely, inadequate levels of vitamin D may increase the risk for development of the disease. However, an interesting finding is that early consumption of cow’s milk (a source of vitamin D) is associated with an increased risk for the development of type 1 diabetes.

Some dietary factors have been linked to an increased risk of developing type 1 diabetes. These include:

- Consuming water that contains nitrates may also increase the risk of type 1 diabetes.
- Introducing cereal as part of the baby’s diet may affect risk. Results from a clinical study indicated that the optimal time for adding cereal to the diet is between the ages of 4 and 7 months. The introduction of cereal and other solid foods is continually being evaluated. The infant’s physician should be the primary guide on diet.
- Consuming certain types of baby formulas may influence the risk of type 1 diabetes. Research findings indicate that giving babies formulas that are easier to digest (such as hydrolysate) when they are between 6 and 8 months old may reduce the risk of type 1 diabetes. But this same study did not link cow’s milk formulas to an increased risk of type 1 diabetes.

**Breast-feeding and diabetes type 1 alert!** Some research studies suggest that breast-feeding can reduce the risk of type 1 diabetes in children.
Risk factors for type 2 diabetes

The single greatest risk for type 2 diabetes in children is excess weight.13 Sadly, obesity has reached epidemic proportions among children in the United States. Almost one in five children is considered overweight, and once a child is found to be overweight, his or her chance of developing type 2 diabetes is doubled.13

It makes sense, therefore, that factors that contribute to being overweight or obese also contribute to the risk of acquiring type 2 diabetes.13 Unhealthy eating habits, such as consumption of fast foods that are high in fat and calories, a lack of fruits and vegetables, and an excess of carbohydrates, all facilitate unhealthy weight gain. Weight gain, in turn, increases the risk of type 2 diabetes.15

A lack of physical activity is also a risk factor for type 2 diabetes (and weight gain).13 Research shows that physical activity has positive health benefits on all body systems. A lack of exercise increases the risk of illness, including type 2 diabetes.2,13 Other medical conditions, hormonal influences, and genetics may also play a role in a child’s weight. Additionally, children’s risk for type 2 diabetes seems to be linked in particular to excess abdominal weight.13 Other risk factors for type 2 diabetes in children include:1,13

- Being female.
- Being part of certain ethnic groups (African-American, Asian American, Hispanic, Pacific Islander, and Native American).
- Hypertension (children as well as adults may be hypertensive).
- Elevated triglycerides.

Complications of diabetes and bodily changes

There are a number of potential complications of diabetes, many of which can be life-threatening. It is important that parents and other caregivers are aware of these complications and what actions to take to prevent their occurrence. As children develop intellectually, they, too, must be taught how to avoid complications of the disease.

Hypoglycemia

Allison is 16 years old and was diagnosed with type 1 diabetes two years ago. Allison is one of the stars on her field hockey team. The team is competing for a state title, and every practice session is important. Practice is scheduled for 10 a.m. on this Saturday morning, but Allison’s day is off to a bad start. She cannot find her hockey stick, and after searching for it for 20 minutes, she discovers that her little brother has hidden it as a “joke.”

Her father has to take her siblings to their various activities as well as drive Allison to practice. He tells her to hurry. Her mother, a nurse at the local hospital, is at work. Allison quickly injects herself with her normal dose of insulin. She means to grab some fruit to eat in the car, but in her haste, she forgets.

As her father drops her off at practice he asks, “Did you take your insulin? Did you eat breakfast?” Not wanting to miss practice, Allison nods her head. About midway through practice, Allison begins to feel “shaky.” Her heart is beating uncomfortably fast, her head aches, and her vision begins to blur. Allison is experiencing hypoglycemia.

Hypoglycemia occurs when the blood glucose level is too low. Allison’s failure to eat breakfast even though she administered her normal dose of insulin led to the development of this complication. Vomiting and diarrhea can also reduce intake of proper nutrients and lead to hypoglycemia. If the child is ill and unable to ingest proper amounts of nutrients, his or her insulin dose may need to be adjusted. The child’s physician should be notified and guidance obtained about any medication dosage adjustments.1,3,8

Signs and symptoms of hypoglycemia include:1,3,8

- Anxiety.
- Double or blurred vision.
- Fatigue.
- Headache.
- Hunger.
- Irritability.
- Numbness or tingling of the skin.
- Rapid, pounding heartbeat.
- Shaking or trembling.
- Sweating.
- Weakness.

Untreated, hypoglycemia may lead to fainting, seizures, and even coma.1,3,8

Treatment involves checking blood glucose level (if possible) and giving the child a quick-acting carbohydrate, such as fruit juice or hard candy.1 If symptoms do not subside or worsen after giving carbohydrates, emergency medical assistance is needed.

Hyperlglycemia

Scott is an outgoing teenager who also happens to have type 1 diabetes. He is usually careful to adhere to his dietary restrictions and takes his insulin faithfully. However, the past week or so, Scott has been less careful. He has been going out with friends after sporting events and going to see various movies at the local cinema. Part of these social activities involves, of course, eating. Scott has been, as he puts it, “cheating on his diet,” indulging in pizza, buttered popcorn, and carbonated soft drinks.

After a few days, Scott begins to complain of being thirsty all of the time; he needs to get up several times at night to go to the bathroom, and he feels nauseous. His parents quiz him about his activities and quickly help him to return to his normal dietary intake.

It can be challenging to adhere to a carefully controlled diet. It can be especially difficult for teenagers who are diabetics. They want to socialize, have fun, and be like their friends. Even the most cautious young diabetics will cheat now and then on their diets. They and their parents and friends need to be able to recognize signs that hyperglycemia is occurring and how to react.

Hyperglycemia is not always caused by a failure to adhere to dietary restrictions. It can be caused by illness, inadequate dosage of insulin, and the lack of recommended physical activity.1

Signs and symptoms of hyperglycemia are similar to those of diabetes and include:1,13

- Excessive thirst.
- Excessive urination and possible bedwetting.
- Nausea and vomiting.
- Weight loss.
If these signs and symptoms appear, the child’s urine is checked for ketones and his or her blood glucose level is checked.

**Diabetic ketoacidosis**

Diabetic ketoacidosis is a medical emergency that, if left untreated, may lead to coma or death. Most common in patients with type 1 diabetes, diabetic ketoacidosis may actually be the first sign of previously undiagnosed type 1 diabetes. In ketoacidosis, there is an absolute, acute deficiency of insulin. Insulin is necessary for the transport of glucose into the cells. Without insulin, the cells do not have glucose to use for energy, so the body breaks down fat in an attempt to find an energy source. As fats are broken down, acids called ketones build up in both the blood and urine. High levels of ketones are poisonous to the body.

At the same time, the levels of blood glucose become alarmingly high, usually greater than 300 mg/dL, because the liver manufactures glucose in an attempt to deal with the buildup of ketones. However, the cells cannot accept glucose without the help of insulin, which is not present.

Although patients with type 2 diabetes can develop ketoacidosis, it is rare and may be a response to a severe illness or infection. Hispanics and African-Americans experience diabetic ketoacidosis more often than other racial groups.

Primary symptoms of diabetic ketoacidosis include:

- Abdominal pain.
- Deep, rapid respirations (Kussmaul’s respirations).
- Dry mouth.

**Heart disease**

Anthony is a 50-year-old high school basketball coach. He has also been dealing with a diagnosis of type 1 diabetes since he was a teenager. Anthony has worked hard to stay physically fit, but does cheat on his diet a “little more than I should.” He exercises regularly and does not drink alcohol. Anthony does, however, smoke 5-10 cigarettes a day. One afternoon, on his way to his team’s practice session, he begins to feel nauseous. After he arrives at the gym, he develops what he describes as a “suffocating” chest pain. One of his students calls 911. At the emergency room, Anthony is diagnosed as having had a myocardial infarction (heart attack).

Heart disease is a common complication of diabetes. Children and teenagers who are diabetics need to work hard to stay physically fit because diabetes does have a negative effect on the cardiovascular system.

Adults who have diabetes have heart disease-related deaths about two to four times greater than adults without diabetes. Moreover, heart disease was noted on 68 percent of diabetic-related death certificates among people ages 65 years or older. In other words, the risk of heart disease increases dramatically for those who are diagnosed with diabetes.

High levels of blood glucose can cause arteriosclerosis, which further increases the risk of heart attack. Children and their parents and caregivers should be taught about the dangers of heart disease and actions to take to reduce its risk as soon as possible after diagnosis. Even young children can learn to avoid high-fat foods and to incorporate exercise into their daily routines. Today, technology facilitates sitting in front of a computer or other devices through which they can access the Internet and play various video games. The dangers of a sedentary lifestyle seem to increase with each new technological advance. Children need to be encouraged to go outside and play games that require physical activity!

Many of the healthy lifestyle actions overlap from risk factor to risk factor. Obesity and lack of exercise contribute to the risk of heart disease as well as many other diseases. Here is a summary of actions that have been shown to reduce the risk of heart disease.

- **Adhere to diabetic treatment plan to control blood glucose levels.** Significantly fluctuating blood glucose levels increase the patient’s risk for complications.
- **Monitor blood pressure.** Avoid excessive amounts of caffeine and sodium, which can facilitate the elevation of blood pressure. If hypertension does develop, follow treatment interventions as prescribed by health care providers.
- **Monitor cholesterol.** If medication is needed to control cholesterol levels, adhere to prescribed treatment regimens.
- **Exercise regularly.** Exercise should be part of everyone’s routine. Children who learn to engage in an active lifestyle at an early age are more likely to continue such behavior into adulthood.
- **Achieve and maintain optimal weight.**
- **Adhere to a diet that facilitates blood glucose control.** Avoid foods high in fat, salt, cholesterol, and excess carbohydrates.
- **Reduce stress as much as possible.** Learn coping skills and seek out support groups for diabetics and families of diabetics. Stress has an adverse effect on many, if not most, of the systems of the body.
- **Review family medical history.** Find out whether there is a family history of heart disease and at what age signs and symptoms of heart disease became evident.
- **Adhere to a treatment regimen.** Diabetics are already dealing with a multitude of treatment interventions such as medication, diet, exercise, and so forth. Adding heart disease interventions may be perceived as too overwhelming. All patients need encouragement and support to take the actions that will help them to achieve their maximum state of health and wellness.
- **Stop smoking, or do not start smoking!**
- **Drink alcohol moderately or not at all.**

**Hyperglycemic alert!** If the signs and symptoms of hyperglycemia are accompanied by deep, rapid respirations and a rapid heart rate, the child may be deteriorating and experiencing the medical emergency condition of ketoacidosis.
Hypertension

Monica is a 40-year-old local television news reporter. She has also been a type 1 diabetic since she was 17 years old. Monica has always done her best to reduce her risk of complications from diabetes. She exercises regularly and carefully monitors her diet. She neither smokes nor drinks alcoholic beverages. Unfortunately she has also developed hypertension. Monica is angry and tells her physician that she has always taken good care of herself and now has to deal with a “new” problem. Her doctor assures her that she is doing exactly what she should do, but she has a family history of hypertension as well as diabetes, and the important thing is to monitor her blood pressure and take an anti-hypertensive as prescribed.

Hypertension is yet another potential complication of diabetes. Statistics available from the National Diabetes Information Clearinghouse (NDIC) include findings that between 2005 and 2008, 67 percent of adults ages 20 or older with self-reported diabetes had blood pressure equal to or greater than 140/90 mm Hg (millimeters of mercury) or used prescription medications to treat hypertension.3

The preventive or management tactics for hypertension are the same as for heart disease. These interventions, such as exercise, diet, stress management, and adherence to treatment regimens, are part of a healthy lifestyle for many, if not most, diseases.

Hypertension is generally referred to as a “silent” problem. It generally produces no symptoms until blood pressure is so high that patients have strokes or other catastrophic manifestations of the condition. The American Diabetes Association recommends that patients have their blood pressure checked at every physician’s office visit or at least two to four times a year.19

Current blood pressure classifications identified by The National Institutes of Health (NIH) are as follows:1

- **Normal**: Less than 120/80 mm Hg.
- **Pre-hypertension**: 120-139 mm Hg systolic or 80 to 89 mm Hg diastolic.
- **Hypertension stage 1**: 140-159 mm Hg systolic or 90 to 99 mm Hg diastolic.
- **Hypertension stage 2**: Equal to or greater than 160 mm Hg systolic or equal to or greater than 100 mm Hg.

 Stroke

Two out of three people with diabetes die from stroke or heart disease.20 High glucose levels can promote the development of arteriosclerosis, which is a risk factor for both stroke and heart disease.3 Just being diabetic increases the risk of stroke.

Other stroke risk factors include:20
- Abnormal cholesterol levels.
- Family history of stroke.
- Hypertension.

**Peripheral arterial disease (PAD)**

Peripheral arterial disease, also referred to as arterial occlusive disease, is the obstruction or narrowing of the lumen of the aorta and its major branches. This causes interference with blood flow, especially to the legs and feet.1

People with diabetes are quite likely to have PAD. It is estimated that one out of every three people with diabetes over the age of 50 has PAD. Other factors that increase the risk of this disease include smoking, hypertension, being overweight, lack of physical activity, and personal or family history of stroke or heart disease.21

Although this complication generally occurs after the age of 50, it is important that young diabetics become aware of complications (when they are ready to learn about them) and steps to take to reduce their risk.

Many diabetics who have PAD do not experience any signs or symptoms. This makes it especially important for people to be aware of this complication and how to screen for it.21

Some persons may have mild leg pain, especially when walking or during exercise. This pain usually disappears after resting for a few minutes. People may also experience numbness, tingling, or coldness in the lower legs or feet. Infections, sores, or lacerations on the feet or legs may heal slowly.21

As young diabetics reach middle age, they may need to be screened for PAD, even if they have no symptoms. PAD is diagnosed via the following diagnostic tests:21

- **Ankle brachial index (ABI)** compares blood pressure in the ankle to blood pressure in the arm. If the blood pressure in the ankle is less than the pressure in the arm, PAD is a possibility. The American Diabetes Association recommends that people with diabetes who are over 50 years old have an ABI to screen for PAD.
- **An angiogram** involves the injection of dye into the blood vessels to determine whether arteries are narrowed or blocked.
- **An ultrasound** uses sound waves to produce images of blood vessels for assessment.
- **An MRI (magnetic resonance imaging)** is performed to identify any blockages within blood vessels.

Exercises, such as walking, can be part of the treatment for PAD and may even help to prevent it. Other measures to manage or prevent PAD include blood glucose control, not smoking, controlling blood pressure, and keeping cholesterol within normal limits. In some cases, surgical interventions such as angioplasty and artery bypass graft may be performed.21

**PAD alert!** Some research studies indicate that anti-platelet medications such as aspirin may lower the risk of heart attacks and strokes in people with PAD.21

Eye problems

Persons with diabetes are at significant risk of eye complications, and most will develop some type of retinopathy, which is the result of damage to blood vessels of the retina.20,22 Here is a summary of the most common eye problems affecting people who have diabetes.
Glaucoma

The longer someone has had diabetes, the greater the probability of developing glaucoma. In fact, diabetics are 40 percent more likely to acquire glaucoma than those without the disease.22

Glaucoma is actually a group of disorders that are characterized by damage to the optic nerve. This damage is most often linked to a high intraocular pressure (IOP). The pressure slows the drainage of aqueous humor, causing it to build up in the eye’s anterior chamber. The pressure “pinches” the blood vessels carrying blood to the retina and optic nerve. A gradual loss of vision occurs as the retina and optic nerve are damaged.23

Treatment of glaucoma includes drug therapy, laser treatments, and surgery.3

Cataracts

Diabetics are 60 percent more likely to develop cataracts than those without diabetes. They often develop cataracts at a younger age, and the cataracts progress more quickly.22 Cataracts are the most common cause of correctable vision loss. Cataracts are gradually developing opacities of the lens of the eye or of the lens capsule. Generally, surgical removal of the lens of the eye or eyes affected by the cataracts improves vision. However, after such surgery, retinopathy may become worse in diabetics, and glaucoma may begin to develop.2,22

Retinopathy

Diabetic retinopathy refers to disorders of the retina caused by diabetes.22 It is characterized by damage to the blood vessels of the retina, the light-sensitive tissue located at the back of the eye.23

Diabetic retinopathy can affect anyone who has type 1 or type 2 diabetes. Initially, there may be no or only mild visual symptoms. However, as the disorder progresses, visual deficits increase and blindness may eventually occur.23

There are two major categories of diabetic retinopathy.22,23

- Nonproliferative diabetic retinopathy (NPDR): NPDR is sometimes referred to as early diabetic retinopathy and is the most common type of diabetic retinopathy. With NPDR, new retinal blood vessels fail to grow or proliferate. The walls of the existing retinal blood vessels weaken. Small bulges (microaneurysms) protrude from the vessel walls and cause leakage of blood and other fluids into the retina. As the disorder progresses, retinal nerve fibers begin to swell. Blood and fluids leak into the macula, the central portion of the retina that focuses vision. The macula swells (macular edema) and vision becomes blurred, and may even be completely lost. NPDR is classified as mild, moderate, and severe, as more and more blood vessels become affected. NPDR in its less severe forms does not usually require treatment. However, macular edema must be treated to stop, and sometimes even reverse, vision loss.

- Advanced diabetic retinopathy or proliferative retinopathy: Proliferative retinopathy (PDR) is the most serious form of diabetic retinopathy. At this stage of retinopathy, new but abnormal blood vessels begin to grow in the retina. These new vessels are weak and can grow or leak blood into the vitreous, the clear, jelly-like substance that “fills” the center of the eye. Scar tissue forms as a result of stimulation from new blood vessel growth. This scar tissue can distort the retina or cause it to detach from the back of the eye (retinal detachment). The new blood vessels may also interfere with the normal flow of fluid out of the eye, causing an increase in pressure that leads to glaucoma. Unfortunately, the retina can be significantly damaged before any vision changes occur. Thus it is imperative that persons with diabetes have regular eye examinations by specialists who are accustomed to treating diabetics.

There are several factors that can increase the risk for diabetic retinopathy. These include:22,23

- Duration of diabetes: The longer someone has diabetes, the greater the risk of diabetic retinopathy.
- Elevated cholesterol.
- Hypertension.
- Poorly controlled blood glucose levels.
- Pregnancy.
- Use of tobacco products.

Retinopathy alert! Nearly all persons who have type 1 diabetes will develop some degree of NPDR. Most people who have type 2 diabetes will also develop the disorder. However, the occurrence of the more serious PDR is significantly less common.22

Diabetic retinopathy usually affects both eyes. Persons with diabetes should be taught that in the early stages of diabetic retinopathy, there are usually no symptoms. As the disease progresses, symptoms that may appear include:23

- Blurred vision.
- Dark or empty areas in visual fields.
- Difficulty distinguishing colors.
- Floaters (dark spots or “strings” that seem to float in the visual fields).
- Vision loss.

Diabetic retinopathy is diagnosed most effectively with a dilated eye exam. During this exam, the physician will look for:23

- Abnormal blood vessels.
- Abnormalities of eye pressure.
- Bleeding into the vitreous.
- Cataracts.
- Detached retina.
- Growth of new blood vessels and the presence of scar tissue.
- Optic nerve abnormalities.
- Vision abnormalities.

Some diagnostic studies that may be performed include:23

- Fluorescein angiography: During this test, the pupils are dilated and pictures are taken of the interior of the eye. Dye is then injected into a blood vessel in the arm. As the dye circulates to and through the eyes, images are taken and abnormalities of the blood vessels are identified.

- Optical coherence tomography (OTC): This is an imaging test that produces images of the retina to assess retinal thickness and whether blood and fluids have leaked into the retina.

Treatment options depend on the severity of the retinopathy. Options include:23

- Focal laser treatment (photocoagulation): This involves treating leakage from abnormal blood vessels with laser treatment. Generally accomplished in a single session in a clinic or physician’s office, this treatment causes blurry vision that generally subsides within a day. Patients may also see small spots in their visual fields that subside within a few weeks. Outcomes are not assured. Some persons may never recover their normal vision, but others may actually experience improved vision.

- Scatter laser treatment (the entire retina): This form of laser treatment shrinks abnormal blood vessels and is performed in the physician’s office or eye clinic. The treatment is generally accomplished in two or more sessions. Vision is blurry for a
Skin problems

It is estimated that about one-third of persons affected by diabetes will develop some type of skin problem caused or affected by diabetes at some point in their lifetime. Fortunately, many of these problems can be prevented or effectively treated if identified early.

Many of these problems are fairly common in the general population. However, people with diabetes are more prone to infections than the general population. Good skin care and hygiene is essential for all persons with diabetes. Children who have diabetes must be taught how to take care of their skin. Even very young children can learn how to wash their hands, always to wear shoes, and to take care of (or seek help to take care of) cuts, scrapes, and other skin injuries. They also need to be taught how to avoid injuring their skin.

Some of the skin complications related to diabetes include:

- **Bacterial infections:** Common bacterial infections include sties, boils, infections around the nails, around the hair follicles, and deep within the skin.
- **Fungal infections:** Most fungal infections affecting persons with diabetes are caused by Candida albicans, which frequently affects moist areas of the skin, such as under the breasts, between fingers and toes, and in the axilla and groin.
- **Diabetic dermopathy:** Diabetes-related changes in the small blood vessels may lead to diabetic dermopathy. This condition causes light brown, scaly patches that are oval or circular. Often mistaken for age spots, this condition usually occurs on the front of both legs. The patches do not cause discomfort, itch, or become open areas on the skin.
- **Eruptive xanthomatosis:** This skin condition is caused by diabetes that is uncontrolled. Yellow, pea-size areas appear on the skin. Each of these “bumps” has a surrounding red halo and may be itchy. The bumps show up most often on the backs of the hands, feet, arms, legs, and buttocks. This problem most often occurs in young men who have type 1 diabetes and elevated cholesterol. The condition subsides when glucose control is achieved or restored.
- **Digital sclerosis:** Digital sclerosis is characterized by tight, thick, “waxy” looking skin on the backs of the hands and occasionally on the toes and forehead. The joints of the fingers become stiff and difficult to move normally.

Neuropathy

Diabetic neuropathy (diabetic nerve damage) affects nearly half of all persons with diabetes. Over the years, elevated blood glucose levels cause injury to the walls of the blood vessels, thus interfering with proper circulation to nerve fibers. Elevated glucose levels interfere with the ability of the nerves to transmit messages to and from the brain to various parts of the body. As nerve fibers are damaged, a variety of symptoms appear. These can range from mild to severe and can even be fatal.

There are four major types of diabetic neuropathy. People may have only one type or be affected by multiple types.

- **Peripheral neuropathy:** This is the most common type of diabetic neuropathy. Feet and legs are usually affected first, followed by the hands and arms. Signs and symptoms include reduced ability to feel pain or changes in temperature; pain and weakness when walking; acute sensitivity to even the lightest touch (e.g., the weight of a sheet in bed); and pain, numbness, weakness, or tingling in the hands and feet.
- **Autonomic neuropathy:** The autonomic nerves of the body control the function of the heart, bladder, lungs, stomach, intestines, eyes, and sexual organs. Damage to these nerves can cause bowel and bladder problems; nausea and vomiting; trouble swallowing; vaginal dryness; erectile dysfunction; diaphoresis; tachycardia; vision problems; and the inability of the body to make necessary adjustments to body temperature, heart rate, and blood pressure to maintain homeostasis.
- **Radiculoplexus neuropathy (diabetic amyotrophy):** This type of neuropathy affects nerves in the thighs, hips, buttocks, and legs. It is more common in older adults and in persons who have type 2 diabetes. Symptoms, which usually occur on one side of the body, include abrupt severe pain in the hips, thighs, or buttocks, weak and atrophied thigh muscles, trouble getting up from a sitting position, weight loss, and abdominal swelling.
- **Mononeuropathy:** This type of neuropathy causes damage to a specific nerve in the face, torso, or leg. It develops abruptly and is most common in older adults. Mononeuropathy causes severe pain that usually resolves itself over a period of several weeks to several months. Signs and symptoms depend on the nerve affected and may cause paralysis on one side of the face (Bell’s palsy); pain in the shin, foot, or front of the thigh; double vision; difficulty focusing the eyes; aching eyes; or chest or abdominal pain.

Diabetes alert! People between 10 and 29 years of age and who have had diabetes for at least five years should have an annual dilated eye exam. Blood pressure should be monitored and controlled within normal limits because hypertension can make eye problems worse.

Nephropathy (kidney disease)

Under normal conditions, the kidneys filter waste products from the body and excrete them as part of the urinary output. Useful substances, such as proteins, remain in the blood. High levels of blood glucose, however, can cause the kidneys to filter excessive amounts of blood. This extra workload places strain on the kidneys and interferes with the normal filtering process, ultimately causing protein to be filtered into the urine instead of remaining in the blood. Small amounts of protein in the urine (microalbuminuria) are an indication of early kidney disease (nephropathy) and have treatment options focused on keeping blood glucose within normal limits and controlling blood pressure.

As nephropathy progresses, larger amounts of protein are found in the urine (macroalbuminuria). This indicates later-stage disease and ultimately progresses to end-stage renal disease (ESRD). At this point, the kidneys are unable to filter waste products, and the kidneys fail. Dialysis or kidney transplantation becomes necessary.

- **Diabetic dermopathy:** This skin condition is caused by diabetes that is uncontrolled. Yellow, pea-size areas appear on the skin. Each of these “bumps” has a surrounding red halo and may be itchy. The bumps show up most often on the backs of the hands, feet, arms, legs, and buttocks. This problem most often occurs in young men who have type 1 diabetes and elevated cholesterol. The condition subsides when glucose control is achieved or restored.
- **Digital sclerosis:** Digital sclerosis is characterized by tight, thick, “waxy” looking skin on the backs of the hands and occasionally on the toes and forehead. The joints of the fingers become stiff and difficult to move normally.

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Foot problems are very common among people who have diabetes. Such problems are closely linked to diabetic neuropathy and can lead to serious complications, such as infection, foot ulcers, reduced arterial blood flow, and amputation of the foot or leg.

Why are these serious problems so common among diabetics? Here are some explanations:

- **Neuropathy**: Neuropathy, or diabetic nerve damage, can cause significant pain. However, damaged nerves may also interfere with the ability to sense pain, heat, and cold. This means that patients may burn themselves (e.g., walking on a sandy beach or hot sidewalk), have chafing of the feet in shoes that do not fit properly, walk with a pebble in the shoe, or experience other annoyances they are not aware of because of the decrease in sensation. These annoyances can turn into serious problems. People with diabetes may not sense a minor injury until the skin breaks down and becomes infected, thus turning into a major injury.

- **Skin changes such as calluses, corns, and ulcers**: Diabetes can cause the skin to become quite dry, peel, crack, and become easily injured. This is most likely caused by damage to the nerves that control the oil and moisture in the feet. The pressure on the feet from walking can cause callus formation. These calluses need to be trimmed by a health care provider to avoid breakdown of the calluses, which may lead to ulcers and infection.

  **Diabetes alert!** Patients should not attempt to trim or remove calluses or corns themselves. Only a trained health care provider should do this!

- **Ulcers of the feet**: Ulcers are found most frequently on the ball of the foot or on the bottom of the big toe. They may also form on the sides of the feet if shoes fit poorly. All ulcers, no matter how small or even if they do not cause pain or other discomfort, should be evaluated by a health care provider. Ulcers may become infected and lead to serious problems, even amputation.

Diabetes causes blood vessels to narrow and harden. This damage inhibits circulation to the extremities and makes persons with diabetes not only more susceptible to infection but also makes it more difficult for infections to heal.

  **Diabetes alert!** Amputations of the lower extremities are far more common among people with diabetes than the general population. Impaired circulation and decreased sensation to the lower extremities facilitate the development of ulcers, calluses, and infections, which may fail to heal and progress to the point that amputation is necessary.

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**Hyperosmolar hyperglycemic nonketotic syndrome (HHNS)**

Hyperosmolar hyperglycemic nonketotic syndrome (HHNS) is a complication seen most often in older adults. It can occur in people with either type 1 or type 2 diabetes, but most often is seen in people with type 2 diabetes. HHNS is usually triggered by another illness or infection.

HHNS is characterized by high, uncontrolled blood glucose levels. The body attempts to compensate by excreting glucose in increasingly high amounts in the urine. Large amounts of urine are excreted, resulting in excessive fluid and electrolyte loss and dehydration. Unchecked, HHNS causes severe dehydration, seizures, and ultimately death. Symptoms of HHNS include blood glucose levels over 600 mg/dl; severe thirst; warm, dry skin; high fever; vision loss; hallucinations; and weakness on one side of the body.

The best way to deal with HHNS is to prevent it by keeping blood glucose levels under control. Even though this is a problem affecting older adults, all persons with diabetics (at all age levels) should be aware of this serious complication.

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**Hearing loss associated with diabetes**

The NIH reports that the rate of hearing loss is 30 percent higher among people with diabetes compared to those with normal blood sugar levels. Such hearing loss occurs at any age, even among children. Assessment of hearing is an ongoing part of regular physical examinations for persons who have diabetes.

Persons with hearing loss may not even be aware that there is any problem. Family members and friends as well as the patients themselves should be alert to the following signs of hearing loss in persons with diabetes.

- Often asking others to repeat themselves.
- Complaining that others are mumbling.
- Difficulty following conversations that involve more than two people.
- Turning the volume of the television, radio, or other devices to very high levels.

**Diabetes alert!** Children may experience difficulty in school, such as deterioration in grades, because they are having trouble hearing their teachers.

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**Gastroparesis**

Gastroparesis is a form of neuropathy characterized by damage to the vagus nerve, which controls movement of food and liquids through the digestive tract. The movement of foods and liquids is slowed or even stopped. Patients with gastroparesis experience heartburn, nausea and vomiting, weight loss, bloating, anorexia, and gastric spasms.

Gastroparesis affects persons with both type 1 and type 2 diabetes. It can be treated with proper management of blood glucose levels, medications, and diet. Severe cases of gastroparesis may require insertion of a feeding tube.

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**DIAGNOSIS OF DIABETES**

**Signs and symptoms of type 1 diabetes in children**

- Increased thirst and fluid intake.
- Increased urination (polyuria).
- Excessive hunger.
- Weight loss.

- Unusual fatigue and lethargy.
- Changes in behavior.
- Irritability.
- Blurred vision.
- Yeast infections (girls may develop genital yeast infections, and infants may develop diaper rash caused by yeast).
Signs and symptoms of type 2 diabetes in children

Compared to signs and symptoms development in persons with type 1 diabetes, those of type 2 diabetes develop slowly. In fact, children (and adults) may not even feel that anything is wrong. Type 2 diabetes may be present for several months or even years before a diagnosis is made.13,14

Signs and symptoms associated with type 2 diabetes include:13,14
- Unusual fatigue.
- Nausea.
- Blurred vision.
- Increased thirst.
- Increased urination.
- Increased appetite.
- Heavy breathing.
- Pruritis.
- Slow healing of cuts, scrapes, or sores.
- Numbness or tingling in the hands or feet.

American Diabetes Association criteria for diagnosis

According to the American Diabetes Association (ADA), diabetes can be diagnosed if any of the following factors exist.1
- Signs and symptoms indicative of diabetes plus a non-fasting (random) blood glucose level greater than or equal to 200 mg/dl.
- A fasting blood glucose level greater than or equal to 126 mg/dl.
- A glucose tolerance test plasma glucose level greater than or equal to 200 mg/dl.

Diabetes alert! The ADA classifies fasting blood glucose levels as follows: normal: less than 100 mg/dl; pre-diabetes: 100 to 125 mg/dl; diabetes: greater than or equal to 126 mg/dl.3

If testing is inconclusive, the child’s physician may order a glycosylated hemoglobin (A1C) test. This test measures the percentage of blood glucose attached to hemoglobin. The higher the glucose levels, the more hemoglobin there is that has sugar attached. The test indicates the average blood glucose levels for the previous two to three months. An A1C result of 6.5 percent or higher on two separate tests indicates diabetes.7

Non-pharmacological treatment of diabetes

The goals of treatment are to normalize and control blood glucose and to decrease complications.3 These goals are achieved through a combination of medication, diet, exercise, and healthy lifestyle behaviors.2

Blood glucose monitoring

Persons with diabetes must learn to monitor their blood glucose levels, a procedure that must be performed for the rest of their lives. Blood glucose testing can seem overwhelming, and it may be tempting to skip testing. It is imperative that children, their parents, other caregivers, and teachers know how to check blood glucose levels. This can be especially critical if the children are displaying signs of hyper- or hypoglycemia (see sections on complications for detailed information).

Depending on the type and severity of diabetes, it may be necessary to check and record blood glucose levels at least three times a day and even more often. This is often accomplished by “finger sticks,” although some blood glucose meters allow testing to be performed on sites other than the fingers.7

Continuous glucose monitoring (CGM) is a newer way to monitor blood glucose levels, but is not yet as accurate as traditional or “standard” monitoring. Therefore, it is used in addition to traditional monitoring.7

Pharmacological treatment of diabetes

About two months ago, 9-year-old Joanna began experiencing bouts of extreme dehydration as well as drastic weight changes. Concerned with her daughter’s symptoms, Joanna’s mom Angela took her to see their primary physician. After physically examining Joanna and collecting blood samples, the physician diagnosed the young girl with type 2 diabetes. Once she overcame the initial shock of her daughter’s diagnosis, Angela needed to know what to do next. She wasn’t familiar with diabetes in children, and she had only known that frequent blood tests and injections were involved because of her grandmother’s struggle with the disease.

After their primary physician directed them to a physician who specialized in diabetes, Angela and Joanna had to begin visiting their local pharmacy—a pharmacy they had only previously used on occasion for their annual flu shots. Overwhelmed by the prospect of their new routine, Angela didn’t even know where to begin after a pharmacy technician filled out more of their information in the system. Joanna was similarly distraught at the thought of having to use injection cartridges for her insulin.

To help Angela and Joanna with this new phase in their lives, the technician called the pharmacist over for a consultation. After the pharmacist gave the mother and daughter a thorough tutorial on insulin and its possible side effects, the technician then explained the limitations of Joanna’s new government-provided insurance to Angela. With Angela and Joanna both seeming much calmer than when they had first walked in, the pharmacy technician lowered her head to Joanna and explained, “My name is Sarah. If you ever need anything or just want to call to say ‘Hi’, we’ll all be here for you, Joanna.”

Once children and their families have worked with a physician to create their regimen of treatment and fully understand the treatment, they are then directed to the pharmacy for medication. For patients diagnosed with type 1 diabetes, it is impossible to control the disease without insulin, which is available at pharmacies. Patients diagnosed with type 2 diabetes may be able to control their glucose levels through weight consistency, exercise, and a specific diet, but this is
very difficult to do, so either insulin or oral medication is oftentimes the safest option. When patients with diabetes begin using the pharmacy for their medication necessities, it is especially important to keep their patient files up-to-date and whole. For patients who transfer to your pharmacy, it is imperative that the pharmacist correspond with their former pharmacies to ensure that all of the correct files were transferred and that their entire history is in your possession. While such file-keeping procedures are necessary for all pharmacy patients, patients with diabetes are likely to be in the system for most of their lives and therefore require extra measures to guarantee accuracy in their treatment.

Patients with diabetes also will likely visit the pharmacy each month for their insulin and needles, so it is helpful to young patients if they are familiar with the staff who will assist them. Remember that these children are who are experiencing an often lifelong disease at such a young age, a disease that many of their peers in school will not have to experience. Nothing will help ease this scary process more than a little compassion and a smile.

When children with diabetes enter a pharmacy, they will not be the only ones facing a new challenge. Parents or guardians of children with diabetes can feel overwhelmed by the situation: their young child has been diagnosed with a chronic disease that even most adults struggle to handle.

While many adults with diabetes are able to monitor their glucose levels and diets as well as administer their own blood tests, this is not as easy for children less than 14 years of age. When children face diabetes, so do their parents. From the early symptoms to the physician’s office, a diabetic child’s care process is cyclic and made much less daunting once parents are in the know and master the routine.

Regardless of whether the parents of newly diagnosed diabetic children ask for a consultation upon their first visit to the pharmacy, one should be given. It could be that a parent is in a state of anxiety over all of this new information and feels timid about asking, or it could be that the parent does not know that some type of consultation with the pharmacist is available to them. And regardless of whether your pharmacy requires consultations with every prescription (which can often be forgotten in the hustle and bustle of a pharmacy), remember that a consultation with parents and their newly diagnosed diabetic child is a must. Apart from the collective staff’s compassion, a substantial amount of information will smooth this transition for the families of diabetic patients.

Outlined below are the various medications that you will be distributing to patients with all forms of diabetes.

### Oral medications

Children (and adults) with type 2 diabetes generally use oral medications (in conjunction with diet, exercise, and healthy lifestyle behaviors) to control blood glucose levels. However, some children with type 2 diabetes may require insulin.

Children and parents must be taught that oral medications are NOT a form of insulin. These medications act by stimulating the release of insulin from functioning pancreatic beta cells and by increasing the sensitivity of the body’s peripheral tissues to insulin. Examples of oral anti-diabetic medications are Glucotrol® (glipizide), Glucophage® (metformin), and DiaBeta® (glyburide).

Commonly occurring side effects of oral anti-diabetic medications include nausea, vomiting, diarrhea, abdominal pain, changes in the sensation of taste, and loss of appetite. These medications should be taken with food to reduce nausea and vomiting.

As children grow and develop, their need for medications may change. Dosage and even the drugs themselves may need to be adjusted.

### Insulin

The goal of insulin therapy is to achieve the best possible control of blood glucose levels by matching the type and amounts of insulin administered with the child’s need for insulin, both day and night. The specific type of insulin, the amounts, and frequency of administration vary according to individual needs. Some children may need two or more insulin injections every day, while others may use an insulin pump to control blood glucose levels.

The various types of insulin can be categorized as follows:

- **Rapid-acting insulin**: This type of insulin (e.g., Humalog®) begins to work within five to 15 minutes, and its effect peaks at 30 to 90 minutes after administration. Duration is about four hours. Rapid-acting insulin is taken to deal with glucose absorption at mealtimes. It is usually administered immediately before eating but can be given immediately afterwards. Rapid-acting insulin can be mixed with intermediate-acting insulin in the same syringe. To date, the safety and efficacy of rapid-acting insulin have not been established in children less than 12 years of age. Insulin should be prescribed for children only by health care providers with expertise in management of diabetes in children.

- **Short-acting insulin**: These types of insulin (e.g., Humulin R®) begin to work 30 to 60 minutes after administration and peak occurs in two to four hours. Duration is about six to nine hours. Short-acting insulin is generally taken about 30 minutes before meals. It can be mixed with intermediate-acting insulin in the same syringe.

- **Intermediate-acting insulin**: Intermediate-acting insulin (e.g., NPH® insulin) is used to control blood glucose levels between meals and throughout the night. This type of insulin begins to work in one to four hours, reaches its peak within four to 12 hours, and has a duration of 10 to 24 hours. Intermediate-acting insulin can be mixed with rapid and short-acting insulin in the same syringe.

- **Long-acting insulin**: Long-acting insulins (e.g., Lantus®) do not peak. They begin to work within one to two hours and last for 18-26 hours. Long-acting insulin is used to control blood glucose levels between meals and throughout the night. Long-acting insulin cannot be mixed with other insulin in the same syringe.

Insulin may be administered via subcutaneous injection or an insulin pen, which is a device that actually resembles an ink pen but has a cartridge filled with insulin. An insulin pump is also an option. The insulin pump is about the size of a cell phone and is situated on the
outside of the body. A tube connects an insulin reservoir of insulin to a catheter inserted under the abdominal skin. Insulin is dispensed in programmed amounts automatically. Programming can be adjusted to deliver more or less insulin, depending on the patient’s activity level, meals, blood glucose levels, and state of health.7

Recording the administration process is very important. Notes should be kept in patients’ files of how their insulin injections are administered. If the injections are given subcutaneously, it is helpful to record their regular needle size so that the wrong size is not distributed.

Insulin reactions are problems that must be anticipated and dealt with by affected children and their families. One of the most common problems is hypoglycemia (see previous section on complications). This problem is most likely to occur if a person eats less than usual, exercises more than usual, or has an illness such as gastrointestinal upset. Under conditions such as these, insulin dosage may need to be decreased.

Health care providers work with children and their families to monitor and adjust insulin doses as necessary.4 Pharmacists work with parents during consultations to increase their awareness of side effects. Insulin adjustments may also be necessary under the following circumstances: 3, 4, 7, 12

- **Taking other medications:** Any medications, including prescription, over-the-counter, herbal preparations, vitamins, and other supplements may affect blood glucose levels. Other medications should never be taken without the knowledge of the child’s health care provider.

- **Diet:** It is important that the child’s eating patterns be considered when insulin is prescribed. Eating patterns change as the child grows. Social activities and peer pressure can also influence dietary intake. Health care providers must be continually made aware of the patient’s eating patterns.

- **Physical activity:** Physical activity usually lowers blood glucose levels and can affect such levels for up to 12 hours after exercise. As children add new or make changes in their physical activities, they may need adjustments in their diets and insulin doses. For example, a snack may be needed before beginning exercise, or an insulin dosage may need to be lowered. Children and parents must work with health care providers to plan for changes in physical activity.

- **Illness:** Some illnesses, such as the common cold, cause an elevation in blood glucose levels. Fever increases metabolism. If these types of illnesses occur, children may need larger or more frequent doses of insulin. Illnesses that cause vomiting or diarrhea reduce the intake of nutrients, and may necessitate insulin dosage adjustments. Children and parents must work with health care providers to develop a plan to manage insulin administration during illness.

- **Puberty and growth spurts:** As children grow and mature, they experience growth spurts and changes related to puberty. Hormonal changes and growth spurts alter insulin requirements. These issues must be monitored and reported to the child’s health care physician so that insulin doses may be adjusted.

**Diabetes alert! Some children are at risk for low blood glucose levels during the night. In these cases, glucose levels should be a bit higher before bed than during the day. Children and parents should work with their health care providers to determine appropriate glucose levels at bedtime.7**

Children may experience unexpected, very low blood glucose levels that cause confusion, seizures, and loss of consciousness. For children prone to this problem, it may be necessary to have glucagon available. Glucagon is a hormone administered via injection that quickly raises blood glucose levels. Parents, teachers, school nurses, athletic coaches, and others should know when and how to administer glucagon.6

**Diabetes alert! Children with diabetes should wear medical identification tags so that in an emergency, caregivers and emergency medical personnel can be made aware they are diabetic.**

**Healthy lifestyle behaviors**

Many healthy lifestyle behaviors help not only with diabetes management but also with the prevention or a reduction in severity of complications, such as heart disease, eye disorders, and skin problems. Diet is often one of the first concerns expressed by parents and children. But the best diet for children with diabetes is one that the whole family can and should follow. It consists of plenty of fruits, vegetables, and whole grains. These foods are high in nutrients and low in fat and calories. Foods derived from animal products and those that contain lots of sugar and carbohydrates should be limited.

This diet is good for the whole family.7 Children, especially teenagers, are concerned with looking fit and slim. This diet will help them to do so as well as help them to be healthy! This kind of healthy diet is also helpful in facilitating cardiovascular health.

The entire family should work with a dietician to help develop an appropriate diet that the whole family can follow. It is not a good idea to have a “special” meal for the child who is diabetic and other foods for the rest of the family.

**Diabetes alert! Smoking and alcohol abuse significantly increase the risk of diabetes complications.24 Children should learn at a young age not to smoke and to avoid large quantities of alcohol as they grow up!**

**Maintaining mental health**

The diagnosis of diabetes is often overwhelming. Children, particularly teenagers, may resist making the lifestyle changes necessary for proper management of diabetes. Children as well as their parents and loved ones may experience a variety of emotions, including anger, denial, and even clinical depression.35

Regular health care examinations are essential, including dilated eye exams as recommended by ophthalmologists with expertise in helping children who have diabetes. Keeping a regular schedule of preventive health exams is imperative!

Regular physical exercise is important and is a healthy lifestyle habit that would benefit the whole family. It is often easier for the child to participate in exercise that is a fun family activity.

Skin care is very important for anyone who has diabetes. Carefully dry areas that tend to become moist, such as between the toes, under the breasts, and the groin area. Creams and oils should not be placed between the toes because it can increase the risk of infection. However, as mentioned earlier, the skin on the soles of the feet and the surface of the feet can become quite dry, leading to peeling and cracking of the skin. Some people find it helpful to apply a thin coat of plain petroleum jelly over these areas (but not between the toes!).29 Members of the diabetic health care team can advise children and parents about proper skin and foot care.

**Diabetes alert! Children should be cautioned NOT to go barefoot. This can be especially tempting as children play with friends, go swimming, and participate in other activities where everyone else is barefoot. However, going barefoot increases the chance of injury and should not be done.**
The normal stressors of growing up compounded by the diagnosis of diabetes can increase stress to dangerous levels. Stress hormones can directly affect blood glucose levels. Additionally, people under stress may not take good care of themselves and engage in unhealthy behaviors.36, 37

Here are some suggestions to help children with diabetes and their families maintain mental health and wellness.36, 37

- Encourage children to take an active role in managing their diabetes. They must be involved in the decision-making process on treatment options and lifestyle changes.
- Stress the need for lifelong diabetes management.
- Teach children as well as their caregivers how to manage their diabetic medication regimen, including administering their own insulin as soon as they are old enough to do so.
- Encourage children to form bonds with their diabetes team members.

Encourage regular physical exercise.
- Encourage children and families to join support groups. Children, especially teenagers, do not want to be different from their peers. Having a network of other teenagers who have diabetes may be very helpful.
- Be alert to the dangers of substance abuse. People who have diabetes have an increased risk of developing depression and anxiety and may turn to alcohol or other drugs as a means of coping. Encourage them to interact with mental health professionals who are part of the diabetes team.

Diabetes is a diagnosis that requires lifelong management. It affects not only the children who are diagnosed but their families and friends as well. It is important that healthy lifestyle changes be incorporated by the entire family to help promote maximum states of health and wellness among all family members!

References and works consulted


DIABETES IN CHILDREN

Final Examination Questions

Choose the best answer for questions 1 through 5 and mark your answers online at Pharmacy.EliteCME.com

1. Type 2 diabetes is often linked with which of the following? a. Obesity. b. Malnourishment. c. Age. d. Gender.
3. In ketoacidosis, there is an absolute, acute deficiency of which of the following? a. Beta cells. b. Insulin. c. Amino acids. d. White blood cells.
4. Which type of insulin is used to control blood glucose levels throughout the night and between meals? a. Rapid-acting insulin. b. Short-acting insulin. c. Long-acting insulin. d. Intermediate-acting insulin.


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