Diabetes: The Science Inside
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Diabetes means that your blood sugar is too high. Your blood always has some sugar in it because the body needs sugar for energy to keep you going. But too much sugar in the blood is not good for your health. There are several different types of diabetes, but they all have to do with the body’s inability to process blood sugar.

Diabetes is a long-lasting, chronic disease that can lead to many difficult health problems. Heart disease, kidney disease, blindness, and amputation are just some of the many complications of diabetes. These problems can shorten the lifespan by many years and cause great misery.

Diabetes used to be untreatable. If you had the disease, you most likely would die prematurely. That changed in 1925 when researchers learned that diabetes can be controlled by injecting insulin. This was not a cure, but it did allow people with the disease to live many years longer. Diabetes was no longer as highly feared as it had once been.

But now there is grave new concern over diabetes. The new concern is that the number of people affected by the disease is increasing at a rapid rate. The increase is occurring with one particular form of the disease called type 2 diabetes. Over the past few decades there has been a big increase in the number of people diagnosed with type 2 diabetes both in the United States and around the world.

Health experts say more than 11 million Americans have been diagnosed with diabetes. Probably 90 to 95 percent of all these diagnosed cases of diabetes are type 2. Experts also estimate that another 6 million Americans have diabetes but don’t know it.

Type 2 diabetes is hitting especially hard among certain groups of Americans. People at special risk for the disease include African Americans, Hispanics, American Indians, Alaska Natives, Asians,
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and other Pacific Islanders. Elderly people and poor people also are at special risk. People from these groups are more likely to get type 2 diabetes and also to suffer from the complications of the disease.

Diabetes has become the sixth leading cause of death in the United States. On average, the risk of death for a person with diabetes is twice as high as for someone without the disease.

The toll from diabetes is greater than these numbers reveal, because health problems and deaths from diabetes are often credited to other causes. That’s why diabetes has the nickname, “the hidden disease.”

The rise of type 2 diabetes is bad news. Fortunately there is also some good news. Modern research has discovered two important lessons about type 2 diabetes. The first lesson is that many cases of this disease can be prevented. The second lesson is that for many people, the health complications of type 2 diabetes can be totally avoided or delayed for many years.

The purpose of this book is to provide basic information about type 2 diabetes: what causes it, how it affects the body, and how it can be prevented and treated. This book is NOT a treatment guide, but it does offer general advice that can help you avoid type 2 diabetes and minimize the complications if you have the disease.

Note to Readers: Boldface words, as well as some underlined words in sidebars, are defined in a glossary that begins on page 49.

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### Diabetes in the U.S. Population

**Total population:** 285 million  
**Number with diabetes:** 15.6 million  
**Prevalence:** 8.2 percent

#### Whites (Non-Hispanic)
- **Number with diabetes:** 11.3 million  
- **Prevalence:** 7.8 percent

#### African Americans (Non-Hispanic)
- **Number with diabetes:** 2.3 million  
- **Prevalence:** 10.8 percent

#### Mexican Americans
- **Number with diabetes:** 1.2 million  
- **Prevalence:** 10.6 percent

#### Other Hispanic/Latino Americans
Altogether twice as likely to have diabetes as non-Hispanic whites of similar age.

#### Native Americans and Alaska Natives
About 2.8 times more likely to have diagnosed diabetes as non-Hispanic whites of similar age.

#### Asian Americans and Pacific Islanders
Studies indicate that some groups within this population are at increased risk. For example, Native Hawaiians appear twice as likely to have diagnosed diabetes as white residents of Hawaii.

Figures are for persons age 20 and over. They do not include the approximately 123,000 cases of diabetes in children and teenagers. Prevalence means number of cases per 100 people. Data from Diabetes Statistics, National Institute of Diabetes and Digestive and Kidney Diseases (NIH Publication No. 99-3921, May 1999).
Part 1: What is type 2 diabetes?

Healthy glucose levels

“Sugar” is a common nickname for diabetes, because it is an illness involving too much sugar in the blood. The formal name is **diabetes mellitus**, which translates from Greek and Latin to “passing through a lot of sugary urine.”

Glucose is a form of sugar found in food. When the body digests food, glucose moves into the bloodstream. In response, the body releases **insulin**, which is a hormone. Hormones are chemicals produced by organs of the body to trigger activity in other locations. The hormone insulin is released by an organ called the **pancreas**, and it triggers the opening of body cells so that glucose may enter and be used for energy.

As glucose moves into body cells, the amount that remains in the bloodstream falls. When it falls below a certain point, the pancreas releases another hormone called **glucagon**. This hormone triggers the release of stored glucose from the liver. Through the work of the two hormones, insulin and glucagon, the body maintains a stable level of glucose in the blood.

Type 2 diabetes

There are several types of illness that fall under the name “diabetes.” In all types, a person’s body has trouble keeping blood sugar stable. With **type 2 diabetes**, the cells resist the efforts of insulin to open them up and let glucose inside. This is known as **insulin resistance**.

Type 1 diabetes is most often diagnosed in people under age 30, while type 2 diabetes is most often diagnosed in older people.
As the condition progresses in many cases of type 2, the pancreas also does not produce enough insulin. Researchers are trying to figure out what causes type 1 diabetes. They are studying whether it might be caused by viruses, chemicals, stress, or even certain foods. Whatever the trigger, it somehow upsets the immune system. Normally, the immune system protects the body against outside invaders such as viruses and bacteria. When the immune system gets confused, it can attack parts of the body itself. With type 1 diabetes, the immune system attacks the insulin-producing cells of the pancreas.

Type 1 diabetes is most often diagnosed in people under age 30, so it is sometimes called juvenile diabetes. However, adults can be diagnosed with type 1. Type 1 affects a greater percentage of white Americans compared to Americans from racial and ethnic minorities.

As the condition progresses in many cases of type 2, the pancreas also does not produce enough insulin.

More than 90 percent of all cases of diabetes are type 2. The disturbing increase in diabetes cases in recent years involves type 2.

Type 2 diabetes is most often diagnosed in older people. This is why it has been called adult-onset diabetes. This label is no longer used, because it is misleading. Young people can also be diagnosed with type 2. In fact, so many young people today are being diagnosed with type 2 diabetes that it is considered an epidemic.

Symptoms of diabetes

The symptoms of all forms of diabetes are alike. One symptom is having to urinate a lot. Other symptoms include blurry vision, itchy skin or skin infections, sores that take a long time to heal, unusual thirst, tiredness, dizzy spells, nerve pain, and losing weight while being hungry all the time.

If you have type 2 diabetes, you may have mild symptoms for many years before learning you have the illness. You may have no symptoms but find out you have the disease after a screening test at the doctor’s office. Diagnosis is important, even when symptoms are mild or absent. Early detection can prevent the health problems that arise sooner or later from untreated type 2 diabetes.

How diabetes affects the body

The problems of diabetes are caused by too much blood sugar, that is, too much glucose in the blood. This creates a chemical imbalance in the body which increases the fats in the blood. The imbalance damages the blood vessels, which are the pipelines through which blood travels to all parts of the body. The damaged blood vessels become clogged and less able to carry blood. This in turn harms body cells that depend on the bloodstream for food and oxygen. The various organs of the body func-
tion poorly when their cells are starved in this way.

Damaged blood vessels in the eyes leak fluid, bleed, and swell. Replacement blood vessels begin to grow, but they are fragile and may also bleed, causing further damage if untreated. This can lead to blindness.

People with diabetes are at greater risk for heart disease. A risk factor for heart disease is high blood pressure (also known as hypertension). High blood pressure occurs when the heart must use greater force than normal to push blood through the pipelines. High blood pressure can damage the heart and further strains the blood vessels that have been damaged as a direct result of glucose imbalance. With high blood pressure comes an increased risk for heart attack and stroke. High blood pressure also stresses the kidneys, which filter the blood. Damage to the kidneys leads to even higher blood pressure, resulting in a dangerous spiral.

As stated above, the chemical imbalance caused by too much blood sugar has an effect on cholesterol levels. Cholesterol is a wax-like substance that circulates in the blood stream and plays an important role in several functions of the cells. Improper amounts of cholesterol can increase the risk for heart disease.

Improper blood sugar also disrupts and damages the nerves. The nerves are the networks of cells that transmit signals from all parts of the body to the brain and back. Since the nerves go everywhere in the body, damaged nerves lead to problems throughout the body.

Despite all the extra sugar in the blood, not enough is getting into the cells that need it. This is because insulin (which triggers cells to open up and take in glucose) is not present or is not working properly. The body thinks the problem is a lack of glucose, so it raids the liver, where

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**A different disease has a similar name.**

When people talk about diabetes they usually mean diabetes mellitus — the subject of this book. But there is another unrelated disease named "diabetes." It is diabetes insipidus, or "water diabetes," and it is quite rare. Only three in every 100,000 people in the United States are affected by it.

Diabetes insipidus occurs when the body does not make or properly store a certain hormone. Without instruction from this hormone, the kidneys do not properly control the level of water in the blood and too much is turned into urine. People with the disease have to urinate a lot. They are very thirsty, too, because their bodies want to replace all the lost water.

Treatment depends on the particular cause. Sometimes a patient can simply drink more to make up for the water loss. Sometimes a patient takes a drug to replace the missing hormone or to lower urine output. Sometimes the disease goes away if the patient stops taking a medicine that causes diabetes insipidus as a side effect. If diabetes insipidus is treated, there are no other problems to health.
glucose is stored. It also breaks into muscle and fat cells that have stored glucose. Without insulin, the released glucose still cannot be used by the cells that need it. They stay deprived of the energy they need to keep working.

This uncontrolled type 2 diabetes creates trouble throughout the entire body and can lead to a long list of breakdowns in health. People often do not make a connection between the illness called diabetes and these other health problems. In fact, diabetes can be the terrible trigger. A description of the many health problems linked to uncontrolled type 2 diabetes appears on page 27.

Causes of type 2 diabetes

A key trigger for type 2 diabetes is overweight or obesity. Obesity is defined as being more than 20 percent over ideal body weight. Carrying extra fat appears to trigger insulin resistance, though researchers do not yet understand why. What they do know is that more than three-fourths of all people with type 2 diabetes are overweight or obese.
Part 1: What is type 2 diabetes?

James R. Gavin III

“Like my grandmother used to say,” says Dr. James R. Gavin III, “we’re digging our graves with our teeth.”

Dr. Gavin is president of the Morehouse School of Medicine in Atlanta, one of the top African-American medical schools in the country. He is also one of the leading diabetes researchers in the United States and chairman of the National Diabetes Education Program.

As a scientist, Dr. Gavin has a deep interest in insulin. Insulin is a hormone that strongly influences blood sugar levels.

As doctor and medical school president, he has his sights set on people and what can be done to keep them from getting diabetes.

Dr. Gavin says the root of the problem is the rise of unhealthy eating habits and the decline of physical activity as part of everyday life. Even kids don’t walk, run, or ride bicycles as much as they used to.

“We have to recognize the price we’re paying for worshipping at the god of convenience,” he says.

Dr. Gavin grew up in Mobile, Alabama, when there were segregation laws denying African Americans equal rights.

Even so, his father worked his way up to become head of the department in charge of the paints and other coatings at a large shipbuilding company. The job involved a lot of practical chemistry.

“He was so much smarter than me,” Dr. Gavin says of his father. “I have no doubt he would have been a great scientist if there had been more opportunities for African Americans.”

Dr. Gavin earned a Ph.D. in biochemistry from Emory University in Atlanta and then his medical degree from Duke University in North Carolina.

Gavin, continued on next page
He sounds a little like a space explorer in the movies when he explains why he became a scientist. “You are facing this vast universe of the unknown. All knowledge comes from scientists having a question and exploring a small part of the unknown through research.”

Dr. Gavin’s research was among the first to show that insulin interacts with blood cells. Now scientists know that insulin roams all over the body, affecting many cells and organs.

Blood sugar has many effects, too. So now doctors treat many people with diabetes with several drugs at once. “Therapy with a single drug just doesn’t cut it for most patients,” says Dr. Gavin.

The diabetes rate in African Americans has tripled in the past 30 years. Dr. Gavin says that African Americans may have genes that make them more vulnerable to the disease. But genes are only part of the story. Only changes in diet and exercise could explain such a fast increase over a relatively short period of time.

Dr. Gavin says there is now a program that encourages friendly competition among groups of African-American men to see which group can become more active and lose weight.

“We need to put a greater emphasis on prevention,” he says. “One way to do that is to get groups in the community working together to reach a common goal.”
Rising incidence of type 2 diabetes

In the last half century there has been a steady rise in type 2 diabetes. Diabetes is now on the list of top ten diseases affecting Americans.

Researchers give several reasons for this increase. One reason is that the health care system is getting better at diagnosing diabetes. Cases that at one time might have gone unnoticed are now recognized. A second reason is that the population is getting older, and aging is a well known risk factor for type 2 diabetes.

The third reason for the increase in diabetes is the most important. Americans are eating too much for the amount of exercise they get. As a result, many Americans carry too many pounds.

Health researchers say that 65 percent of adults in the U.S. are overweight or obese — that’s almost two-thirds of the adult population. Rates of overweight and obesity are climbing for children and teens, too. The rate is 16 percent for children ages 12 to 19, and 15 percent for children ages 6 to 11. Even the very young are gaining too much weight, with 10 percent of youngsters ages 2 to 5 falling into the overweight category.

Being overweight and obese are key risk factors for type 2 diabetes. People who carry their extra pounds around the middle are at special risk. The risk comes even with just a few pounds of extra fat. A recent study found that people who are in a “high healthy” weight range have up to twice the risk of diabetes as those in a “low healthy” range.

Uneven impact of diabetes

For the U.S. as a whole, diabetes affects women more than men. Among Americans age 20 or older, 8.3 percent of all men have diabetes, compared to 8.9 percent of all women. Diabetes strikes unevenly in other ways, too.

According to the Centers for Disease Control, the percent of obese adult American women rose from 12.2 % in 1991 to 20.8 % in 2001. Over this same 10-year period, the percentage of obese Hispanic women rose from 11.6% to 23.7% and the percentage of obese Black, non-Hispanic women rose from 19.3 % to 31.1%. Obesity is associated with a variety of illnesses, including diabetes and high blood pressure.
Type 2 affects a far higher proportion of people from minority ethnic and racial groups than it does white Americans. Some groups have rates of type 2 diabetes that are two to three times higher than the rate for white Americans. The populations at higher risk for diabetes include African Americans, Hispanic Americans, Native Americans, Alaska Natives, Asian Americans, and Pacific Islanders. Elderly people and poor people also are at increased risk.

Genetic reasons for the uneven impact

Health researchers are trying to explain why diabetes has such an unequal impact on minority groups. This unequal impact is called a health disparity. Several theories try to explain the diabetes health disparity.

One set of theories has to do with genetics. This is the field of science that looks at how genes are passed down through families to affect traits. For example, it is thought that some racial or ethnic groups carry genes that increase the chances of developing diabetes. This is referred to as genetic predisposition.

One theory along this line is called the thrifty gene theory. According to this theory, a gene (or more likely, a set of genes) evolved in ancient people to help them survive periods of famine. The gene helped their bodies store the most energy possible from food, for later when food was scarce. Today, people who inherit the thrifty gene usually do not face long periods with little food. All the same, their bodies are quick to build up fat, leading to higher risk for type 2 diabetes.

There’s another side to this thrifty gene theory. Some ancient people travelled over great distances and used huge amounts of energy tracking down food. The ones who survived had genes that could support this high-activity lifestyle. They passed down those genes to their children. Most people today with these genes are far less active, and this again could lead to easy weight gain and type 2 diabetes.

The uneven availability of health care

There is another reason for the diabetes health disparity. It is that health care is more available to some people than to others. Those people who have good health care are more likely to have their type 2 diabetes diagnosed early, treated, and kept under control. They have a better chance of avoiding type 2
Part 2: Who has type 2 diabetes?

diabetes in the first place because they receive medical advice on how to stay healthy.

Most people in the U.S. receive health insurance through their jobs. People without jobs, or with low-wage, part-time or temporary jobs, may not have health coverage for themselves or their families. People who move around frequently, such as migrant workers, also may have more limited access to health care.

Wealthier people are more likely to have better coverage from their health insurance. Plus, they can afford to pay for extra medical costs that might not be covered by insurance. They are more likely to be served by doctors who have the latest equipment and knowledge.

All these factors can lead to big differences in the amount and quality of care received. Consider the fact that a certain type of diabetes treatment costs about twice as much as other forms of diabetes care. This is because it requires more check-ups and more supplies for blood testing (see page 33 for information on this form of treatment, which is called tight control). Over the long run, this treatment leads to better health. Those who cannot afford it have less fortunate outcomes.

Other factors leading to the health disparity

Poor people have a harder time taking care of their health, and this is not just because they have less access to good health care. They are less likely to live near a large grocery store stocked with good produce and other fresh food ingredients. As a result they may tend to eat a greater proportion of prepackaged, processed foods that contain more fat, salt, and sugar. In some poor communities, the water supply is not very good so people tend to drink more bottled or canned beverages such as soft drinks. People who are poor may not live near good recreation centers or be able to afford the fees.

Some people also do not have the education they need to take care of their own health. They may not have learned how to read food labels to avoid high-salt, high-sugar, and high-fat foods. They may not

For Hispanic Americans 50 years or older, up to 30 percent are diagnosed with diabetes or have the disease but don’t know it.
know how to fit fruits and vegetables into their budget. They may not know about the low-cost, easy ways to fit exercise into everyday life. They may not value fitness because they do not know how it connects to health. Such people are less likely to develop healthful eating and exercise habits.

All of these factors can lead to overweight or obesity, conditions linked to type 2 diabetes. In these kinds of ways poverty, which affects minority groups in greater proportion than it does whites, can create a diabetes health disparity.

Until recently, most diabetes education efforts have been aimed at the white, English-speaking, middle-class, native-born American. These efforts have been less effective at educating other types of people. For example, many immigrants to this country do not speak English well. Many immigrants as well as native-born Americans do not read well or have very limited education. Such people are not likely to understand the diabetes information that is available by talking with health care workers or from TV, radio, books, and information sheets.

Sometimes health information fails because it does not make sense to people based on how they look at the world. For example, some immigrants have moved here from less-developed countries where death and disease are more common and health care is hard to come by. In their home country, they may have had very little control over sickness. These people may have learned to be passive in the face of an illness such as diabetes. In fact many groups of Americans, not just some immigrants, share this acceptance of fate. They do not think of a disease like diabetes as something to prevent or manage.

**Diabetes affects all types of people.**

- In the total U.S. population, 17 million people have diabetes. That’s more than 6 out of every 100 people.
- Each year, about 1 million new cases are diagnosed in adults (age 20 years or older).
- Among children and teens (people under age 20), more than 150,000 have diabetes — about 1 in every 500.
- Among people age 65 and over, 7 million have diabetes — about 20 out of every 100.
- Among Non-Hispanic whites, about 11.4 million have diabetes — almost 8 out of every 100.
- Among Non-Hispanic blacks, 2.8 million have diabetes — about 13 out of every 100.
- Among Hispanic/Latino Americans, 2 million have diabetes — more than 10 of every 100.
- Among American Indians and Alaska Natives, 105,000 have diabetes — more than 15 of every 100 — but this number only includes those who receive care from the Indian Health Service. The number for the entire group is certainly higher.
- For Asian Americans, Native Hawaiian, or other Pacific Islanders, the total number with diabetes is unknown. Studies on individual groups within this population show them to be at higher risk for the disease, compared to non-Hispanic whites.
For some people, tradition tells them to be respectful or even fearful of doctors. They may have a hard time seeking help from doctors, asking them questions, or accepting the idea of being a partner with doctors in their own care.

Teenagers come from a different culture than adults. Young people are not used to thinking about sickness and death. They do not easily connect today’s actions to tomorrow’s health. They also are more concerned with growing up and fitting in. These concerns can make it much harder for teens to follow diabetes prevention or treatment advice.

Diabetes has earned yet another nickname — the “wasteful” disease. It’s called that because so much illness and death can be avoided. It can be avoided if everyone receives proper health care, if everyone is reached with health information, and if everyone at risk from diabetes takes action for their health. Because of economic, cultural, and lifestyle barriers, this is not happening. Until it does, diabetes will have an unequal impact across America.

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**Raul Sosa**

What was Raul Sosa’s attitude toward diabetes?

“Didn’t have it,” he says. “Didn’t care.”

Now he cares—a lot. Sosa was diagnosed with type 2 diabetes eight years ago. He has lost weight, quit smoking, and gets exercise. He is also careful about what he eats.

Sosa says he is motivated partly by the example of his father. His father didn’t have diabetes. But he had a heart attack when he was about 40.

Diabetes makes people vulnerable to heart attacks.

“His heart condition dominated the rest of his life after his heart attack,” Sosa says. “I really didn’t want that to happen to me.

*Sosa, continued on next page*
Diabetes runs in Sosa’s family. His mother, Aida, and several of her sisters have the disease.

The Sosas aren’t alone. Many Latino families are affected by the disease. On average, Latino Americans are about twice as likely to have diabetes as other people of the same age. About 10% of Latino Americans have diabetes.

Sosa lives in Evanston, Illinois, outside of Chicago and works as a computer technician for an insurance company.

He is 5-foot-8-inches tall and weighed about 240 pounds when he was diagnosed with diabetes. Sosa got some exercise, but nothing that would burn a lot of calories. He pitched for several softball teams and played golf, although he admits “I rode in a golf cart most of the time.”

And his eating habits were, well, pretty bad. His weakness? Breyers vanilla ice cream. “I used to sit and eat a half gallon at a time,” says Sosa. “That is how I got to 240 pounds!”

Sosa was diagnosed with diabetes after his periodonist (a dentist who takes care of gums) thought his bad gums might be from diabetes. Blood tests showed the periodonist was right. Sosa’s doctor was blunt:

“He said, ‘Mr. Sosa if you don’t do what I tell you to do, you’re going to die.’”

Most doctors aren’t going to scare their patients like that, but the harsh warning got Sosa’s attention.

“I don’t want diabetes to be the most important thing in my life,” he says. “At the same time, I know I need to take care of myself.”

Sosa’s blood sugar is under control, partly because he takes diabetes medications.

But he has also lost a great deal of weight. He now weighs 170 pounds, 70 less than he used to. He goes to the gym nearly every day and competes in bicycle races during the warm-weather months.

Food is a challenge. Chicken, vegetables, and whole grains are on his menu. He tries to steer clear of restaurants that specialize in large portions. And he has put a total ban on ice cream.

“I like it too much to just eat in moderation.”
Part 3: How is type 2 diabetes prevented and treated?

**Diagnosing diabetes**

Although the amount of glucose in your blood varies depending on when and what you eat, the range should be relatively narrow. In general, your blood sugar is highest after you eat and lowest after you have not eaten for 8-10 hours. After fasting all night, most persons have blood glucose levels between 70 and 110 milligrams of glucose per deciliter of blood (mg/dL). After eating a large meal, a person’s blood sugar will rise, but generally not above 140 mg/dL. People with untreated diabetes will have higher blood sugars after fasting and after eating.

To check if you have diabetes, your doctor will test your blood sugar levels. The results of these tests and other clinical findings will be used to decide if you have diabetes and what type. Doctors cannot diagnose diabetes on the basis of one single test. Instead, they will perform two or more glucose tests before confirming your diagnosis. The most common tests to measure glucose are the fasting plasma glucose test, the random blood sugar test, and the oral glucose tolerance test.

- **Fasting plasma glucose test.** Most experts recommend using a fasting plasma glucose test to diagnose diabetes. Before taking this test, you cannot eat anything for 8 to 10 hours. Blood will be drawn from a vein in your arm and sent to a laboratory for testing. If your fasting blood glucose is 126 mg/dL or higher, your doctor will probably diagnose you with diabetes.

- **Random blood sugar test.** Many cases of diabetes are found during routine physical exams when blood is drawn for other tests. Since you don’t necessarily fast before these physical exams, you may have just eaten and your blood sugar may be high. Even so, it shouldn’t be higher than 200 mg/dL. If your random blood glucose is higher than 200 mg/dL, your doctor will probably suspect diabetes and may want to give you a fasting plasma glucose test.

- **Oral glucose tolerance test.** In this test, a person consumes a drink containing glucose dissolved in water. Blood is then drawn in timed intervals over a three-hour period. If plasma glucose levels rise more than
expected, the person is diagnosed with diabetes. This test is often used to check pregnant women for gestational diabetes. It is rarely used to diagnose diabetes in other patients, because it is cumbersome and time-consuming.

Doctors will diagnose type 1 or type 2 after studying the patient’s symptoms and medical condition. People diagnosed with type 2 diabetes tend to have less severe symptoms. In fact, some people with type 2 do not realize they have the disease until they are given their glucose test results. People with type 2 tend to be overweight, even though unexplained weight loss may be one of their symptoms. People with type 2 also may show signs of the complications of diabetes, such as nerve pain or eye problems. This is because they may have had the disease for years without knowing it.

Sometimes a test will reveal that your glucose level is higher than normal, but not high enough to fit a diagnosis of diabetes. Instead you may be told that you have prediabetes. This means you have a high risk of developing type 2 diabetes or suffering from diabetes-like problems.

### Preventing and controlling diabetes

There is not yet a cure for type 2 diabetes. It is a chronic disease, which means it is long-lasting and on-going. A patient who is diagnosed with the illness has it for life. Fortunately, it can be controlled through treatment. In fact, the symptoms may practically disappear so long as treatment is followed.

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**Diabetes touches some groups more than others…**

- For all age groups, white Americans are less affected by diabetes compared with Americans from other racial and ethnic groups.
- American Indians and Alaska Natives are 2.6 times as likely to have diabetes as non-Hispanic whites of a similar age. Rates vary widely among tribes, on average.
- African Americans are 2 times as likely to have diabetes as white Americans of similar age, on average.
- Hispanic Americans are 1.9 times more likely to have diabetes than non-Hispanic whites of similar age, on average. Mexican American and Puerto Rican adults are at slightly greater risk and Cuban Americans at slightly lower risk.
- Some Asian American and Pacific Islander groups may at increased risk for diabetes compared with non-Hispanic whites. For example, studies conducted among Native Hawaiians indicate that they may have much higher rates of diabetes than non-Native white residents of Hawaii.
- Most children with type 2 diabetes are minorities.

…*and it hits them harder, too.*

- As groups, many ethnic and racial minorities have less risk for cardiovascular disease than white Americans. However, this protection ends for those who develop diabetes. In these groups, cardiovascular disease is the main cause of death linked to diabetes.
- Minorities with diabetes are more likely to have more lower limb amputations.
- Diabetes-related kidney failure occurs at higher than average rates for African Americans, Native Americans, and Hispanic Americans.
- Gestational diabetes affects just under 5 percent of all pregnancies. But for minorities, the rate is almost 15 percent. Among African-American women, the rate of gestational diabetes is more than double the rate for white women.
It’s important to diagnose type 2 diabetes as early as possible, so that treatment can be started and complications avoided. Your particular treatment will be tailored to your state of health, your particular body, your personality, and your lifestyle. Your treatment also may change over time, so you need to have an on-going relationship with health care providers.

There are four main tasks in the treatment of type 2 diabetes:

• Eat healthfully and get exercise.
• Manage your blood sugar.
• Keep your blood pressure under control.
• Keep your cholesterol levels in the healthy range.

If you have type 2 diabetes, it will be your job to carry out these tasks. Your health care providers will give you advice, medical care, and drug prescriptions as needed. However, the most important person in managing your day-to-day care will be yourself.

Managing blood sugar

If your body fails to make insulin, then insulin has to be added to keep it healthy. You do this by injecting insulin — either with needle shots, high-speed jet injectors, or pumps attached by a thin tube to the body.

Less than half of all people with type 2 diabetes must take insulin. The rest produce enough insulin so that they do not need to take it by injection. Instead they may manage their blood sugar by taking pills. These pills increase the effect of the insulin already in their bodies or block the uptake of glucose from the gut. Because many people who have type 2 diabetes do not need to take insulin to survive, this form of the illness has sometimes been referred to as noninsulin-dependent diabetes. (This contrasts with insulin-dependent diabetes, which is another term for type 1 diabetes.)

Over time type 2 patients may lose the ability to produce enough insulin. When this happens, they must start injections. Many women with gestational diabetes can get by without taking insulin, but some have to take insulin or take pills.

Some people take insulin at set times in the day, such as morning and evening. Others take insulin as needed based on readings of their blood sugar. You measure blood sugar using a blood glucose meter. You draw a drop of blood and put it on a strip of plastic that you insert into the meter. Some meters use chemicals and others use electricity to measure the glucose. If you have diabetes, you may have to test your blood sugar and take insulin many times a day regardless of the treatment you are on.
It’s important to test your blood sugar often because many factors can affect your levels. For example, eating certain foods can cause blood sugar to rise. Exercise can cause blood sugar to drop because active muscle cells use up their glucose and pull more out of the bloodstream. Stress and illness both may trigger the release of extra hormones that send blood sugar to higher levels. Therefore a person with diabetes may test before, during, or after eating, exercising, experiencing stress, or suffering an illness.

If the blood sugar is high, they may take extra insulin. If the blood sugar is low, they may eat a little more carbohydrate food or take a glucose tablet. These tablets are an easy-to-carry way to put glucose into the bloodstream more quickly and conveniently than food.

Eating healthfully

Many cases of type 2 diabetes can be controlled almost completely by eating healthfully. A good diet can help keep blood sugar levels stable, bring blood pressure down, and keep cholesterol at healthy levels. As a result, by eating healthfully you may be able to avoid the need for diabetes pills or insulin injections. You also stand a better chance of avoiding the complications of diabetes.

There are several different eating plans for people with type 2 diabetes. If you have the disease, the plan that
is best for you will depend on the state of your health, your reactions to certain foods, your tastes, and your lifestyle. Most eating plans include these recommendations:

• Watch the carbohydrates (sugars and starches) you eat. The best carbohydrates for the diabetic person contain fiber, are not heavily processed, and are not too sugary. Good choices include apples, peas, beans, whole grain rice, whole grain breads, and oat or bran cereals.

• For cooking and seasoning, use vegetable oils (such as olive, canola, corn, and peanut oil) instead of animal fats (such as lard, bacon grease, side meat, or fat back). Also, use herbs and spices instead of salt.

• Avoid foods that are high in saturated fat (fat from animal products) and hydrogenated fat (vegetable oils that have been processed into solid fats). Saturated fat is found in fatty meats, processed meats, cheese, whole milk, ice cream, butter, and lard. Hydrogenated fat is found in hard stick margarine and shortening and in many processed foods, snack foods, and fried foods.

• Check the labels of packaged snacks and sweets. Avoid the ones that contain coconut oil, palm oil, or hydrogenated vegetable oil.

• Avoid high-cholesterol foods. These are foods from animal products such as meats, butter, cheese, whole milk, cream, and eggs.

• Watch portion size. Portions that are too large may cause you to gain weight and may drive up your blood sugar. One way to watch portion size is to measure your food. Another way is to use the “plate method” to keep your portions in balance (see pg. 20).

• Do not drink large amounts of alcohol. Blood sugar drops as alcohol is digested. Too much alcohol can lead to hypoglycemia, which in turn can cause dizziness and confusion. These are the same symptoms as for being drunk. A person who has had some drinks may not be alert enough to recognize that they are not just tipsy but also hypoglycemic. This can be very dangerous because hypoglycemia must be treated right away. Also, heavy drinking can lead to nerve damage over time. This is on top of the nerve damage that can come from diabetes. Finally, over-consumption of alcohol can lead to bad cholesterol levels, which worsens the risks for heart disease.

If you want to drink alcohol occasionally, consult with your health care provider about the amount that is safe for you.
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Getting exercise

Exercise is a key part of treatment for type 2 diabetes, because it uses up glucose and therefore lowers blood sugar. At the same time, it reduces insulin resistance, which also lowers blood sugar.

One concern about exercise, however, is that in some circumstances hard physical activity can cause blood sugar to drop too low. This is especially true for people who are taking glucose-lowering drugs. Therefore, anyone with type 2 diabetes needs to have an exercise plan, to make sure the workout is the right amount at the right level. Walking is often recommended because it is easy on the body, free, enjoyable, requires no equipment, and can be done almost anywhere.

Another benefit from exercise is that it lowers cholesterol. This reduces your risk for the heart disease that is associated with diabetes. It also lowers blood pressure, which reduces your risk for both strokes and heart problems. Finally, regular exercise can help you be fit and trim. This is an important benefit since overweight and obesity are key risk factors for type 2 diabetes and its complications.

Monitoring your blood pressure

Blood pressure is the force of the heart as it pushes blood through the arteries, the blood vessels that carry blood away from the heart. Measurement of blood pressure is easily done by a health care provider using a cuff placed on your arm. Blood pressure is measured at two different moments:

- When the heart beats. This is systolic pressure, and it is when blood pressure is highest.
- When the heart rests between beats. This is diastolic pressure, and it is when blood pressure is lowest.

Both measurements are important. If either one is too high, it is a sign of high blood pressure.

Your blood pressure varies during the day, depending on what you have been doing and your emotions. Therefore, health care providers like to determine your average blood pressure by measuring it over time such as at several doctor’s visits.

High blood pressure must be treated to prevent strokes, heart attacks, vision problems, and other complications of diabetes. Treatment for high blood pressure may include improvements
to your diet (such as eating less salt), changes to your lifestyle (such as more exercise), and medicines.

Keeping cholesterol at healthy levels

Cholesterol is checked by drawing blood. The blood test measures the presence in the blood of two different types of cholesterol (HDL and LDL) and triglycerides. The healthy range for each measurement varies depending on the number of risk factors for heart disease that you have (examples of these risk factors include high blood pressure, having family members with heart disease, advanced age, and being a smoker). People with diabetes are at twice the risk for cardiovascular disease. If any measurement is outside the healthy range, you may need to be treated to prevent heart disease. Treatment for high-risk cholesterol levels may include improvements to your diet (such as eating more fiber and less fatty foods), changes to your lifestyle (such as more exercise), and medicines.

Diabetes treatment plans

Eating healthily, getting exercise, and monitoring blood sugar, blood pressure and cholesterol, are the cornerstones to controlling diabetes. These tasks often go together in a treatment plan. The plan is a set of steps for a person with diabetes to follow in order to maintain good health. Ideally, this treatment plan is put together by a team of health professionals working with the patient.

If you have type 2 diabetes, an important part of your plan will be regular visits to health care providers. Your symptoms will be reviewed at each check-up. You may undergo a special blood test to find out how glucose levels have averaged over the past few months. Medicines may be prescribed to control blood sugar, blood pressure, or cholesterol. You will meet with specialists to check various parts of the body such as the eyes, feet, and teeth. You also may see mental health professionals for help dealing with the challenges of the disease.

Between visits with health care providers, treatment rests in your hands. In diabetes health care this is called self-management, and it is central to the success of any plan. The reason it is so important is that a treatment plan is only good if it is followed. If you have diabetes, self-management training can help you gain the skills and confidence needed to succeed with a treatment plan.

In self-management training you learn how to monitor blood sugar, how to take injections, how to pay attention to your body’s signals and symptoms, and how to take special

Pills may be prescribed for type 2 diabetes.

If you have type 2 diabetes, you may get prescriptions for one or more diabetes pills. Here’s what they do:

- Oral hypoglycemics work on the pancreas to increase insulin production.
- Starch blockers slow digestion so that glucose does not rise too quickly after eating.
- Metformin slows down glucose production in the liver and speeds glucose uptake by the cells.
- Insulin sensitizers make body cells more receptive to insulin.
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care of the skin, feet, and teeth. You get advice on how to shop for and cook healthful meals and how to select the right foods off a menu. You learn the best way to exercise and how often to do the workout.

Finally, you learn how to keep a daily log of blood sugar levels, meals, exercise, and symptoms. The log is referred to at check-ups and it is used to fine-tune the treatment plan.

You should be tested for diabetes if you have symptoms or are at risk.

You should be tested for diabetes if you have the symptoms described on page 4.

You should be tested every three years if you have no symptoms but are over age 45. And if you have one or more risk factors (see below), you may want be tested more often and starting at an earlier age.

You should be tested if you are an overweight child or teen with two or more risk factors (see below).

Risk factors:
- Close relative with diabetes
- Belonging to an at-risk group (Native American, Alaska Native, African American, Hispanic American, Asian American)
- High cholesterol
- High blood pressure
- History of impaired glucose tolerance
- Dark and thickened patches of skin, usually on the neck, under the arms, or inside the elbows (this symptom tends to appear in obese members of ethnic minority groups). These patches are called acanthosis nigricans.
- Having diabetes when pregnant OR delivery of a baby that weighs more than nine pounds

Pumps offer convenience and good control.

If you have diabetes and want to maintain tight control, discuss the benefits of using a pump with your health care team. A pump is a small device, about the size of a pack of cards, that you wear or carry.

Insulin moves from the pump to your body through a thin tube to a needle that is inserted under your skin. You can program the pump to automatically deliver doses of insulin. You can also control the pump to give extra insulin, or to adjust amounts, based on your blood sugar tests.

Pumps have several benefits. You don’t have to stick yourself with a needle every time you need insulin, because the pump’s needle stays painlessly in place for days at a time. You don’t have to remember when to give yourself regular doses of insulin because the pump remembers for you. And if you eat a little extra sugar, work out a little harder than usual, or in any other way cause your blood sugar to go up or down, you can easily adjust the pump.
Dr. Francine Kaufman

Life for children with diabetes is complicated. They must be careful about keeping their blood sugar levels just right—and be kids.

“It is a continual balancing act of the medications, the amount of insulin you take, your activity, and what you eat,” says Dr. Francine Kaufman.

For over 25 years, Dr. Kaufman has been helping children with diabetes and their families keep that balance. She is director of the Comprehensive Childhood Diabetes Center at Childrens Hospital Los Angeles.

She is also president of the American Diabetes Association, the largest organization in the country for doctors who treat people with the disease.

Dr. Kaufman says she specialized in diabetes care for children because she wanted to build relationships over many years.

She is especially close to several patients. Lance Kinkead and Lupe Pena are two patients who have moved in and lived with Dr. Kaufman’s family. Karen Matsuoka is a former patient who says Dr. Kaufman instilled with her life-long self-confidence. (See adjoining article.)

Ideas about how best to care for children with diabetes have changed since Dr. Kaufman entered the field.

Doctors worried that trying to keep blood sugar under control might be dangerous. They feared that control would go too far and sometimes cause sudden dips in sugar levels that could cause comas and other problems.

Doctors also figured that the complications from high blood sugar did not come until later—after children had grown up and become adults.

But studies showed that tight sugar control is important to preventing complications from diabetes, even in children. Researchers also proved that tight control can be accomplished without producing sugar “lows.”

In addition, invention of home glucose monitoring devices has made it relatively easy for children and their parents to check blood sugar levels several times each day. (Glucose is another word for the type of sugar in the blood.)
Now children and their families are involved in the medical care of diabetes on a daily basis. “We are asking them to do several diabetes-related tasks every day,” says Dr. Kaufman.

Dr. Kaufman and the American Diabetes Association are now working with educators to make sure diabetic children get help during the school day.

Dr. Kaufman says, “It really comes down to protecting the rights of these children to go to school like everyone else.”

In some ways, machines are making it easier for even children to take care of diabetes. “Prickless” devices collect blood samples for glucose monitoring. Instead of insulin injections, many people have automatic pumps that provide a continuous flow of insulin through a plastic tube inserted just under the skin.

In the future there may be something like an artificial pancreas. It will read blood sugar levels and provide insulin whenever it is needed.

But machines can’t replace doctors like Dr. Kaufman. “Diabetes is a complex, lifelong condition,” she says. “The doctor, the patients, and their families really need to be partners, working together.”

“I couldn’t have asked for a better doctor,” says Karen Matsuoka, a 28-year-old Stanford graduate and Rhodes Scholar who has been a patient of Dr. Kaufman’s since she was a young girl.

Matsuoka first met Dr. Kaufman at a camp for diabetic children. “On the first day of camp I was waiting in line for dinner when I started to cry for no particular reason. Dr. Kaufman was busy giving other children their evening injections but she immediately dropped everything, took me aside, held me on her lap, and asked me what was wrong. Sure enough, my blood sugar was low. I knew she was very busy and had hundreds of other kids to look after, but she made me feel that she had all the time in the world for me if I needed it.”

Some doctors are like drill sergeants, says Matsuoka. They tell their patients what they can and cannot do. Not Dr. Kaufman, she says:

“Her philosophy was more ‘Okay, you want to do something. Let’s figure out a way for you to do it while keeping your blood sugars in the normal range.’ Dr. Kaufman helped me realize that diabetes is only as limiting as I allow it to be.”

“I think this is the greatest gift that any physician can give to their patients with a manageable chronic illness like diabetes.”

When Matsuoka has finished her studies, she wants to be a health care policy analyst and work on improving access to health care.

“Yes, to a certain extent, how well diabetic patients do is up to them and how well they control their diabetes. But if they can’t even afford blood-testing supplies, how can anyone expect them to stay well?”
Discoveries through research

Long ago, insects were used to diagnose diabetes. A doctor would pour a patient’s urine next to an anthill. If the ants ran over to the urine, then it contained a lot of sugar and this meant diabetes. It was simple, but it was scientific.

Over the centuries, other discoveries followed. In the 1700s, scientists figured out that sugar is not just in the urine of people with diabetes. Some amount is in everyone’s body fluids. This led to research into the purpose of blood sugar.

About one hundred years later, researchers learned about the role of the pancreas. It started when a researcher experimented on a dog. After he removed the dog’s pancreas, the dog urinated a great deal. The researcher knew this was one of the symptoms of diabetes. This discovery led to a search for what happens inside the pancreas to cause diabetes. After several decades of work, researchers learned that certain cells produce insulin. These cells are found in the pancreas. Because they lie in island-like clumps, they are called islet cells. It was many researchers working over many years who discovered the benefits of injecting insulin, who figured out how to extract and purify insulin from animals, and who invented the technique for growing human insulin in the laboratory. And it was many researchers working over

Researchers work on new products that make it easier to manage diabetes.

For many people with diabetes, treatment is a lot of trouble. That’s why a great deal of research goes into finding products that can make treatment tasks easier. Here are some products that may soon be available:

**An internal insulin pump.** An internal pump will not be as cumbersome as the kind worn outside the body, and it will not use any needle. The internal pump will automatically sense blood sugar and deliver the needed amount of insulin.

**Insulin inhalers.** Instead of injecting insulin, a person will simply hold the inhaler to the mouth and breathe in a spray. Inhalers have been around a long time, but until now they have not been effective with insulin. That problem appears to be solved with these new inhaler models. Other insulin-delivering products in the research stage include skin patches, nasal sprays, and pills. (Currently insulin is not available in pill form because when pills reach the stomach, the insulin is destroyed during digestion.)

**Glucose watches.** These watches do not tell time. Instead they use tiny electrical impulses to measure blood sugar in the blood vessels of the wrist. They set off an alarm when blood sugar falls outside a programmed safe range. They also keep records that can be transmitted to a computer and printed out, so patients do not have to keep written logs. Other glucose-monitoring devices under development include sensors that are implanted under the skin, handheld lasers, and ultrasound devices.
many years who discovered how to diagnose diabetes, how to treat it, and how to reduce the complications. This research has led to big improvements in the quality of life for people with diabetes. It also lends hope to the promise of someday finding a cure.

Current lines of research

Research continues to explore more questions about diabetes. Why does it affect some groups more than others? How can treatment be made better and easier? How can diabetes be prevented? What are the best ways to educate people about diabetes? Today, research in all branches of science is adding to the knowledge about diabetes. Here are some of the types of research underway.

Population studies. By studying a group of people over time, researchers can learn a great deal about how they are affected by a disease. One of the most significant population studies in the diabetes field has focused on the Pima Indians of Arizona. More than 30 years ago, researchers noticed that the Pimas had a very high rate of diabetes. The Pimas agreed to volunteer for diabetes research, and the partnership continues to this day. This research has yielded valuable information about the nature of the disease and its effects on the body. Information from the research has helped with diagnosis, prevention, and treatment strategies.

Just one example of how this partnership has worked is a study comparing the Arizona tribe to another Pima tribe in Mexico. The Mexican Pimas live traditionally. They eat more healthful foods and lead more active lives. They also have a much lower rate of diabetes. This research helped confirm the connection between lifestyle and diabetes.

Genetic research. Researchers are investigating the genes that regulate body weight, energy use, and body type. They are figuring out how these genes affect the development of obesity and diabetes in different groups. They are exploring ways to alter gene function to prevent the weight gain that can trigger diabetes, how to prevent the disease itself, and how to reduce its complications.

Some of this research takes place in the lab, using gene samples and high-tech equipment. Researchers look inside cells to see how genes send signals to trigger activity in the body. They hope to figure out how to correct the improper signalling that leads to diabetes. Other gene studies take place in the field. Researchers talk with families to learn about how the disease has passed down through the generations and the particular ways it has affected them.
When type 2 diabetes is undiagnosed or not controlled properly, it can lead over time to major damage to the body. The many problems linked to diabetes are described below.

It's important to remember that these problems often can be avoided or delayed if the diabetes is controlled. Be sure to read on to the next chapter, "How is type 2 diabetes prevented and treated?"

**DIABETIC ACIDOSIS.** Glucose builds up in the blood when the body does not have enough insulin to move it inside cells needing nourishment. This condition is called hyperglycemia. Despite all the glucose, the body acts as if none is available. It begins to breaks down muscle and fat cells in search of glucose. The fat is converted to strong acids called ketones. In large amounts, ketones in the blood are like poison and can lead to shock, difficulty breathing, and coma.

**INSULIN REACTION.** If there is too little glucose in the blood, a condition called hypoglycemia can occur. This causes weakness, tiredness, confusion, dizziness, sudden sweating, rapid heartbeat, strange behavior, and passing out. A sudden onset of these symptoms is called an insulin reaction. All persons with diabetes have to guard against insulin reaction. However, it occurs more often in people who inject insulin to control their diabetes. The symptoms can be reversed by eating or drinking a product containing sugar or by taking glucose tablets.

**NERVOUS SYSTEM DISEASE.** Diabetes leads to nerve damage, called neuropathy. This can cause loss of feeling and pain, especially in the feet or hands. It also can cause problems in the heart, digestive system, sexual organs, and just about every other part of the body. Problems may take years to develop, but up to 70 percent of people with diabetes suffer from some type of nervous system damage.

**CARDIOVASCULAR DISEASE.** The nerve damage from diabetes can have an effect on heart rate. Diabetes also affects the body's cholesterol levels. Two proteins called "lipoproteins" carry cholesterol to and from cells. Many people with diabetes have too much of the lipoprotein that delivers cholesterol to cells (this is called "LDL"). As a result, cholesterol tends to clog and scar blood vessels. This makes it more difficult for blood to pass through. People with diabetes also are at risk for high triglycerides, a form of fat that the body obtains from food and uses for energy. Along with cholesterol, triglycerides can clog and scar blood vessels. Together, these complications from diabetes can build up to cardiovascular disease. Symptoms range from weakness and poor circulation to heart attack and stroke. The rate of cardiovascular disease among people with diabetes is two to four times as high as it is for adults without the disease. It is the number one cause of diabetes-related deaths.

**BLINDNESS.** The damage from diabetes to nerves and blood vessels can destroy the retina, a light-sensing part of the eye. This problem is called retinopathy, and it can lead to blindness. People with diabetes have a 25-times greater risk for blindness compared to the general population.

**KIDNEY DISEASE.** Diabetes stresses the kidneys and reduces their function. This kidney damage is called nephropathy. Damaged kidneys no longer clean the blood properly. Waste builds up in the bloodstream, leading to grave sickness. Survival may require a kidney transplant or dialysis, the use of a machine to clean the blood. Diabetes is the most common cause of kidney failure.

**AMPUTATIONS.** Because diabetes stresses the heart and blood vessels, blood does not travel through the body the way it should. Poor circulation of blood reduces the amount of food and oxygen that are delivered to cells and the amount of waste that is carried away. Poor circulation can be a particular problem for the feet, which are farthest from the heart. Infected skin and sores to the legs and feet are more likely to occur and they may not heal properly. These problems may not be treated promptly because they go unnoticed due to the loss of sensation from nerve damage. If the decay is bad enough, the limb must be cut off. More than 60 percent of all lower limb amputations in the U.S. happen to people with diabetes.

**GUM DISEASE:** Because of the damage to body tissue caused by diabetes, gum disease is a common side effect that can lead to tooth loss. For people over age 19 with type 1 diabetes, about 30 percent have gum disease.

**COMPLICATIONS OF PREGNANCY.** Babies born to mothers with diabetes are at risk for growing too large, too fast. This can lead to an early delivery and the complications of being born before the lungs are ready. If the baby is very large at birth, the delivery may be difficult. The diabetic mother also is at higher risk for toxemia, an illness caused by the build-up of poisons in the bloodstream.

Part 4: How do researchers study diabetes?
An example of this kind of research is a study taking place in five locations in Western Africa. This research may uncover the reasons why diabetes hits so hard among African Americans.

**Weight management.** Three great puzzles yet to be solved by science are: how to lose extra weight, how to keep it off, and how to stay slim in the first place. A lot of current research seeks to solve these puzzles. This would be a great advance against diabetes, since it mainly affects people who are overweight.

One example of this kind of study is trying to figure out how to help very young children lose weight. It involves children ages five to eight who are obese and have a family history that puts them at risk for diabetes and heart disease. Another study of this type is focusing on prevention. Called Quest, it is being conducted with the Pima Indians. Children as young as kindergarten age are screened for diabetes, taught healthy habits, and provided with exercise and balanced meals at school.

A large U.S. trial is looking at whether adult diabetes patients who get in shape have better health over the long term. The study is nicknmed Look AHEAD, for Action for Health in Diabetes, and it will last more than ten years. It involves 5,000 middle-aged, overweight men and women with type 2 diabetes. Half the group is being put into a diet and exercise program with the goal of reducing weight by up to 10 percent in the first year. The other half is being enrolled in education classes on nutrition and exercise.

Researchers also are trying to find out how various hormones help the body manage its supply of fat. Researchers have discovered that they can make fat mice lose weight by giving them doses of different fat-managing hormones. They are trying to figure out how to make an artificial hormone product that could help overweight humans lose weight.

**Transplants.** Most kidney transplants are performed on patients with diabetes. Some diabetes patients also have benefited from pancreas transplants. A lot of effort has been spent in recent years to make transplants more successful. Steady gains are being made in basic transplant techniques. Researchers are learning how to overcome the problems of organ rejection, too.

These advances have opened the door for new attempts at islet cell transplants. As explained earlier, islet cells are the cells inside the pancreas that produce insulin. Recently in Canada a small trial of this type was successful in patients with type 2 diabetes. This is very promising, because transplanting islet cells is a minor procedure compared to transplanting a
Part 4: How do researchers study diabetes?

whole pancreas. The experiment is now being repeated in a trial involving volunteers from ten medical centers in the United States and Canada. If this second trial shows positive results, then an even larger trial will follow.

Stem cell research. Even if islet cell transplants become successful, they will not help everyone in need. There simply are not enough donated pancreata from which to extract islet cells. Stem cells may present a way around this shortage. Stem cells have the ability to grow into many different kinds of cells. Researchers are trying convert stem cells into islet cells. The lab-grown islet cells could then be used for transplant.

Prediction. Researchers are trying to learn how to better predict who is at risk for diabetes. Researchers also are trying to learn how to predict who is at greater risk for the complications of diabetes. Good prediction is important, because it could lead to more targeted prevention and treatment. One idea researchers are looking at is to find the genes that are more common in people who develop diabetes. If such genes are found, a gene test could be developed to predict those at risk. Another idea is to study different groups of people to learn more about the unique ways in which they are affected by diabetes.

Primary health care provider (such as a doctor, nurse, or physician’s assistant): monitors your overall health, directs medical treatment, and coordinates care

Diabetes educator: teaches you how to follow the treatment plan and how to perform any procedures that are part of the plan

Dietician: matches you with an eating plan and provides training and support so you eat healthfully

Exercise specialist: matches you with an exercise plan and provides training and support so you get the right physical activity

Ophthalmologist (eye doctor) or optometrist (eye care professional): regularly checks your eyes to prevent and delay blindness

Mental health professional: helps you maintain emotional well-being in the face of the changes brought about by diabetes

Podiatrist (foot doctor): regularly monitors your legs and feet to prevent problems and the need for amputation

Dentist: regularly checks your teeth and mouth to prevent or treat gum disease

Pharmacist: dispenses prescriptions, helps you keep track of medications, and offers advice on tools and equipment for managing diabetes

These people will help you stay healthy with diabetes.

The important role of volunteers

Advances in diabetes knowledge could not happen without volunteers. These are the people who agree to share information about their health, who agree to donate
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tissue samples for lab study, and who agree to participate in clinical trials. Clinical trials are research projects, involving people who have volunteered to participate. They test the success of a medical treatment, medicine, or prevention strategy. A clinical trial usually is conducted only after the treatment has been successful in laboratory tests and on animals. Over the years, hundreds of thousands of Americans have volunteered to take part in clinical trials leading to today’s better understanding of diabetes.

Diabetes affects different parts of the American population in very different ways. For this reason, research into diabetes needs to involve Americans of all types — both males and females and people of all racial and ethnic groups, ages, and lifestyles. In the past, researchers were not sensitive to the need to study different groups. But today they are quite aware that research on one cluster of people may not reveal useful information about another group.

Many communities have begun to realize how they can benefit from taking part in research. When a community’s members enroll in clinical trials, they stand a better chance of access to brand new, effective treatments. At the very least, their health will be monitored by medical personnel during the course of the trial and they will have the best standard of care. These volunteers also get the satisfaction of helping uncover information that could some day reduce the impact of diabetes on their families and communities.

Children and teens with type 2 present different challenges.

The sharp rise in type 2 diabetes among teens and younger children creates all sorts of new challenges. Many health care providers are not yet aware that this form of diabetes can affect children, and so they may not diagnose the illness properly. In fact, illness may not be diagnosed at all until damage to nerves and blood vessels has begun. Most of what is known about symptoms, treatments, and complications of type 2 comes from research with adults. For this reason, health care providers have to do more guesswork working with younger patients.

Another challenge is that many children with type 2 belong to families that as a whole eat poorly and exercise little. Changing the child’s lifestyle often means working to change the entire family.

Teenagers tend to resist treatment, so doctors have to be creative in finding a plan that the patient agrees to follow. Young patients typically need frequent re-teaching, too.

Finally, type 2 diabetes in younger people is such a new trend that some insurance plans do not cover the special care that may be required. Parents may have a hard time getting insurance to pay for this care.

Despite these challenges, treatment for young patients is very important. They have many years ahead of them, and the longer a patient has diabetes the more risk there is of complications.
Jerry Stackhouse

Jerry Stackhouse plays guard for the Washington Wizards, the professional basketball team in Washington, D.C. And he is one of the top players in the NBA.

His life is a dream come true. But Stackhouse has seen how diabetes can cut lives and dreams short.

Two of his older sisters, Delois and Jean, died from complications from diabetes. Now his mother, Minnie, and his father, George, have been diagnosed.

Stackhouse says, “People think diabetes is an old people’s disease and that it is not really a deadly disease. But because of my sisters, I have seen how it can kill people in their 40s.” He has started his own charity called the Triple Threat Foundation to fund research and raise awareness of diabetes. Stackhouse has filmed public service announcements for television and spoken about diabetes before Congress. “Managing diabetes,” he has said, “is tougher than anything I do on the basketball court.”

Stackhouse grew up in small town in eastern North Carolina called Kinston. Because of his sisters, he thought insulin shots were normal. “I guess that’s because I grew up the disease. It was just something that people did, like pouring milk into cereal. My sister had to take shots. I didn’t think it was anything major,” he says.

And like many people, he thought that diabetes came from eating too much sugar. In fact, Stackhouse says, “sugar” is what people in Kinston often called diabetes. Bad diet may increase your chances of getting diabetes, but sugar doesn’t cause it.

It became clear to Stackhouse just how serious diabetes could be when his sister started to suffer complications. Delois had her left foot amputated. Jean suffered both kidney failure and hepatitis.

Stackhouse, continued on next page
One of Stackhouse’s main goals is to raise awareness of diabetes in the African, Latino and Native American communities. The disease hits those groups especially hard. The statistics are shocking. Thirteen percent of all adult African Americans have diabetes, 10 percent of all adult Latinos, and, by some estimates, 15% of all adult American Indians and Alaska Natives.

Stackhouse thinks one place to start is to educate people about symptoms so they will get a diagnosis, early treatment, and advice about how to control the disease. “If people have blurry vision or find that that they have to go to the bathroom a lot, they should go get checked out,” he says.

Stackhouse does not have diabetes now, but he knows he is at risk because of his family history. He is careful about what he eats. As a pro basketball player, he is very active, to put it mildly. But once his playing days over, Stackhouse knows he is going to be have to careful. “I’m definitely not out of the woods with this disease.”
Part 5: Let’s take control over type 2 diabetes.

How you can help

Type 2 diabetes does not have to throw its shadow over the lives of so many people. The rising number of cases can be reversed, but this is not a task for the medical workers alone. How can any one person help? Here are some ideas. Look on page 39 for resources to get you started.

Educate yourself about type 2 diabetes. You have begun to educate yourself by reading this information. Keep educating yourself. Go to your library and ask for information on diabetes. Use your computer, or a computer at the library, to search the Internet. Librarians will help you in your Internet search if you need it. Then share your knowledge with other members of your family and community.

Recognize that you can make a difference in your own health and the health of your family. The two key preventions — healthy eating and exercise — don’t happen in the doctor’s office. Learn about and practice the habits that can keep diabetes away from your family.

Clinical study proves the value of tight control.

In 1993, a revolution occurred in the treatment of diabetes. That year a 10-year study was completed, called the Diabetes Control and Complications Trial (DCCT). The trial involved 1,441 people with type 1 diabetes who were treated at 29 medical centers across the U.S. and Canada.

Volunteers were randomly placed in two groups. The first group received standard treatment. This was the best care known for the time, which involved injecting insulin once or twice per day. The second group followed an experimental treatment known as tight control. This meant the volunteers tested their blood frequently throughout the day and ate food or injected insulin as needed to keep blood sugar stable.

The study proved beyond a doubt that excess blood sugar is the source of the problems that come with diabetes. It proved that tight control of blood sugar can delay and reduce complications. In fact, the differences between the two groups was dramatic. Eye disease was 76 percent lower in the tight control group. Nerve disease was 60 percent lower, and kidney disease was 50 percent lower.

The study also showed that some control, even if it could not be called tight, was better than no control. A follow-up study showed that the benefits of control last for years.

Another major study came to the same conclusions for people with type 2. This was the United Kingdom Prospective Diabetes Study (UKPDS). It was a twenty-year study with patients in England, Ireland, and Scotland.

Tight control is not a perfect solution to the problems of diabetes. It requires attention and effort. People who maintain tight control are more likely to suffer from low blood sugar problems (hypoglycemia). Even so, these studies show that the benefits of tight control are far greater than the drawbacks.
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Arrange for testing if you or family members are at risk for diabetes. Risk factors include a family history of diabetes, obesity, membership in a minority racial or ethnic group, age, and symptoms (see page 4 for a description of symptoms). Ask your doctor for diabetes screening.

If you have diabetes, accept the changes that you must make. A diabetes diagnosis means changes in the way you live. You have to watch your diet and take up exercise, pay careful attention to your body, and go in for health check-ups. You may have to take medicine. You cannot look at these changes as annoying or optional. They have to become part of your daily habits. They are the necessary steps only you can make to preserve your health.

Seek good prenatal care for women in your community. When diabetes is avoided or controlled during pregnancy, complications at delivery are reduced. Work to educate women of child-bearing age about diabetes. Join efforts to make prenatal care available to all who need it.

Help bring diabetes prevention programs into your community. Learn from the prevention programs that have succeeded in communities like yours. Work with a local organization to create a prevention program that fits your community. (To obtain a small grant to support your community prevention program, see Healthy People Library Project in the Resources list on page 39.)

Encourage schools to lead in diabetes prevention. Ask your local schools to review lunch menus and vending machine products to make sure healthful foods are available to students. Find out if schools provide enough gym classes, recess play, and after-school activities so students get the exercise they need. Help plan prevention programs for students.

Volunteer for diabetes or diabetes prevention trials. Obtain information on upcoming trials. Volunteer yourself for a trial, and promote these opportunities to members of your community. Find out if your community can be a site for a research trial on prevention.

Encourage young people to seek careers in diabetes research, treatment, and prevention. Ask the local school system to provide challenging “college prep” science classes. Help young people find the scholarships and college courses that lead to careers in diabetes.
Part 5: Let’s take control over type 2 diabetes.

Huge clinical trial shows that low-fat diet and exercise reduce risk for type 2 diabetes.

Are you overweight? Do you have impaired glucose tolerance? Then you are at high risk for type 2 diabetes. But here’s what you can do to reduce your risk: lose some weight and take up exercise. Even small changes in weight and exercise can protect you.

This news comes from the Diabetes Prevention Program, a multi-year study conducted at several hundred clinics in the U.S. and Canada. The study involved more than 3,000 overweight volunteers with impaired glucose tolerance. A cross-section of people took part, including people over age 60, women with a history of gestational diabetes, people with close relatives who have the disease, and members of minority groups with high rates of type 2 diabetes.

One set of volunteers was given advice and support to lose weight by eating a low-fat diet and exercising for about a half-hour five days a week. Most of the volunteers exercised by walking.

Over three years, this set of volunteers developed diabetes at a rate that was 58 percent lower compared to another set who received standard health advice but no extra diet or exercise help. Twice as many of these volunteers regained normal glucose tolerance, compared to the volunteers who did not receive the extra help.

Another group of volunteers received health advice and took an insulin-regulating medicine called metformin. They reduced their risk by 31 percent compared to the volunteers who did not receive extra help.

Researchers continue to follow the progress of the volunteers to find out whether the benefits of good diet and exercise last over time.

Ruby Wolf: A tireless campaigner against diabetes

“I lost my parents to diabetes,” says Ruby Wolf. “What I saw with my parents is not what I want for my community.”

Wolf is a member of the Zuni tribe that lives in the high desert of New Mexico. Traditionally Zuni people were lean and athletic. Runners often traveled long distances to reach farm fields or to carry messages between villages.

Lard and sugar, cars, sit-down habits, and other modern influences have brought a huge change to the Zuni. Many now fall victim to obesity and its companion, type 2 diabetes.

Some 1,400 Zuni are diabetic in a tribe of only 10,000. That’s three times the rate for the general population.

Wolf believes that education is key to turning this around—education about type 2 diabetes and about healthful Zuni traditions.

As director of a local nutrition clinic, Wolf works with other activists to re-introduce healthy practices into daily life. A majority of Zuni women once again breastfeed their infants. New playgrounds have been
constructed. The community drinks low-fat milk instead of whole, and bottled water is now stocked in vending machines.

The Zuni gym is constantly busy with group workout sessions and individual users of the weights and stationary bikes. There’s also the Zuni Fitness Series. Runs, walks, and other fitness events take place each month starting in the spring and building up to a 25-mile reservation relay in August.

By offering a wide variety of events, Wolf says, “we’ve been able to motivate people who are not necessarily interested in competing at sports or running.”

There used to be a charge to take part in the Fitness Series, but that’s been dropped. Now participants are asked for something else: information. The registration form asks about body mass index, risk factors for diabetes, and other health information. Wolf explains that these data, along with follow-up data collected at future events, will be used to measure the community’s progress toward fitness.

Meanwhile Wolf’s nutrition clinic continues to educate about wellness through a Healthy Lifestyles project. The project puts out fitness information through radio, bulletin boards, articles, and other means, but especially through the fourteen staff people who make personal visits to community members. On these visits staff members are able to spend more time educating clients compared to health workers in a medical setting. Also, they are able to help entire families learn what to do to stay fit, so the burden of change is not on one person alone.

The Healthy Lifestyles project recently succeeded in getting a wellness curriculum included in the public schools at all grade levels. Another recent success is a grant to the schools for fruit and vegetable snacks, so children are less tempted by junk food.

Wolf says that what has really helped get the message across is providing educational materials in the Zunian language. Some people have told her, “I never knew that until I heard it in Zuni.”

What keeps Wolf inspired are those moments when people are having fun staying in shape. “Five hundred-plus walkers out at 7:30 in the morning,” she says. “What motivation!”

She’s also inspired by the need to undo the myth that to be Zuni means to get diabetes. “We say no, this is not what has to happen, this is not the belief we should have anymore,” she says. “We’re going back to tradition and if we do that we’ll have healthier lifestyles.”
If you have not been diagnosed with diabetes...

Am I at risk for diabetes?
Should I be tested for diabetes?
What is my body mass index (BMI)?
Does my BMI suggest that I might be at increased risk for diabetes?
What are the symptoms of diabetes that I should watch out for?
What do I need to do differently to prevent diabetes?
Can you help me lose weight?
Can you tell me how to eat better?
Can you help me get started on an exercise plan?

If you have been diagnosed with diabetes...

What can be my short-term goals for control of the diabetes?
What can be my long-term goals?
What is my treatment plan?
Who can help me learn self-management of my diabetes?
What medications will help control my diabetes?
What do I need to do differently to follow my treatment plan?
What other specialists do I need to see?
What is my schedule for check-ups?
If I get pregnant, how will diabetes affect my baby and myself?
Can you help me locate a clinical trial to join?

When you volunteer for a research study, you may be able to improve your own health or the health of future generations. But before you volunteer, do some research yourself. Find out if the study is the right for you.
By law, researchers must have your informed consent before they can include you in a study. This means:

• You agree to participate.
• You know what the study is about.
• You know what your rights are.
• You know how you will be protected from harm.

Here are important questions you should ask of anyone who wants you or a loved one to be part of a research study on diabetes.

What is the study about?
Who put this study together?
How can people like me share their ideas as you do this study?
Who is going to be in this study?
What will I get out of this study?
How will I be protected from harm?
How will my privacy be protected?
What do I have to do in this study?
What will happen with the information you collect, and the research results, after the study is over?
Do you have a patient advocate — someone who can help me understand this information?
How much time do I have to decide whether I want to participate?

These questions are adapted from a more detailed brochure called Taking Part in Research Studies — What Questions Should You Ask?

You can view it on-line by typing “Taking Part in Research Studies” into the “Quick Search” box at www.cdcnpin.org/

You also can order copies of “Taking Part in Research Studies” (item number D025) from:
National Prevention Information Network
P.O. Box 6003
Rockville, MD 20849-6003
1-800-458-5231
Resources

**American Association of Diabetes Educators**
*Promotes diabetes education and patient care.*
100 West Monroe, 4th Floor
Chicago, IL 60603
(312) 424-2426
www.aadenet.org

**American Diabetes Association**
*Promotes diabetes prevention and treatment and advocates for improved quality of life for people with diabetes.*
National Service Center
1701 North Beauregard Street
Alexandria, VA 22311
1-800-DIABETES or (703) 549-1500

**ClinicalTrials.gov**
*A Web-based resource for finding clinical trials in need of volunteers.*
www.clinicaltrials.gov
Select the “diabetes” topic to search for diabetes-related trials.

**Comprehensive Health Information Database**
*A web-based service that combines resources on diabetes and other diseases from several federal agencies. A service of the National Institutes of Health.*
chid.nih.gov/simple/simple.html

**Diabetes Research and Training Centers**
**Diabetes Endocrinology Research Centers**
*Two types of diabetes research centers supported by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK).*
www.niddk.nih.gov

**DPT-1 Clinical Centers**
*Enrolls volunteers into the Diabetes Prevention Trials. Free diabetes testing for volunteers is provided through hundreds of screening centers in the U.S. and Canada.*
1-800-HALT-DM1
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Healthy People Library Project
A nationwide health promotion and disease prevention campaign sponsored by the Department of Health and Human Services. One of the goals of the campaign is to reduce health disparities.
Office of Disease Prevention and Health Promotion
200 Independence Avenue SW., Room 738G
Washington, DC 20201
(800) 367-4725
www.health.gov/healthypeople

For information on the Healthy People Microgrant program that finances community-based prevention activities, go to the following web site:
www.health.gov/healthypeople/implementation/community/

Indian Health Service National Diabetes Program
Supports and promotes health efforts that prevent and control diabetes among Native Americans.
Indian Health Service
5300 Homestead Road, NE
Albuquerque, NM 87110
(505) 248-4182

Medlineplus
A comprehensive source of health information provided by the National Library of Medicine.

National Center for Chronic Disease Prevention and Health Promotion
Promotes the transfer of research knowledge into actual prevention and treatment strategies. Provides information to the general public.
Centers for Disease Control and Prevention
Division of Diabetes Translation
Mail Stop K-10
4770 Buford Highway, NE
Atlanta, GA 30341-3717
1-800-CDC-DIAB
www.cdc.gov/diabetes
National Diabetes Education Program (NDEP)
A federally-sponsored initiative that involves public and private partners to improve the treatment and outcomes for people with diabetes, to promote early diagnosis, and to prevent the onset of diabetes.
NIDDK
National Institutes of Health
Bethesda, MD 20892-2560
1-800-438-5383
http://www.ndep.nih.gov/

National Diabetes Information Clearinghouse
A source of information for professionals and for the general public.
A clearinghouse of NIDDK.
1 Information Way
Bethesda, MD 20892-3580
1-800-860-8748 or (301) 654-3327

National Eye Health Education Program
Sponsors eye health education programs to promote early diagnosis and treatment of diabetic eye disease.
National Eye Institute
Box 20/20
Bethesda, MD 20892-3655
1-800-869-2020 (health professionals)
(301) 496-5248 (general public)
www.nei.nih.gov

National Heart, Lung, and Blood Institute Information Center
Provides patient education and professional materials on topics of interest to diabetes patients such as cholesterol, high blood pressure, heart disease, exercise, and obesity.
P.O. Box 30105
Bethesda, MD 20824-0105
(301) 592-8573
www.nhlbi.nih.gov/health/infoctr
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National Kidney and Urologic Diseases Information Clearinghouse
Provides information about kidney disease as it relates to diabetes.
3 Information Way
Bethesda, MD 20892-3580
1-800-891-5390 or (301) 654-4415
www.niddk.nih.gov/health/kidneys/kidney.htm

National Oral Health Information Clearinghouse
Provides information for the oral health of special care patients such as diabetics.
1 NOHIC Way
Bethesda, MD 20892-3500
(301) 402-7364
www.nohic.nidcr.nih.gov

Native American Research Centers for Health
Research centers that link the Native American community with health research and that work to increase the number of Native American scientists and health professionals.
National Institute of General Medical Sciences
National Institutes of Health
45 Center Drive MSC 6200
Bethesda, Maryland 20892-6200
(301) 496-7301
www.nigms.nih.gov

New York Online Access to Health
A searchable health information resource in English and Spanish.
www.noah-health.org/index.html

Office for Human Research Protections
A source of information on the guidelines and ethics of research studies with humans.
Department of Health and Human Services
The Tower Building
1101 Wootton Parkway, Suite 200
Rockville, MD 20852
(301) 496-7005
http://ohrp.osophs.dhhs.gov/address.htm
Resources

Office of Minority Health Resource Center
Serves as a national resource and referral service on minority health issues, including diabetes. Affiliated with the U.S. Department of Health and Human Services.
P.O. Box 37337
Washington, D.C. 20013-7337
1-800-444-6472
www.omhrc.gov/omhrc/

National Center on Minority Health and Health Disparities
Promotes the health of racial and ethnic populations through research and education and through support of minority involvement in research careers. Affiliated with the National Institutes of Health.
6707 Democracy Boulevard
Suite 800
MSC 5465
Bethesda, MD 20892-5465
1-800-444-6472
301- 402- 1366
www.ncmhd.nih.gov

Weight-Control Information Network
Health information and educational materials on weight loss. A clearinghouse of National Institutes of Diabetes and Digestive and Kidney Diseases (NIDDK).
1 WIN Way
Bethesda, MD 20892-3665
1-800-WIN-8098 or (301) 984-7378
www.niddk.nih.gov/health/nutrit/win.htm

Veterans Health Administration Diabetes Program
Works to ensure state-of-the-art care for diabetes patients served by veterans hospitals.
Program Chief, Diabetes
Veterans Health Affairs
810 Vermont Avenue, N.W.
Washington, D.C. 20420
(202) 273-8490
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— Research Advances and Directions. “A New Era of Hope” chapter.

Oxford Centre for Diabetes, Endocrinology & Metabolism, Diabetes Trial Unit. “Better blood pressure control...” Accessed 3/6/03. [http://www.dtu.ox.ac.uk/ukpds/results.html](http://www.dtu.ox.ac.uk/ukpds/results.html)


www.uclh.org/services/diabetes/protocol/complications/lipid_mgmt.shtml

University of Arizona Native American Research and Training Center.  
Type 2 diabetes: What’s next? NARTC conference looks at impact on minority youth. *NARTC newsletter*. DATE.


Glossary

Note: in the definitions below, some words are in *italics*. These words have their own entries in this glossary.

a•can•tho•sis ni•gri•cans: dark and thickened patches of skin, usually on the neck, under the arms, or inside the elbows. These patches can be a symptom of diabetes. They tend to appear in obese members of racial and ethnic minority groups.

Ac•tion for Health in Di•a•be•tes: A ten-year study of 5,000 diabetes patients, nicknamed Look AHEAD. The study seeks to find out if the complications of type 2 diabetes can be reduced through weight loss and exercise.

ac•tion time: a term that describes how quickly an insulin product takes effect and how long it lasts.

ad•ult-on•set di•a•be•tes: a name for type 2 diabetes. It is no longer used by health professionals, because the illness affects young people as well as adults.

am•pu•ta•tion: the removal of a limb because it is diseased or decayed. It is one of the possible complications of diabetes.

ar•ter•ies: the blood vessels through which blood moves away from the heart. Other blood vessels, called veins, carry blood back to the heart.

blin•d•ness: a condition of being unable to see. It is one of the possible complications of diabetes. The form of blindness linked to diabetes is called retinopathy.

blood glu•cose me•ter: a machine that analyzes a tiny blood sample placed on a test strip to produce a measurement of blood sugar.

blood sug•ar: glucose in the blood.

blood pres•sure: the force of the heart as it pushes blood through the arteries.

blood ves•sels: the pipelines through which blood travels to all parts of the body.

bod•y mass in•dex (BMI): reflects the ratio of height and weight. An adult with a BMI of 25 or higher may be overweight and therefore at increased risk of diabetes. To calculate BMI, go to http://www.cdc.gov/nccdphp/dnpa/bmi

car•bo•hy•drates: foods that contain sugars or starches.

car•di•o•vas•cu•lar disease: the combination of disease of the blood vessels and disease of the heart. It is one of the possible complications of diabetes.

cho•les•ter•ol: a wax-like substance found in human cells. Some cholesterol is needed for healthy cells, but too much can build up in blood vessels and block the flow of blood.

chron•ic: long-lasting and on-going.

clin•i•cal tri•als: research tests using people that are performed to test the success of a medical treatment, medicine, or prevention strategy. A clinical trial usually is conducted only after the treatment has been successful in the laboratory and on animals.

com•pli•ca•tions of di•a•be•tes: health problems that often develop in people with diabetes. These complications include heart disease, nerve damage, kidney disease, blindness, amputations, skin problems, and other health conditions.
com•pli•ca•tions of preg•nan•cy: problems that are not expected in a healthy pregnancy. These include birth defects, illness at birth for the mother or baby, injury or death to the newborn, and injury or death to the mother. Complications of pregnancy are more likely if the mother has diabetes.

den•tist: a doctor who specializes in the teeth and gums.

Di•a•be•tes Con•trol and Com•pli•ca•tions Tri•al (DCCT): a ten-year study, completed in 1993, that proved the value of tight control over blood sugar to avoid and delay complications of type 1 diabetes.

di•a•be•tes ed•u•ca•tor: a health care professional who provides self-management training and support to patients so they can control their diabetes.

di•a•be•tes mel•li•tus: a set of illnesses caused by improper amounts of glucose in the blood. A more formal name for diabetes.

di•a•be•tes pills: medicine taken in pill form that helps promote the action of insulin. These pills may be prescribed to patients with diabetes.

Di•a•be•tes Pre•ven•tion Pro•gram: a multi-year study of patients at risk for type 1 and type 2 diabetes that is testing strategies for preventing the illnesses.

di•a•be•tic ac•i•do•sis: a condition in which large quantities of acids are dumped into the bloodstream following the breakdown of fat cells. The acids can act like poison and lead to shock, difficulty breathing, and coma.

di•ag•no•sis: a professional medical opinion, based on an exam and history of the patient, about what is causing symptoms of illness.

di•al•y•sis: the use of a machine to perform the function of the kidneys, which is to clean the blood.

di•a•sto•lic pres•sure: the pressure in the arteries when the heart rests between beats. It is the second number reported in a blood pressure reading.

di•eti•cian: a health care professional who advises patients on diet and eating.

ep•i•dem•ic: a rapidly spreading and increasing problem, such as a disease which is gaining hold in more and more people

ex•er•cise spe•cial•ist: a health care professional who trains and advises patients in physical activity appropriate for their condition.

fast•ing glu•cose test: a test for diabetes that measures blood sugar. This test requires the patient to stop eating several hours beforehand.

genes: units of hereditary information contained in each cell of the body.

ge•net•ic pre•dis•po•si•tion: the term for a person's increased likelihood of developing some trait or illness because he or she carries certain genes.

ge•net•ics: the field of science that looks at how genes are passed down from one generation to another to influence traits.

ges•ta•tion•al di•a•be•tes: a form of diabetes that appears during pregnancy.

 glu•cose: a form of sugar found in food that is the body's main fuel.

 glu•cose chal•lenge: a test to measure glucose that involves drinking a standard dose of oral glucose and fasting for a short period. This test is given to screen for diabetes.

 glu•cose tab•lets: small pills containing glucose that are a convenient and quick way to increase blood sugar.

 gum dis•ease: disease of the tissues that hold the teeth in place. It is one of the possible complications of diabetes.

 health dis•par•i•ty: the uneven impact of a health problem that may occur between groups of people.
heart attack: a failure of the heart to perform its job of pushing blood through the blood vessels.

heart disease: disease of the heart, the organ that pumps blood through the body. It is one of the possible complications from diabetes.

high blood pressure: a condition in which blood is pushed through the body’s blood vessels at greater force than normal. It is one of the possible complications from diabetes, and can lead to tiredness, heart attack, stroke and other health problems. High blood pressure is also known as hypertension.

hormone: a protein produced by an organ of the body to trigger activity in other locations. Insulin is an example of a hormone.

hydrogenated fat: vegetable oils that have been processed into solid fats. This type of fat should be avoided by the person with diabetes.

hypoglycemia: a condition in which there is an excess of blood sugar.

hyperglycemia: a condition in which a person has high levels of insulin in the blood. This condition indicates a risk for developing type 2 diabetes.

hypertension: another term for high blood pressure.

hypoglycemia: a condition in which there is too little blood sugar.

immune system: the coordinated responses of the body that serve to protect it against outside invaders such as viruses and bacteria.

impaired fasting glucose or impaired glucose tolerance: a condition in which a person has blood sugar levels that are higher than normal but not high enough to confirm a diagnosis of diabetes. This condition indicates a risk for developing type 2 diabetes.

informed consent: a volunteer’s agreement to participate in a research study, based on a full and complete understanding of what the study is about. This includes information on the risks for the volunteer, the rights of the volunteer, and the ways in which the volunteer will be protected from harm.

insulin: a hormone released by the pancreas that triggers the opening of body cells so that glucose may enter and be used for energy.

insulin reaction: a condition in which there is not enough glucose in the blood, leading to symptoms ranging from weakness and strange behavior to loss of consciousness. This condition is also called hypoglycemia.

insulin resistance: actions by the cells to oppose insulin, which seeks to open the cells so that glucose may enter.

insulin sensitizers: medicine that makes cells more receptive to insulin. This medicine may be prescribed in pill form to patients with diabetes.

insulin-dependent diabetes: a form of diabetes in which the pancreas has stopped producing insulin so that patients must inject insulin daily. It is also called type 1 diabetes.

islet cells: cells that are small, island-like areas in the pancreas that produce insulin and other hormones. They are also known as islets of Langerhans.

juvenile diabetes: a name for type 1 diabetes. It is no longer used by health care professionals, because it affects adults as well as young people.

ketones: strong acids created from the breakdown of fat.
kid•ney dis•ease: a disease of the kid-
neys, the pair of organs that clean the
blood. The disease can lead to kidney
failure. It is also called nephropathy.
It is one of the possible complica-
tions from diabetes.

kid•neys: the pair of organs that have
the job of filtering the blood.

men•tal health pro•fes•sion•al: a
health care worker who provides emo-
tional counselling and medicines for
mood to patients.

met•for•min: medicine that slows
down glucose production in the liver
and speeds glucose uptake by the
cells.
This medicine may be prescribed in
pill form to patients with diabetes.

ne•phrop•a•thy: a disease affecting
the kidneys. It is also called kidney
disease. It is one of the possible com-
plications from diabetes.

nerves: the network of cells that trans-
mit signals from all parts of the body
to the brain and back.

ner•vous sys•tem dis•ease: a disease
affecting the nerves. It is also called
neuropathy. It is one of the possible com-
plications from diabetes.

neu•rop•a•thy: a disease affecting the
nerves. Another term for it is nervous
system disease. It is one of the possible complica-
tions from diabetes.

non•in•su•lin-de•pen•dent
di•a•be•tes: a form of diabetes in
which the pancreas does not produce
enough insulin and the cells resist the
action of any insulin that is produced.
With this illness, patients often do not
have to inject extra insulin. It is also
called type 2 diabetes.

o•be•si•ty: the condition of being over-
weight. Obesity is diagnosed in
patients who are more than 20 per-
cent over ideal body weight.

oph•thal•mol•o•gist: a physician or
M.D. who specializes in the eyes.

op•tom•e•trist: a doctor or eye care
specialist who tests eyes, detects eye
problems, prescribes lenses, and
treats some eye conditions.

oral hy•po•gly•ce•mics: medicines
that work on the pancreas to increase
insulin production. These medicines
may be prescribed in pill form to
patients with diabetes.

ox•y•gen free rad•i•cals: leftovers
made when the body pulls oxygen
from cells. These radicals can attach
to other cells, damaging them.

pan•cre•as: the organ of the body that
produces insulin and other hormones.

phar•ma•cist: a health care profes-
sional who fills prescriptions, dispens-
es medicines, and sells or rents med-
ical tools and equipment.

po•di•a•trist: a doctor who specializes
in the feet.

prev•a•lence: a statistical term that
means the number of cases in a stan-
dard sample, such as 100 or 1,000.

pri•mar•y doc•tor: the doctor in
charge of a patient’s care.

prog•no•sis: A professional medical
opinion, based on exams and medical
findings, about the patient’s likely
future health.

ran•dom glu•cose test: a test for dia-
abetes that measures blood sugar. For
this test, it does not matter when the
patient last ate.

ret•i•na: a light-sensing part of the
eye.

ret•i•nop•a•thy: a disease of the eye’s
retina that can lead to blindness. It is
one of the possible complications of
diabetes.

sat•u•rat•ed fat: fat from animal
products, such as butter and lard and
the fat on meat. This type of fat should be avoided by the person with diabetes.

**self-manage•ment**: the behavior of a patient that is required to follow a treatment plan.

**self-manage•ment train•ing**: the education and support a patient receives from health care professionals so that he or she has the skills and confidence needed to follow a treatment plan.

**starch bloc•kers**: medicine that slows digestion so blood sugar does not rise too quickly after eating. This medicine may be subscribed in pill form to patients with diabetes.

**stem cells**: unspecialized cells that have the ability to grow into many different kinds of cells. They are obtained from embryos or from adult cells. Stem cell research seeks to create insulin-producing cells that could be transplanted into diabetes patients.

**stroke**: damage to the blood vessels in the brain that can result in the inability to speak or move part of the body.

**symptom**: a sign of a problem such as a disease.

**sys•tol•ic pres•sure**: the pressure in the arteries when the heart beats. It is the first number reported in a blood pressure reading.

**thrif•ty gene the•o•ry**: a theory that suggests a gene or genes evolved in ancient populations to help them maximize the storage of energy from food. This would have helped them survive through periods of starvation. In modern society, people who have inherited these genes may gain weight very easily, leading to a higher risk for type 2 diabetes.

**tight con•trol**: a treatment for diabetes that involves keeping close watch over blood sugar and taking insulin or eating as necessary to keep those levels steady.

**tox•e•mi•a**: an illness caused by the build-up of poisons in the bloodstream. Diabetes can sometimes trigger toxemia during pregnancy.

**treat•ment plan**: a set of steps for a person with diabetes to follow to maintain good health. Ideally, the treatment plan is put together by a team of health care professionals working with a patient.

**tri•gly•cer•ides**: a form of fat that the body obtains from food and uses for energy.

**type 1 di•a•be•tes**: an illness in which the pancreas has stopped producing insulin, leading to imbalances in blood sugar.

**type 2 di•a•be•tes**: an illness in which the pancreas does not produce enough insulin and the cells resist the action of any insulin that is produced.

**United King•dom Pro•spec•tive Di•a•be•tes Stud•y**: A twenty-year study with patients in England, Ireland, and Scotland that proved the value of tight control over blood sugar to avoid and delay complications of type 2 diabetes.
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