DIABETES

An introduction to aging science brought to you by the American Federation for Aging Research
WHAT IS DIABETES?

The full name of diabetes is diabetes mellitus. It is characterized by a consistently high level of a particular sugar, called glucose, circulating in the blood. Insulin, a hormone produced by the pancreas, stimulates fat and muscle cells to absorb glucose for immediate use as fuel, or for storage. Diabetes occurs when there is either too little insulin in the blood or cells become resistant to its effects.

There are three types of diabetes:

- **Type 1**
- **Type 2**
- **Gestational**

The vast majority of diabetes in older adults is type 2. Type 1 is most commonly a disease of childhood and adolescence. Gestational diabetes is a disease of women of childbearing age.

Another, much rarer, condition, diabetes insipidus, is entirely different and unrelated, featuring excessive urination due to either brain or kidney hormone imbalances. Blood sugar levels are normal in diabetes insipidus.

Type 2 (previously called non-insulin dependent or adult onset) diabetes is far more common than type 1, accounting for 90 to 95 percent of all cases in North America and approaching 99 percent of cases worldwide. It usually develops in individuals over age 30. In type 1, blood sugar levels are high because the pancreas can’t produce enough—if any—insulin. In type 2, the pancreas usually continues to produce insulin, but the cells no longer respond well to it. Over time, however, the production of insulin by the pancreas also decreases.

As obesity has become more prevalent in the United States, with more and more young people afflicted, type 2 diabetes is appearing at younger and younger ages—even in school-age children.

DIAGNOSING DIABETES

As with any illness, a diagnosis of diabetes is based on an understanding of the patient’s history, a physical examination, and laboratory tests.

Signs and symptoms

Signs and symptoms of high blood sugar levels include frequent urination, increased thirst, and weight loss. These are often accompanied by blurry vision, fatigue, and nausea. High circulating glucose levels encourage infections, which can be bacterial or fungal (particularly, repeated vaginal yeast infections).

Infrequently, the diagnosis is delayed until serious complications occur, such as confusion or unconsciousness.

Physical examination

The examination might be completely normal, or it might reveal early complications of diabetes (eye damage, nerve damage, heart disease, kidney problems).

Laboratory tests

All individuals should be routinely screened for diabetes at age 45 and every three years thereafter. You should be tested more frequently if you have any of the risk factors for the disease. These include:

- Age over 40 and overweight
- Family history of diabetes
- History of gestational diabetes
- African American, Latino, Native American, or Pacific Islander ethnicity
The American Diabetes Association recommends a fasting plasma glucose test (no food for eight hours before) because it is a simple, inexpensive (about $10), and reliable measure of circulating blood glucose.

Usually, doctors will make a diabetes diagnosis if you have a fasting blood sugar of 126 mg/dl or more on two occasions.

In 2010, the American Diabetes Association endorsed using the Hemoglobin A1c test (value > 6.5 percent) as a way of diagnosing diabetes. The Hemoglobin A1c number represents the average blood sugar measurement over the previous three months and is the primary way for doctors to track how well a patient’s sugars are being controlled.

Additional screening tests will show glucose and sometimes protein in the urine. Urinary protein can be an early herald of kidney complications associated with diabetes.

**RISK FACTORS FOR DEVELOPING DIABETES**

Obesity is the most important modifiable risk factor for diabetes. African Americans, Latinos, and Native Americans are at substantially higher risk, and the risk of developing type 2 diabetes increases with age. Scientists are also discovering many genes that predispose a patient to develop diabetes.

**COMPLICATIONS OF DIABETES**

Diabetes has a menu of complications that can impair quality of life and function and lead to premature death. Many patients have diabetes for several years before they become aware of it and develop complications during that time.

Very high sugars over a short period of time can cause life-threatening complications, such as coma. For most older patients, this occurs when sugar levels are over 500 for many days.

Moderately high sugars can also cause symptoms that may decrease an older patient’s quality of life. For example, some patients may feel lethargic, have difficulty thinking clearly, or have increased trouble with urinary incontinence.

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increased numbness in their legs, or more nausea if sugar levels are over 300. However, many patients do not have any of these symptoms with sugar levels in the 300s or higher.

Even mildly elevated sugar increases the risk of complications, if it remains elevated for many years. Excessive glucose damages the blood vessels that supply vital oxygen and nutrition to organs in the body. Most diabetes complications are due to this blood vessel damage.

Although controlling blood sugar is important, controlling high blood pressure and cholesterol appears to be even more important in decreasing the risk of many diabetes complications, which include the following:

- **Blindness.** Diabetes is a major cause of blindness. In fact, it is the single leading cause of blindness in adults aged 20 to 74 years. Each year, roughly 20,000 people lose their sight because of diabetes. Excellent diabetes care can delay the onset and reduce severity of visual impairment associated with the disease. Because good therapies are available to treat eye disease both in early and advanced stages, it is important that all diabetes patients have their eyes examined regularly.

- **Kidney disease.** Diabetes is the leading cause of end-stage renal disease (kidney failure), accounting for 40 percent of all new cases. As with eye disease, excellent treatment reduces the likelihood of kidney complications, though even the best therapy may not prevent all cases. One in five people with diabetes go on to develop kidney disease that requires dialysis or a kidney transplant.

- **Nerve damage.** About 60 to 70 percent of diabetics have nerve damage. Nerve damage in the hands and feet can cause numbness and tingling; nerve damage in the stomach can cause nausea; nerve damage in the sexual organs can cause sexual dysfunction; and nerve damage can affect the body’s control of blood pressure and heart rate. Again, excellent control of blood glucose can reduce and delay nerve damage.

- **Heart disease and stroke.** Diabetics are two to four times more likely to have heart disease or suffer a stroke. Excellent control of high blood pressure and cholesterol are the most important factors that can decrease the risk of these complications.

- **Amputations.** Diabetes is the most frequent cause of non-traumatic, lower-limb amputations. More than 56,000 diabetics have amputations each year. Damage to blood vessels can impair delivery of oxygen and nutrients to the limb. Loss of pain sensation due to nerve damage often allows small injuries and infections to go unnoticed. This combination can lead to ulcers, infections, and gangrene. Older adults are more likely to develop the complications that lead to amputation. Good shoes and meticulous inspection of the feet and toenails on a daily basis (with a good light and mirror if necessary) can detect the earliest signs and is one of the best defenses.

- **Sexual dysfunction.** Both males and females can have sexual dysfunction as a result of poor glucose control, which can lead to damage of the nerves and blood vessels in the sexual organs.

- **Increased risk of infection.** High circulating blood sugar levels reduce immune function, allowing infections to occur more easily and last longer individuals with diabetes. Bacterial skin infections and yeast infections (oral thrush, vaginal yeast, fungal infections of the groin, feet, armpits, and under the breasts) are also common. Bacteria can infect diabetic foot ulcers and can then travel inward and infect the bone. Infections following surgery also increase in people with uncontrolled diabetes.

## TREATMENTS FOR DIABETES

Ideally, type 2 diabetes should be prevented before it ever starts. A Finnish study (British Medical Journal, July 2001) demonstrated that lifestyle changes were effective in preventing the onset of type 2 diabetes. A group of 522 overweight adults with known impaired glucose tolerance (prediabetes) participated in a randomized trial. Half were counseled to lose weight, improve their diet, and increase their physical activity. The other half received no such intervention. Although the amount of weight lost in the intervention group was minimal, an average of 3.5 kilograms, their risk of developing diabetes was 58 percent lower than that of the control group. A similar, larger study conducted in the United States showed virtually identical results.

Overall treatment for diabetes focuses on minimizing symptoms
and decreasing the risks of complications. For both of these goals, high blood pressure, high cholesterol, and high blood sugar need to be addressed.

Typically, a newly diagnosed older patient with type 2 diabetes is advised to meet with a diabetes educator who will work with the patient on a regimen of diet and exercise. These interventions are tried first because they have many benefits (decreased blood pressure, decreased cholesterol, decreased blood sugar, improved cardiovascular health) and few side effects.

The American Diabetes Association recommends a diet that consists of 50 to 60 percent carbohydrates, 12 to 20 percent protein, and no more than 30 percent fat. Since close to 90 percent of those with type 2 diabetes are overweight, calorie restriction is usually recommended, with the goal of losing one to two pounds per week. Diabetic individuals should consult with a dietician or nutritionist with experience in planning diabetic diets, since the same diet is not optimal for everyone. For recipes and diet tips click here.

Exercise is beneficial in weight loss, improves cardiovascular health, and can increase one’s sense of well being. Long-term, regular exercise increases insulin sensitivity in type 2 diabetes and can lower the need for medications.

Although many patients are able to improve their diabetes with diet and exercise, some are unable to achieve good control of their blood pressure and cholesterol. At this point, medications are often needed.

**Complications of Treatment: Hypoglycemia**
A common, serious side effect of many medications is hypoglycemia (low blood sugar). The classic symptoms of hypoglycemia, which include sweatiness, anxiety, shakiness, faintness, palpitations, and hunger, may not be present in some patients with diabetes. Symptoms of more severe hypoglycemia include confusion, inappropriate behavior (people are occasionally believed to be intoxicated), visual problems, depressed consciousness, coma, seizures, and death. One of the earliest consequences of hypoglycemia is impaired judgment. The treatment for hypoglycemia is sugar; thus, non-diet sodas and candy bars are a convenient remedy.

**Oral Medications Sulfonylureas.** Medications in this category increase insulin output by the pancreas. These agents can cause very low blood sugars that can persist for days. Therefore, older people must use them with extreme caution. Medications in this group include:

- Glyburide (Micronase, Dia-beta, Glynase)
- Glipizide (Glucotrol)
- Glimepiride (Amaryl)
- Tolbutamide (Tolinase)
- Chlorpropramide (Diabinese)

**Other insulin secretagogues.** These are additional substances that stimulate insulin secretion. They include repaglinide (Prandin) and nateglinide (Starlix), which are shorter acting. Therefore, they must be taken several times a day before meals. An advantage of these medications is that they are less likely to cause hypoglycemia.

**Alpha glucosidase inhibitor.** These medicines slow the digestion of starches and other carbohydrates in the intestinal tract. In the U.S., medications in this category include acarbose (Precose) and miglitol (Glyset). Common side effects of these drugs include abdominal bloating, cramping, and diarrhea. These medications do not cause hypoglycemia.

**Biguanide.** This reduces how much glucose the liver releases into the bloodstream. The only drug in the U.S. in this category is metformin (Glucophage). It can
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cause diarrhea and should not be used by anyone with impaired kidney function or other severe medical illnesses (except under careful guidance by physicians).

Thiazolidinediones. These reduce insulin resistance in the muscles and liver and thereby improve cells’ responsiveness to insulin. They include Rosiglitazone (Avandia) and Piaglitazone (Actos). In November 2007, the FDA added a “Black Box Warning” for rosiglitazone and pioglitazone because they may lead to an increased risk of heart failure.

Insulin
For some patients, diet, exercise, and oral medications will not lead to good control of blood sugar. At this point, insulin therapy is often needed. Some patients require only one injection a day of insulin, whereas others require several injections with meals each day. Insulin therapy often requires close monitoring with finger-stick testing, so that changes in blood sugar (too high or too low) can be detected quickly and appropriately treated.

FRAIL ELDERS AND DIABETES
Older adults who are frail should generally follow a less aggressive approach to blood sugar control for several reasons. First, elders on numerous medications with multiple chronic conditions are more likely to suffer hypoglycemia and other adverse reactions from diabetes medications. Further, some of the benefits of good blood sugar control (such as decreased risk of cardiovascular disease) appear less pronounced in frail older adults. So treating diabetes in these individuals should focus on controlling symptoms such as fatigue, thirst, frequent urination, or incontinence, rather than achieving a specific target number for blood glucose.
THE FUTURE OF DIABETES RESEARCH

Because there are so many promising developments in current research on diabetes, it is difficult to predict which of them will prove fruitful enough to set the direction for future inquiry. Here, however, are a few of the possibilities:

- **Improved delivery.** Significant advances include implantable insulin pumps, oral insulin, and insulin inhalers.
- **Better medications.** These include a spectrum of more effective drugs, as well as faster acting insulin. A protein called GPR120, which indirectly stimulates increased insulin production, looks particularly promising.
- **Enhanced monitoring.** Pain-free systems are currently under development, as are systems that continuously monitor blood glucose levels. Current systems require the patient to stick a finger with a small needle to take a blood sample.
- **Weight control.** A protein called VGF seems to play an important role in regulating metabolism. This could lead to a weight-control medication, and weight loss, in turn, could help control diabetes in some patients.

Some, though not all, past studies on chromium, which the body requires for good health, have suggested that supplementation with this heavy metal may aid in blood sugar control. The same is true for vanadium, another heavy metal. However, only additional research can confirm whether either of these substances is effective in lowering blood sugar.

In the meantime, there are some safety issues to consider with both chromium or vanadium. If they do work to lower blood glucose, it is absolutely essential that you check with your doctor before using them in conjunction with medications you may already be taking for the same purpose. The combination could drive your glucose level too low, putting you in danger of coma or death. You'll also need to be careful not to take too much of either mineral. The upper limit for chromium is 200 mcg, daily; for vanadium, 1.8 mg. Any more than this can be toxic.