Controlling Diabetes

Experts at the University are attacking diabetes and related problems from several perspectives.

Physician Kevin Peterson sees a considerable number of patients with diabetes. Unfortunately, this is not surprising. Diabetes—a serious metabolic disorder in which the body is unable or has difficulty regulating sugars—is becoming increasingly prevalent in adults and children.

More than 18 million people in the United States have diabetes, according to estimates of the National Institutes of Health. Of those, 13 million people have been diagnosed, while 5 million remain undiagnosed. Each year more than one million people ages 20 or older are diagnosed with diabetes. By 2025, diabetes is predicted to reach nearly 9 percent of the population.

The effects can be devastating. Diabetes is one of the leading causes of death and disability in the United States and is associated with long-term complications that affect almost every part of the body. Diabetes can lead to blindness, heart and blood vessel disease, stroke, kidney failure, amputations, and nerve damage. In addition, uncontrolled diabetes can complicate pregnancy.
What is diabetes?

Glucose, a form of sugar in the blood, is the main source of fuel in the body. When digestion occurs, glucose passes into the bloodstream where it is used by cells for growth and energy. For glucose to enter cells, insulin, a hormone produced by islet cells in the pancreas, must be present. In healthy people, the pancreas produces the right amount of insulin to metabolize glucose.

People with diabetes, however, have a shortage of insulin or a decreased ability to use it. In type 1 diabetes, the body destroys its own islet cells. This form of diabetes usually appears during childhood or adolescence. In type 2 diabetes, the body does not destroy its own islet cells, but cannot effectively use the insulin being produced. Type 2 is the most common form of diabetes, accounting for nearly 90 percent of diabetes cases. Although it often appears in people older than 40, it is increasingly seen in children and teens.

Managing diabetes

Once diagnosed, diabetes needs to be carefully managed, says Peterson. In addition to recommending healthy eating and physical activity, Peterson screens his patients for potential complications by performing a battery of tests to monitor circulation, eyesight, and blood glucose levels, among others. “It’s also essential that patients are able to control their blood glucose levels, which can change radically depending on a person’s food intake and daily activities,” he says. In order to achieve the correct balance of blood glucose levels, patients may need to take insulin or other medication.

For Peterson, patient treatment is only one aspect of the performance of clinical trials in the community.

Endocrinologist John Bantle continues to build on discoveries in diabetes management. In 1993, a multi-center National Institutes of Health study, led locally by Bantle, demonstrated that intensive glucose-control treatment of type 1 diabetes protects against eye, kidney, and nervous system complications. Bantle is now leading the follow-up phase to the study, looking at the long-term impact of glucose control and cardiovascular disease.

Peterson and Bantle are among more than 90 researchers at the University of Minnesota investigating diabetes. “Diabetes research is vast,” says Elizabeth Seaquist, director of the Medical School’s Center for Diabetes Research. “It covers everything from glucose metabolism, cholesterol metabolism, kidney disease, clinical heart disease, and eye and nerve disease, as well as obesity.”

Diabetes prevention

Preventing type 1 diabetes and halting its progression in newly diagnosed patients are goals for pediatric endocrinologist Toni Moran. As regional director of TrialNet, a nationwide National Institutes of Health-sponsored study, Moran and her team screen relatives of people with type 1 diabetes to identify high-risk patients, conduct genetic studies in families who have more than one child with diabetes, and prescribe immunosuppressive drugs to people with newly diagnosed diabetes. “We hope to determine whether new therapies can delay or prevent the onset of type 1 diabetes,” says Moran. “Also, in those who are recently diagnosed, we want to know if it’s possible to preserve insulin production, which may make diabetes easier to manage and reduce the risks of abnormal blood sugar levels and long-term complications.”
Healthy lifestyles go a long way in preventing the onset of type 2 diabetes, says epidemiologist Robert Jeffery, director of the Obesity Prevention Center. “Good nutrition and exercise are directly connected to preventing adult onset diabetes.” Because it’s best to promote healthy lifestyles early in life, says Jeffery, he and his team are working with schools on how to provide cost-effective, nutritious meals. Epidemiologist Simone French has collaborated with food service staff in 20 high schools to increase healthful a la carte and vending machine choices. “It’s important that children are supported to make better food choices,” she says.

Even in adults, “losing weight is one of the best ways to reduce the risk of diabetes,” says Jeffery, who along with Bantle is co-leading the nation’s first research project to look at the long-term health effects of weight loss in men and women who are overweight and have type 2 diabetes. The multi-center project, Look AHEAD, is funded by the National Institute of Diabetes and Digestive and Kidney Diseases, and will follow 5,000 participants over 15 years. “We’re tracking whether heart disease will be prevented in those with type 2 diabetes who maintain a healthy weight,” he says.

**Metabolic syndrome**

Metabolic syndrome means a person simultaneously has several metabolic disorders, such as obesity and high blood pressure. It may contribute to the development of diabetes and diabetes-related complications. Endocrinologist Shalamar Sibley is investigating the syndrome and the role of visceral fat, or centralized fat distribution in the body. Diabetes-related vascular complications “are not just about blood sugar control,” she says. “High amounts of visceral fat appear to be more influential in the development of diabetes-related complications, such as cardiovascular disease, than previously thought.”

**Transplantation**

For patients who are insulin-dependent, diabetes treatment may include pancreas or islet transplantation. Transplantation has come a long way since 1966 when the world’s first successful pancreas transplant was conducted at the University of Minnesota.

A less invasive form of transplantation is being pioneered by surgeon Bernhard Hering, head of the islet transplant program at the University’s Diabetes Institute for Immunology and Transplantation. This procedure targets islet cells, produced in the pancreas, that allow insulin to be secreted into the blood. Islets are isolated from a donor pancreas and infused into a patient. Currently in clinical trials, in which people participate in research, islet transplants may help the body to regulate its blood sugar by replacing insulin-producing beta cells.

Beta cells, produced by islets, also are the focus for stem cell researcher Meri Firpo. She’s trying to coax embryonic stem cells to produce a sustainable supply of beta cells to better understand how they produce insulin. If she can get beta cells to grow in the lab, the discovery could boost the limited amount of islet cells that are currently available through organ donation for transplant.

**In the mind**

Until recently, insulin was not thought to influence the brain. Using powerful imaging tools at the Center for Magnetic Resonance Research, however, Seaquist and center researchers are able to view the brain’s response to insulin—and the results are surprising. First, the brain’s ability to store glycogen, a form of glucose, may trick a person into thinking there is enough glucose in the body, masking the symptoms of hypoglycemia, or low-blood sugar. “If you can’t recognize the symptoms of being hypoglycemic, you won’t know you’ve used up all your fuel until it’s very low.”
serious,” says Seaquist. To better understand this, Seaquist is measuring brain glycogen in people with diabetes.

In addition, she is examining how the level of insulin in the brain may influence a person’s memory. “We’ve found that electrical activity measured during a memory task is different when insulin is present than when it is not,” she says. In some people, it seems that insulin signals cannot get into the brain cells, leading some researchers to speculate whether there may be a link between Alzheimer’s and insulin resistance.

**Fat cats**

Diabetes is not confined to people. As with people, animals that are overweight show decreased sensitivity to their own insulin and an increased risk for developing diabetes. When treating dogs and cats for diabetes, veterinarian clinical nutritionist Julie Churchill works with their human companions toward gradual, lifelong change.

Along with medication, diet and exercise can play an important role in the management of diabetic pets. Whisky, a 13-year-old cat, is a “poster cat for success,” says Churchill. Diagnosed with diabetes in June 2004, Whisky has since made a complete recovery, losing nearly 10 pounds and no longer needing insulin injections. Barb Yungers says her cat is almost like a kitten again. For exercise, “we would chase him through the house,” she says. “Now he’s so active, we don’t have to chase him anymore.”

University researchers continue to chase answers to the growing problem of diabetes and metabolic disorder, with hopes that human patients can similarly regain their vigor.

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For more information on diabetes, including transplantation, visit the Diabetes Institute for Immunology and Transplantation at [www.diabetesinstitute.org](http://www.diabetesinstitute.org).

For details about the ACCORD study for type 2 diabetes, go to [www.med.umn.edu/endo/clinicalresearch/accord/home.html](http://www.med.umn.edu/endo/clinicalresearch/accord/home.html).

Further information on the clinical trials for type 1 diabetes can be found at [www.med.umn.edu/peds/endocrin/diabetesstudies/home.html](http://www.med.umn.edu/peds/endocrin/diabetesstudies/home.html).

For health information from the University of Minnesota, see the Health Talk & You Web page, [www.healthtalkandyou.com](http://www.healthtalkandyou.com).

For more information on health sciences education at the University, go to the AHC Office of Education web page, [www.ahceducation.umn.edu](http://www.ahceducation.umn.edu).