National Institutes of Health

Fact Sheet — *Type 1 Diabetes*

Yesterday

- In the 1950s about one in five people died within 20 years after a diagnosis of type 1 diabetes. One in three people died within 25 years of diagnosis.
- About one in four people developed kidney failure within 25 years of a type 1 diabetes diagnosis. Doctors could not detect early kidney disease and had no tools for slowing its progression to kidney failure. Survival after kidney failure was poor, with one of 10 patients dying each year.
- About 90 percent of people with type 1 diabetes developed diabetic retinopathy within 25 years of diagnosis. Blindness from diabetic retinopathy was responsible for about 20 percent of new cases of blindness between the ages of 45 and 74.
- Studies had not proven the value of laser surgery in reducing blindness.
- Major birth defects in the offspring of mothers with type 1 diabetes were three times higher than in the general population.
- Patients relied on injections of animal-derived insulin. The insulin pump would soon be introduced but would not become widely used for years.
- Studies had not yet shown the need for intensive glucose control to delay or prevent the debilitating eye, nerve, kidney, heart, and blood vessel complications of diabetes. Also, the importance of blood pressure control in preventing complications had not been established yet.
- Patients monitored their glucose levels with urine tests, which recognized high but not dangerously low glucose levels and reflected past, not current, glucose levels. More reliable methods for testing blood glucose levels had not been developed yet.
- Researchers had just discovered autoimmunity as the underlying cause of type 1 diabetes. However, they couldn't assess an individual's level of risk for developing type 1 diabetes, and they didn't know enough to even consider ways to prevent type 1 diabetes.

Today

- The long-term survival of those with type 1 diabetes has dramatically improved in the last 30 years. For people born between 1975 and 1980, about 3.5 percent die within 20 years of diagnosis, and 7 percent die within 25 years of diagnosis. These death rates are much lower than those of patients born in the 1950s, but are still significantly increased compared to the general population.
- After 20 years of annual increases from 5 to 10 percent, rates for new kidney failure cases have leveled off. The most encouraging trend is in diabetes, where rates for new cases in whites under age 40 are the lowest in 20 years. Improved control of glucose and blood pressure and the use of specific antihypertensive drugs called ACE inhibitors and ARBs prevent or delay the progression of kidney disease to kidney failure. With good care, fewer than 10 percent of people with diabetes develop kidney failure.
- Annual eye exams are recommended because, with timely laser surgery and appropriate follow-up care, people with advanced diabetic retinopathy can reduce their risk of blindness by 90 percent.
- For expectant mothers with type 1 diabetes, tight control of glucose that begins before conception lowers the risk of birth defects, miscarriage, and newborn death to a range that is close to that of the general population.
- Patients use genetically engineered human insulin in a variety of formulations, e.g., rapid-acting, intermediate acting, and long-acting insulin, to control their blood glucose. Insulin pumps are widely used, and inhaled insulin is available. Components of an artificial pancreas are being tested in clinical studies.
- A major clinical trial, the Diabetes Control and Complications Trial (DCCT), showed that intensive glucose control dramatically delays or prevents the eye, nerve, and kidney complications of type 1 diabetes. A paradigm shift in the way type 1 diabetes is controlled was based on this finding. As researchers continued to follow study participants, they found that tight glucose control also prevents or delays the cardiovascular complications of type 1 diabetes, such as heart attack and stroke.

- The DCCT and its follow-on study also showed that recurrent episodes of low blood sugar (hypoglycemia) do not affect patients' long-term cognitive function and do not result in long-term damage to patients' brains.

- Patients can regularly monitor their blood glucose with precise, less painful methods, including a continuous glucose monitor. The widely used hemoglobin A1c test (HbA1c) shows average blood glucose over the past 3 months. The HbA1c Standardization Program has enabled the translation of tight blood glucose control into common practice.

- In addition to identifying a key gene region that contributes nearly half the increased risk of developing type 1 diabetes, scientists have identified other genes associated with susceptibility to developing the disease. With new technologies and biosample collections, we are poised to discover additional genes and gene regions associated with type 1 diabetes.

- Researchers have learned a great deal about the underlying biology of autoimmune diabetes and can now predict who is at high, moderate, and low risk for developing type 1 diabetes. This knowledge and recent advances in immunology have enabled researchers to design studies that seek to prevent type 1 diabetes and to preserve insulin production in newly diagnosed patients. This new understanding has prevented life-threatening complications in clinical trial participants at risk for developing diabetes.

- Many people who received islet transplants for poorly controlled type 1 diabetes are free of the need for insulin administration a year later, and episodes of dangerously low blood glucose are greatly reduced for as long as 5 years after transplant, according to studies at 19 medical centers in the United States and Canada. However, the function of transplanted islets is lost over time, and patients have side effects from immunosuppressive drugs.

- The SEARCH for Diabetes in Youth Study has provided the first national data on prevalence of diabetes in youth: 1 of every 523 youth had physician diagnosed diabetes in 2001 (this number included both type 1 and type 2 diabetes.) SEARCH has also provided the first data on the rate of development of new cases of childhood diabetes and will continue to monitor trends in the future.

Tomorrow

The NIH is poised to make major discoveries in the *prediction* of who will develop type 1 diabetes and its complications, to *personalize* individual treatments, and to use this information to *preempt* disease onset and development of complications. This knowledge will have a major impact on reducing the human and economic toll of type 1 diabetes.

- By finding all the genes and environmental factors (e.g., viruses, toxins, dietary factors) that contribute to type 1 diabetes, researchers will develop ways to safely prevent or reverse the autoimmune destruction of insulin-producing cells.

- New therapies will preempt the vascular changes in the eye that are currently treated with laser therapy.

- Methods for safely imaging the insulin-producing beta cells will help scientists better understand the disease process and assess the benefits of treatments and preventions that are under study.

- Knowledge about biological pathways regulating development and growth of insulin-producing beta cells will help scientists generate beta cells in the lab. This progress may relieve the shortage of beta cells for transplantation and lead to ways to promote beta cell regeneration in people with type 1 diabetes.

- Toxic suppression of the immune system to prevent rejection of transplanted organs and tissues will be replaced with safer, more targeted methods of immune modulation.

- New technologies, such as a closed loop system that automatically senses blood glucose and adjusts insulin dosage precisely, will become available-allowing patients to more easily control their blood glucose levels and develop fewer complications.

- As the molecular pathways by which blood glucose causes cell injury are better understood, scientists will develop medicines that prevent and repair the damage.

Some of the most important progress in type 1 diabetes has been gained from clinical studies in patients with diabetes and those at risk for the disease. To maintain the rapid pace of discovery, it is critical for individuals to take part in well designed clinical studies. As one leading researcher put it, "The patient is the most important member of the research team."

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