National Diabetes Statistics, 2007

**U.S. Department
of Health and
Human Services**

**NATIONAL
INSTITUTES
OF HEALTH**

NIDDK

NATIONAL INSTITUTE OF
DIABETES AND DIGESTIVE
AND KIDNEY DISEASES

General Information

What is diabetes?

Diabetes is a group of diseases marked by high levels of blood glucose, also called blood sugar, resulting from defects in insulin production, insulin action, or both. Diabetes can lead to serious complications and premature death, but people with diabetes can take steps to control the disease and lower the risk of complications.

Types of Diabetes

Type 1 diabetes was previously called insulin-dependent diabetes mellitus (IDDM) or juvenile-onset diabetes. Type 1 diabetes develops when the body's immune system destroys pancreatic beta cells, the only cells in the body that make the hormone insulin that regulates blood glucose. To survive, people with type 1 diabetes must have insulin delivered by injection or a pump. This form of diabetes usually strikes children and young adults, although disease onset can occur at any age. In adults, type 1 diabetes accounts for 5 to 10 percent of all diagnosed cases of diabetes. Risk factors for type 1 diabetes may be autoimmune, genetic, or environmental. No known way to prevent type 1 diabetes exists. Several clinical trials for the prevention of type 1 diabetes are currently in progress or are being planned.

Type 2 diabetes was previously called non-insulin-dependent diabetes mellitus (NIDDM) or adult-onset diabetes. In adults, type 2 diabetes accounts for about 90 to 95 percent of all diagnosed cases of diabetes. It usually begins as insulin resistance, a disorder in which the cells do not use insulin properly. As the need for insulin rises, the pancreas gradually loses its ability to produce it. Type 2 diabetes is associated with older age, obesity, family history of diabetes, history of gestational diabetes, impaired glucose metabolism, physical inactivity, and race/ethnicity. African Americans, Hispanic/Latino Americans, American Indians, and some Asian Americans and Native Hawaiians or other Pacific Islanders are at particularly high risk for type 2 diabetes and its complications. Type 2 diabetes in children and adolescents, although still rare, is being diagnosed more frequently among American Indians, African Americans, Hispanic/Latino Americans, and Asians/Pacific Islanders.

Gestational diabetes is a form of glucose intolerance diagnosed during pregnancy. Gestational diabetes occurs more frequently among African Americans, Hispanic/Latino Americans, and American Indians. It is also more common among obese women and women with a family history of diabetes. During pregnancy, gestational diabetes requires treatment to normalize maternal blood glucose levels to avoid complications in the infant. Immediately after pregnancy, 5 to 10 percent of women with gestational diabetes are found to have diabetes, usually type 2. Women who have had gestational diabetes have a 40 to 60 percent chance of developing diabetes in the next 5 to 10 years.

Other types of diabetes result from specific genetic conditions, such as maturity-onset diabetes of youth; surgery; medications; infections; pancreatic disease; and other illnesses. Such types of diabetes account for 1 to 5 percent of all diagnosed cases.

Treating Diabetes

Diabetes can lead to serious complications, such as blindness, kidney damage, cardiovascular disease, and lower-limb amputations, but people with diabetes can lower the occurrence of these and other diabetes complications by controlling blood glucose, blood pressure, and blood lipids.

- Many people with type 2 diabetes can control their blood glucose by following a healthy meal plan and exercise program, losing excess weight, and taking oral medication. Some people with type 2 diabetes may also need insulin to control their blood glucose.

- To survive, people with type 1 diabetes must have insulin delivered by injection or a pump.

- Among adults with diagnosed diabetes—type 1 or type 2—14 percent take insulin only, 13 percent take both insulin and oral medication, 57 percent take oral medication only, and 16 percent do not take either insulin or oral medication. Medications for each individual with diabetes will often change over the course of the disease.

- Many people with diabetes also need to take medications to control their cholesterol and blood pressure.

- Self-management education or training is a key step in improving health outcomes and quality of life. It focuses on self-care behaviors, such as healthy eating, being active, and monitoring blood glucose. It is a collaborative process in which diabetes educators help people with or at risk for diabetes gain the knowledge and problem-solving and coping skills needed to successfully self-manage the disease and its related conditions.

Treatment with insulin or oral medication among adults with diagnosed diabetes, United States, 2004–2006

16%
14%
13%
57%

☐ Insulin only
☐ Insulin and oral medication
☐ Oral medication only
☐ No medication
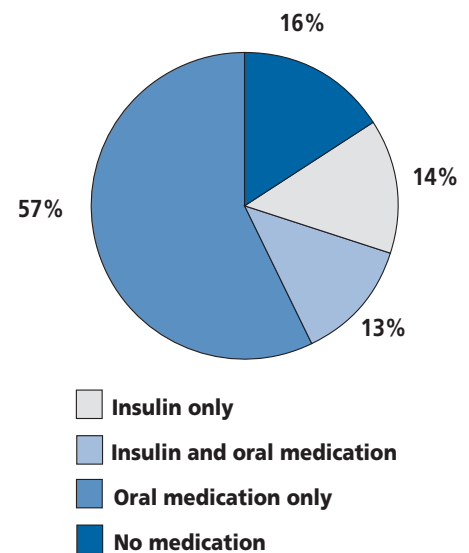
Source: 2004–2006 National Health Interview Survey.

Pre-diabetes: Impaired Glucose Tolerance and Impaired Fasting Glucose

Pre-diabetes is a condition in which individuals have blood glucose levels higher than normal but not high enough to be classified as diabetes. People with pre-diabetes have an increased risk of developing type 2 diabetes, heart disease, and stroke.

- People with pre-diabetes have impaired fasting glucose (IFG) or impaired glucose tolerance (IGT). Some people have both IFG and IGT.

- IFG is a condition in which the fasting blood glucose level is 100 to 125 milligrams per deciliter (mg/dL) after an overnight fast. This level is higher than normal but not high enough to be classified as diabetes.

- IGT is a condition in which the blood glucose level is 140 to 199 mg/dL after a 2-hour oral glucose tolerance test. This level is higher than normal but not high enough to be classified as diabetes.

- In 1988 to 1994, among U.S. adults aged 40 to 74 years, 33.8 percent had IFG, 15.4 percent had IGT, and 40.1 percent had pre-diabetes—IGT or IFG or both. More recent data for IFG, but not IGT, are available and are presented below.

Prevalence of Impaired Fasting Glucose in People Younger than 20 Years of Age, United States

- In 1999 to 2000, 7.0 percent of U.S. adolescents aged 12 to 19 years had IFG.

Prevalence of Impaired Fasting Glucose in People Aged 20 Years or Older, United States, 2007

- In 2003 to 2006, 25.9 percent of U.S. adults aged 20 years or older had IFG—35.4 percent of adults aged 60 years or older. Applying this percentage to the entire U.S. population in 2007 yields an estimated 57 million American adults aged 20 years or older with IFG, suggesting that at least 57 million American adults had pre-diabetes in 2007.

- After adjusting for population age and sex differences, IFG prevalence among U.S. adults aged 20 years or older in 2003 to 2006 was 21.1 percent for non-Hispanic blacks, 25.1 percent for non-Hispanic whites, and 26.1 percent for Mexican Americans.

Prevention or Delay of Diabetes

- Progression to diabetes among those with pre-diabetes is not inevitable. Studies have shown that people with pre-diabetes who lose weight and increase their physical activity can prevent or delay diabetes and even return their blood glucose levels to normal.

- In the Diabetes Prevention Program, a large prevention study of people at high risk for diabetes, lifestyle intervention reduced the development of diabetes by 58 percent over 3 years. The reduction was even greater, 71 percent, among adults aged 60 years or older.

- Interventions to prevent or delay type 2 diabetes in individuals with pre-diabetes can be feasible and cost-effective. Research has found that lifestyle interventions are more cost-effective than medications.

National Estimates on Diabetes

Estimation Methods

The estimates on diabetes in this fact sheet were derived from various data systems of the Centers for Disease Control and Prevention (CDC), the outpatient database of the Indian Health Service (IHS), the U.S. Renal Data System of the National Institutes of Health (NIH), the U.S. Census Bureau, and published studies. Estimates of the total number of persons with diabetes and the prevalence of diabetes in 2007 were derived using 2003–2006 National Health and Nutrition Examination Survey (NHANES), 2004–2006 National Health Interview Survey (NHIS), 2005 IHS data, and 2007 resident population estimates. Many of the estimated numbers and percentages of people with diabetes were derived by applying diabetes prevalence estimates from health surveys of the civilian, noninstitutionalized population to the most recent 2007 resident population estimates. These estimates have some variability due to the limits of the measurements and estimation procedures. The procedures assumed that age-race-sex-specific percentages of adults with diabetes—diagnosed and undiagnosed—in 2007 are the same as they were in earlier time periods—for example, 2003 to 2006—and that the age-race-sex-specific percentages of adults with diabetes in the resident population are identical to those in the civilian, noninstitutionalized population. Deviations from these assumptions may result in over- or under-estimated numbers and percentages. For further information on the methods for deriving total, diagnosed, and undiagnosed prevalence of diabetes from NHANES data, see *www.cdc.gov/mmwr/preview/mmwrhtml/ mm5235a1.htm.*

Prevalence of Diagnosed and Undiagnosed Diabetes in the United States, All Ages, 2007

Total: 23.6 million people—7.8 percent of the population—have diabetes.
Diagnosed: 17.9 million people
Undiagnosed: 5.7 million people

Prevalence of Diagnosed and Undiagnosed Diabetes among People Aged 20 Years or Older, United States, 2007

Age 20 years or older: 23.5 million, or 10.7 percent, of all people in this age group have diabetes.
Age 60 years or older: 12.2 million, or 23.1 percent, of all people in this age group have diabetes.
**Men:** 12.0 million, or 11.2 percent, of all men aged 20 years or older have diabetes.
Women: 11.5 million, or 10.2 percent, of all women aged 20 years or older have diabetes.
Non-Hispanic whites: 14.9 million, or 9.8 percent, of all non-Hispanic whites aged 20 years or older have diabetes.
Non-Hispanic blacks: 3.7 million, or 14.7 percent, of all non-Hispanic blacks aged 20 years or older have diabetes.

Estimated prevalence of diagnosed and undiagnosed diabetes in people aged 20 years or older, by age group, United States, 2007
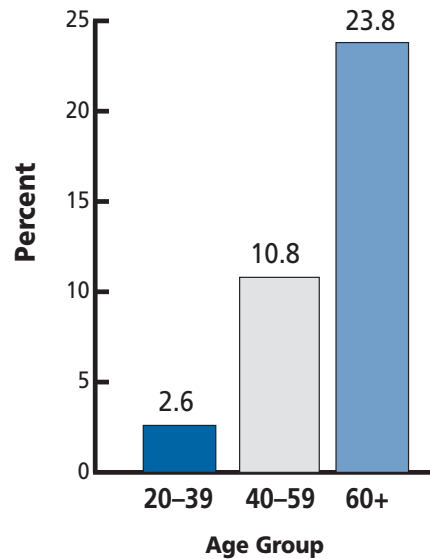
Source: 2003–2006 National Health and Nutrition Examination Survey estimates of total prevalence (both diagnosed and undiagnosed) were projected to year 2007.

Prevalence of Diagnosed Diabetes in People Younger than 20 Years of Age, United States, 2007

- About 186,300 people younger than 20 years have diabetes—type 1 or type 2. This represents 0.2 percent of all people in this age group. Estimates of undiagnosed diabetes are unavailable for this age group.

Race and Ethnic Differences in Prevalence of Diagnosed Diabetes

Sufficient data are not available to derive prevalence estimates of both diagnosed and undiagnosed diabetes for all minority populations. For example, national survey data cannot provide reliable estimates for the Native Hawaiian and other Pacific Islander population. However, national estimates of diagnosed diabetes for certain minority groups are available from national survey data and from the IHS user population database, which includes data for approximately 1.4 million American Indians and Alaska Natives in the United States who receive health care from the IHS. Because most minority populations are younger and tend to develop diabetes at earlier ages than the non-Hispanic white population, it is important to control for population age differences when making race and ethnic comparisons.

- Data from the 2005 IHS user population database indicate that 14.2 percent of the American Indians and Alaska Natives aged 20 years or older who received care from IHS had diagnosed diabetes. After adjusting for population age differences, 16.5 percent of the total adult population served by IHS had diagnosed diabetes, with rates varying by region from 6.0 percent among Alaska Native adults to 29.3 percent among American Indian adults in southern Arizona.

- After adjusting for population age differences, 2004 to 2006 national survey data for people aged 20 years or older indicate that 6.6 percent of non-Hispanic whites, 7.5 percent of Asian Americans, 10.4 percent of Hispanics, and 11.8 percent of non-Hispanic blacks had diagnosed diabetes. Among Hispanics, rates were 8.2 percent for Cubans, 11.9 percent for Mexican Americans, and 12.6 percent for Puerto Ricans.

Estimated number of new cases of diagnosed diabetes in people aged 20 years or older, by age group, United States, 2007
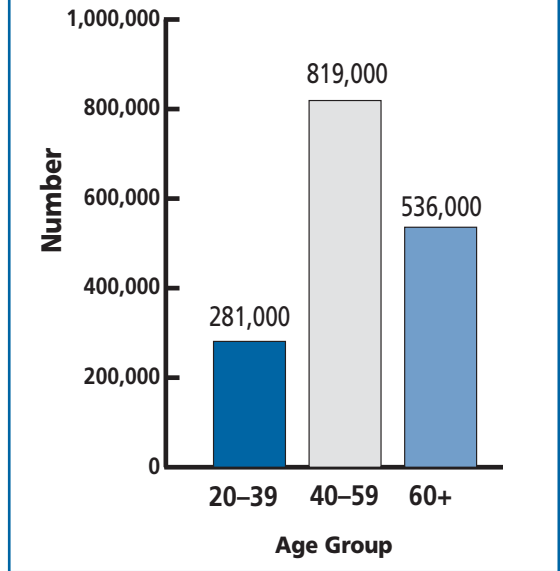
Source: 2004–2006 National Health Interview Survey estimates projected to year 2007.
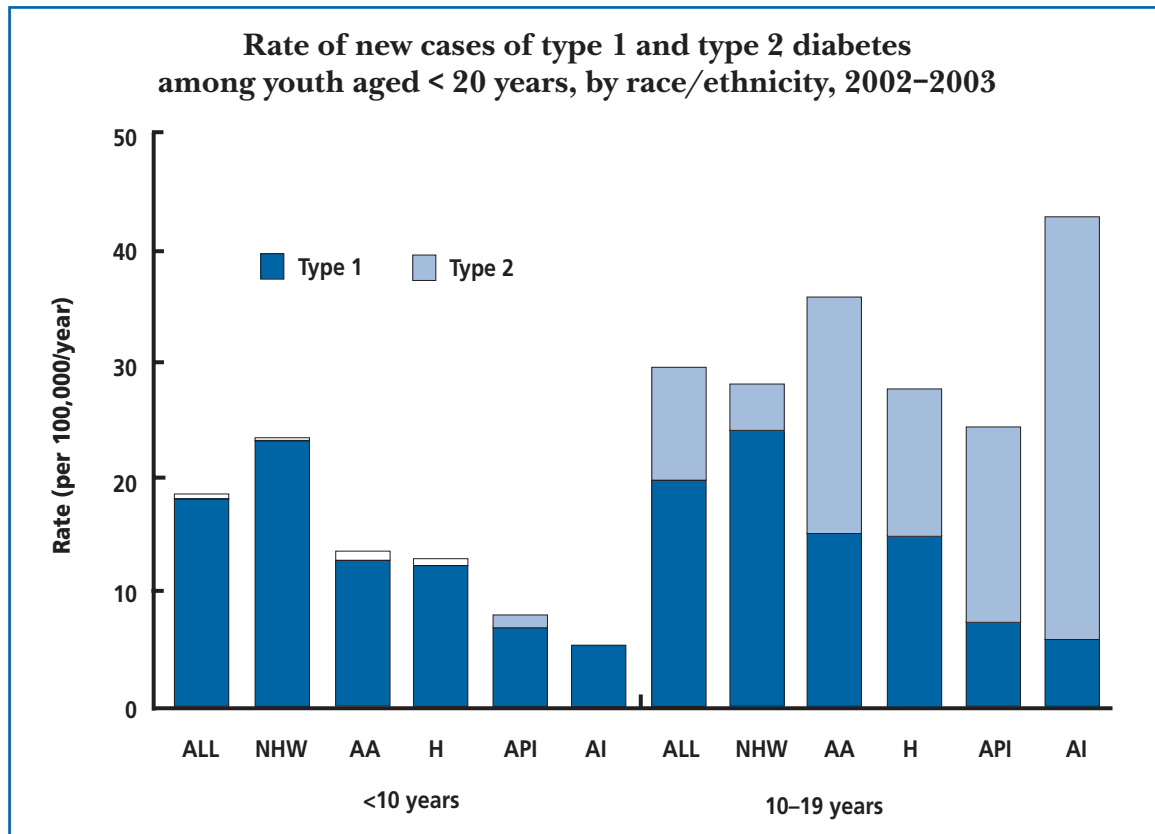
Incidence of Diagnosed Diabetes among People Aged 20 Years or Older, United States, 2007

A total of 1.6 million new cases of diabetes were diagnosed in people aged 20 years or older in 2007.

Incidence of Diagnosed Diabetes in People Younger than 20 Years of Age, United States, 2002 to 2003

SEARCH for Diabetes in Youth is a multicenter study funded by the CDC and the NIH to examine diabetes—type 1 and type 2—among children and adolescents in the United States. SEARCH findings for the communities studied include:

- Based on 2002 to 2003 data, 15,000 youth in the United States were newly diagnosed with type 1 diabetes annually, and about 3,700 youth were newly diagnosed with type 2 diabetes annually.

- The rate of new cases among youth was 19.0 per 100,000 each year for type 1 diabetes and 5.3 per 100,000 for type 2 diabetes.

- Non-Hispanic white youth had the highest rate of new cases of type 1 diabetes.

- Type 2 diabetes was extremely rare among youth aged <10 years. While still infrequent, rates were greater among youth aged 10 to 19 years compared with younger children, with higher rates among U.S. minority populations compared with non-Hispanic whites.

- Among non-Hispanic white youth aged 10 to 19 years, the rate of new cases of type 1 diabetes was higher than for type 2 diabetes. For Asian/Pacific Islander and American Indian youth aged 10 to 19 years, the opposite was true—the rate of new cases of type 2 was greater than the rate for type 1 diabetes. Among African American and Hispanic youth aged 10 to 19 years, the rates of new cases of type 1 and type 2 diabetes were similar.

**Rate of new cases of type 1 and type 2 diabetes
among youth aged < 20 years, by race/ethnicity, 2002−2003**

Source: SEARCH for Diabetes in Youth Study.
NHW=Non-Hispanic whites; AA=African Americans; H=Hispanics; API=Asians/Pacific Islanders;
AI=American Indians

Deaths among People with Diabetes, United States, 2006

- Diabetes was the seventh leading cause of death listed on U.S. death certificates in 2006. This ranking is based on the 72,507 death certificates in 2006 in which diabetes was listed as the underlying cause of death. According to death certificate reports, diabetes contributed to a total of 233,619 deaths in 2005, the latest year for which data on contributing causes of death are available.

- Diabetes is likely to be underreported as a cause of death. Studies have found that only about 35 to 40 percent of decedents with diabetes had it listed anywhere on the death certificate and only about 10 to 15 percent had it listed as the underlying cause of death.

- Overall, the risk for death among people with diabetes is about twice that of people without diabetes of similar age.

Complications of Diabetes in the United States

Heart Disease and Stroke

- In 2004, heart disease was noted on 68 percent of diabetes-related death certificates among people aged 65 years or older.

- In 2004, stroke was noted on 16 percent of diabetes-related death certificates among people aged 65 years or older.

- Adults with diabetes have heart disease death rates about two to four times higher than adults without diabetes.

- The risk for stroke is two to four times higher among people with diabetes.

High Blood Pressure

- In 2003 to 2004, 75 percent of adults with self-reported diabetes had blood pressure greater than or equal to 130/80 millimeters of mercury (mm Hg) or used prescription medications for hypertension.

Blindness

- Diabetes is the leading cause of new cases of blindness among adults aged 20 to 74 years.

- Diabetic retinopathy causes 12,000 to 24,000 new cases of blindness each year.

Kidney Disease

- Diabetes is the leading cause of kidney failure, accounting for 44 percent of new cases in 2005.

- In 2005, 46,739 people with diabetes began treatment for end-stage kidney disease in the United States and Puerto Rico.

- In 2005, a total of 178,689 people with end-stage kidney disease due to diabetes were living on chronic dialysis or with a kidney transplant in the United States and Puerto Rico.

Nervous System Disease

- About 60 to 70 percent of people with diabetes have mild to severe forms of nervous system damage. The results of such damage include impaired sensation or pain in the feet or hands, slowed digestion of food in the stomach, carpal tunnel syndrome, erectile dysfunction, or other nerve problems.

- Almost 30 percent of people with diabetes aged 40 years or older have impaired sensation in the feet—for example, at least one area that lacks feeling.

- Severe forms of diabetic nerve disease are a major contributing cause of lower-extremity amputations.

Amputations

- More than 60 percent of nontraumatic lower-limb amputations occur in people with diabetes.

- In 2004, about 71,000 nontraumatic lower-limb amputations were performed in people with diabetes.

Dental Disease

- Periodontal, or gum, disease is more common in people with diabetes. Among young adults, those with diabetes have about twice the risk of those without diabetes.

- Persons with poorly controlled diabetes (A1C > 9 percent) were nearly three times more likely to have severe periodontitis than those without diabetes.

- Almost one-third of people with diabetes have severe periodontal disease with loss of attachment of the gums to the teeth measuring 5 millimeters or more.

Complications of Pregnancy

- Poorly controlled diabetes before conception and during the first trimester of pregnancy among women with type 1 diabetes can cause major birth defects in 5 to 10 percent of pregnancies and spontaneous abortions in 15 to 20 percent of pregnancies.

- Poorly controlled diabetes during the second and third trimesters of pregnancy can result in excessively large babies, posing a risk to both mother and child.

Other Complications

- Uncontrolled diabetes often leads to biochemical imbalances that can cause acute life-threatening events, such as diabetic ketoacidosis and hyperosmolar, or nonketotic, coma.

- People with diabetes are more susceptible to many other illnesses and, once they acquire these illnesses, often have worse prognoses. For example, they are more likely to die with pneumonia or influenza than people who do not have diabetes.

- Persons with diabetes aged 60 years or older are two to three times more likely to report an inability to walk a quarter of a mile, climb stairs, do housework, or use a mobility aid compared with persons without diabetes in the same age group.

Preventing Diabetes Complications

Diabetes can affect many parts of the body and can lead to serious complications such as blindness, kidney damage, and lower-limb amputations. Working together, people with diabetes, their support network, and their health care providers can reduce the occurrence of these and other diabetes complications by controlling the levels of blood glucose, blood pressure, and blood lipids and by receiving other preventive care practices in a timely manner.

Glucose Control

- Studies in the United States and abroad have found that improved glycemic control benefits people with either type 1 or type 2 diabetes. In general, every percentage point drop in A1C blood test results—for example, from 8.0 to 7.0 percent—can reduce the risk of microvascular complications—eye, kidney, and nerve diseases—by 40 percent.

- In patients with type 1 diabetes, intensive insulin therapy has long-term beneficial effects on the risk of cardiovascular disease.

Blood Pressure Control

- Blood pressure control reduces the risk of cardiovascular disease—heart disease or stroke—among persons with diabetes by 33 to 50 percent, and the risk of microvascular complications—eye, kidney, and nerve diseases—by approximately 33 percent.

- In general, for every 10 mm Hg reduction in systolic blood pressure, the risk for any complication related to diabetes is reduced by 12 percent.

Control of Blood Lipids
- Improved control of LDL cholesterol can reduce cardiovascular complications by 20 to 50 percent.

Preventive Care Practices for Eyes, Feet, and Kidneys
- Detecting and treating diabetic eye disease with laser therapy can reduce the development of severe vision loss by an estimated 50 to 60 percent.

- Comprehensive foot care programs can reduce amputation rates by 45 to 85 percent.

- Detecting and treating early diabetic kidney disease by lowering blood pressure can reduce the decline in kidney function by 30 to 70 percent. Treatment with angiotensin-converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) are more effective in reducing the decline in kidney function than other blood pressure lowering drugs.

- In addition to lowering blood pressure, ARBs reduce proteinuria, a risk factor for developing kidney disease, by 35 percent—similar to the reduction achieved by ACE inhibitors.

Estimated Diabetes Costs in the United States in 2007

Total—direct and indirect: $174 billion

Direct medical costs: $116 billion

- After adjusting for population age and sex differences, average medical expenditures among people with diagnosed diabetes were 2.3 times higher than what expenditures would be in the absence of diabetes.

  Indirect costs: $58 billion—disability, work loss, premature mortality

Acknowledgments

- National Institute of Diabetes and Digestive and Kidney Diseases of the NIH
www.niddk.nih.gov

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www.omhrc.gov

Note

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Data Sources, References, and Methods for Estimates of Diabetes

Treating Diabetes

1. 2004–2006 National Health Interview Survey (NHIS), National Center for Health Statistics, Centers for Disease Control and Prevention. Available at: www.cdc.gov/nchs/nhis.htm.

Methods: The percent distribution of the type of treatment among civilian, noninstitutionalized adults aged 18 years or older with diagnosed diabetes was calculated using treatment questions from the 2004–2006 NHIS.

Pre-diabetes: Impaired Glucose Tolerance (IGT) and Impaired Fasting Glucose (IFG)

1. The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Report of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care*. 1997;20:1183–1197.

2. Coutinho M, Gerstein HC, Wang Y, Yusuf S. The relationship between glucose and incident cardiovascular events. A metaregression analysis of published data from 20 studies of 95,783 individuals followed for 12.4 years. *Diabetes Care*. 1999; 22:233–240.

3. Meigs JB, Nathan DM, D'Agostino RB Sr, Wilson PW; Framingham Offspring Study. Fasting and postchallenge glycemia and cardiovascular disease risk: the Framingham Offspring Study. *Diabetes Care*. 2002;10:1845–1850.

4. Smith NL, Barzilay JI, Shaffer D, Savage PJ, Heckbert SR, Kuller LH, Kronmal RA, Resnick HE, Psaty BM. Fasting and 2-hour postchallenge serum glucose measures and risk of incident cardiovascular events in the elderly: the Cardiovascular Health Study. *Archives of Internal Medicine*. 2002;162:209–216.

5. Harris MI, Flegal KM, Cowie CC, Eberhardt MS, Goldstein DE, Little RR, Wiedmeyer HM, Byrd-Holt DD. Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in U.S. adults. The Third National Health and Nutrition Examination Survey (NHANES III) 1988–1994. *Diabetes Care*. 1998;21(4):518–524.

6. NHANES III 1988–1994, National Center for Health Statistics, Centers for Disease Control and Prevention. Available at: www.cdc.gov/nchs/nhanes.htm.

Methods: The prevalences of IGT, IFG, and pre-diabetes in the civilian noninstitutionalized population were estimated using 1988–1994 NHANES III data. People previously diagnosed with diabetes and those with undiagnosed diabetes—i.e., without a history of diabetes but with a fasting plasma glucose of 126 or more—were excluded from the prevalence counts of IGT, IFG, and pre-diabetes. Persons were classified as having IGT if they had 2-hour plasma glucose values of 140 to 199 mg/dL after an oral glucose tolerance test. They were classified as having IFG if they had fasting plasma glucose values of 100 to 125 mg/dL—regardless of their 2-hour plasma glucose values. Those with IGT or IFG or both were classified as having pre-diabetes.

Prevalence of IFG in People Younger than 20 Years of Age, United States

1. Williams DE, Cadwell BL, Cheng YJ, Cowie CC, Gregg EW, Geiss LS, Engelgau MM, Venkat Narayan KM, Imperatore G. Prevalence of impaired fasting glucose and its relationship with cardiovascular disease risk factors in US adolescents, 1999–2000. *Pediatrics*. 2005;116;1122–1126.

Prevalence of IFG in People Aged 20 Years or Older, United States, 2007

1. Cowie CC, Rust KF, Byrd-Holt DD, Eberhardt MS, Flegal KM, Engelgau MM, Saydah SH, Williams DE, Geiss LS, Gregg EW. Prevalence of diabetes and impaired fasting glucose in adults in the U.S. population: NHANES 1999–2002. *Diabetes Care*. 2006;29(6):1263–1268.

2. NHANES 2003–2006, National Center for Health Statistics, Centers for Disease Control and Prevention. Available at: www.cdc.gov/nchs/nhanes.htm.

3. U.S. Census Bureau, resident population estimates for 11/1/2007. Available at: www.census.gov/popest/national/asrh/2006_nat_res.html.

Methods: The prevalence of IFG in the civilian noninstitutionalized population was estimated using 2003–2006 NHANES data. Persons were classified as having IFG if they had fasting plasma glucose values of 100 to 125 mg/dL. Persons previously diagnosed with diabetes and those with undiagnosed diabetes—i.e., without a history of diabetes but with a fasting plasma glucose of 126 or more—were excluded from the case counts of IFG. The 2007 estimated number of those aged 20 years or older with IFG is the sum of the numbers derived by applying the age-race-sex-specific estimates of IFG prevalence from the 2003–2006 NHANES to the corresponding age-race-sex-specific estimates of the 2007 resident population. IGT prevalence was not estimated because NHANES did not include glucose tolerance test measurements in 2003–2004. IFG prevalence by race are age and sex adjusted by the direct method based on 2000 U.S. standard population.

Prevention or Delay of Diabetes

1. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM. Diabetes Prevention Program Research Group. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *New England Journal of Medicine*. 2002;346(6):393–403.

2. The Diabetes Prevention Program Research Group. Costs associated with the primary prevention of type 2 diabetes mellitus in the Diabetes Prevention Program. *Diabetes Care*. 2003;26:36–47.

3. Diabetes Prevention Program Research Group. Within-trial cost-effectiveness of lifestyle intervention or metformin for the primary prevention of type 2 diabetes. *Diabetes Care*. 2003;26(9):2518–2523.

4. Herman WH, Hoerger TJ, Brandle M, Hicks K, Sorensen S, Zhang P, Hamman RF, Ackermann RT, Engelgau MM, Ratner RE. Diabetes Prevention Program Research Group. The cost-effectiveness of lifestyle modification or metformin in preventing type 2 diabetes in adults with impaired glucose tolerance. *Annals of Internal Medicine*. 2005;142:323–332.

Prevalence of Diagnosed and Undiagnosed Diabetes in the United States, All Ages, 2007

1. Cowie CC, Rust KF, Byrd-Holt DD, Eberhardt MS, Flegal KM, Engelgau MM, Saydah SH, Williams DE, Geiss LS, Gregg EW. Prevalence of diabetes and impaired fasting glucose in adults in the U.S. population: NHANES 1999–2002. *Diabetes Care*. 2006;29(6):1263–1268.

2. NHANES 2003–2006, National Center for Health Statistics, Centers for Disease Control and Prevention. Available at: www.cdc.gov/nchs/nhanes.htm.

3. 2004–2006 NHIS, National Center for Health Statistics, Centers for Disease Control and Prevention. Available at: www.cdc.gov/nchs/nhis.htm.

4. U.S. Census Bureau, resident population estimates for 11/1/2007. Available at: www.census.gov/popest/national/asrh/2006_nat_res.html.

Methods: The total number of people with diabetes is the sum of the estimated number of those aged 20 years or older with diagnosed and undiagnosed diabetes in 2007—see next section for calculation methods—and the estimated number of those younger than 20 years with diagnosed diabetes in 2007—see section after next section on diagnosed diabetes among people under 20 years of age for calculation methods. The percentage of the population with diabetes is the estimated total number with diabetes in 2007 divided by the estimated 2007 U.S. resident population.

The total number of persons with diagnosed diabetes in 2007 is the sum of the estimated numbers of those younger than 20 years and those aged 20 years or older with diagnosed diabetes.

Information about how NHANES data can be used to estimate diagnosed, undiagnosed, and total prevalence of diabetes is available in the Cowie et al. reference listed above.

Prevalence of Diagnosed and Undiagnosed Diabetes among People Aged 20 Years or Older, United States, 2007

1. Cowie CC, Rust KF, Byrd-Holt DD, Eberhardt MS, Flegal KM, Engelgau MM, Saydah SH, Williams DE, Geiss LS, Gregg EW. Prevalence of diabetes and impaired fasting glucose in adults in the U.S. population: NHANES 1999–2002. *Diabetes Care*. 2006;29(6):1263–1268.

2. NHANES 2003–2006, National Center for Health Statistics, Centers for Disease Control and Prevention. Available at: www.cdc.gov/nchs/nhanes.htm.

3. U.S. Census Bureau, resident population estimates for 11/1/2007. Available at: www.census.gov/popest/national/asrh/2006_nat_res.html.

Methods:

Aged 20 years or older

The 2007 estimated number of those aged 20 years or older with diagnosed and undiagnosed diabetes is the sum of the numbers derived by applying the age-race-sex-specific estimates of total diabetes prevalence—both diagnosed and undiagnosed—from the 2003–2006 NHANES to 2007 resident population estimates. The percentage of the population with diabetes aged 20 years or older is this estimated number divided by the estimated 2007 U.S. resident population aged 20 years or older. Information on the use of NHANES data to measure diabetes prevalence—including diagnosed and undiagnosed diabetes—is available from the Cowie et al. reference listed above.

Aged 60 years or older

The 2007 estimated number of those aged 60 years or older with diabetes was derived by applying race-sex-specific estimates of total diabetes prevalence—both diagnosed and undiagnosed diabetes—in this age group from the 2003–2006 NHANES to 2007 resident population estimates. The percentage of the population with diabetes aged 60 years or older is this estimated number divided by the estimated 2007 U.S. resident population aged 60 years or older.

Men and women

The 2007 estimated number of men and women aged 20 years or older with diabetes is the sum of the sex-specific numbers derived by applying age-race-sex-specific estimates of total diabetes prevalence—both diagnosed and undiagnosed diabetes—from the 2003–2006 NHANES to 2007 resident population estimates. The percentage of men and women with diabetes are these estimated numbers divided by the sex-specific estimated 2007 U.S. resident population aged 20 years or older.

Non-Hispanic whites and non-Hispanic blacks

The 2007 estimated numbers of non-Hispanic whites and the number of non-Hispanic blacks aged 20 years or older with diabetes are the sums of the non-Hispanic race-specific numbers derived by applying non-Hispanic age-race-sex-specific estimates of total diabetes prevalence—both diagnosed and undiagnosed diabetes—from the 2003–2006 NHANES to 2007 resident population estimates. The percentages of non-Hispanic whites and non-Hispanic blacks with diabetes are these estimated numbers divided by the non-Hispanic race-specific estimates of the 2007 U.S. resident population aged 20 years or older.

Graph of prevalence by age group
The age-specific prevalences of diagnosed and undiagnosed diabetes in people aged 20 years or older were obtained by applying age-race-sex-specific estimates of total diabetes prevalence—both diagnosed and undiagnosed diabetes—from the 2003–2006 NHANES to 2007 resident population estimates. The derived age-specific counts were then divided by the estimated 2007 U.S. resident population to obtain the 2007 age-specific percentages.

Prevalence of Diagnosed Diabetes in People Younger than 20 Years of Age, United States, 2007

1. 2004–2006 NHIS, National Center for Health Statistics, Centers for Disease Control and Prevention. Available at: www.cdc.gov/nchs/nhis.htm.

2. U.S. Census Bureau, resident population estimates for 11/1/2007. Available at: www.census.gov/popest/national/asrh/2006_nat_res.html.

Methods: The number of persons under 20 years of age with diagnosed diabetes in 2007 was estimated by applying the 2004–2006 NHIS prevalence estimate of diagnosed diabetes in the civilian, noninstitutionalized population younger than 20 years to the 2007 resident population estimate of this age group. The percentage of persons under 20 years of age with diagnosed diabetes in 2007 was assumed to be the same as the 2004–2006 NHIS estimate. Estimates of undiagnosed diabetes for persons younger than 20 years are not available.

Race and Ethnic Differences in Prevalence of Diagnosed Diabetes

1. Acton KJ, Burrows NR, Geiss LS, Thompson T. Diabetes prevalence among American Indians and Alaska Natives and the overall population—United States, 1994–2002. *Morbidity and Mortality Weekly Report*. 2003;52(30);702–704.

2. Burrows NR, Geiss LS, Engelgau MM, Acton KJ. Prevalence of diabetes among Native Americans and Alaska Natives, 1990–1997: an increasing burden. *Diabetes Care*. 2000;23(12):1786–1790.

3. 2004–2006 NHIS, National Center for Health Statistics, Centers for Disease Control and Prevention. Available at: www.cdc.gov/nchs/nhanes.htm.

4. Indian Health Service (IHS), 2005 outpatient database.

Methods: All estimates presented are for persons aged 20 years or older. Rates were age-adjusted by the direct method based on the 2000 U.S. standard population. With the exception of the prevalence among American Indians and Alaska Natives (AIANs), race/ethnicity-specific prevalences of diagnosed diabetes were calculated using the 2004–2006 NHIS, also available at *www.cdc.gov/nchs/nhis.htm*. The estimated diagnosed diabetes prevalence for the Native Hawaiian and other Pacific Islander population was not included because the NHIS estimate for this group is considered unreliable due to a small sample size.

The prevalence of diagnosed diabetes among AIANs was derived from the 2005 user population database of the IHS. The IHS operates a health-services system delivered directly through IHS facilities, purchased by IHS through contractual agreements with private providers, or delivered through tribally operated programs and urban Indian health programs. Approximately 60 percent of the nearly 3 million AIANs residing in the United States live in IHS health-care delivery areas, are eligible to receive IHS services, and use IHS medical facilities. Diabetes cases among AIANs aged 20 years or older were identified by using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD–9–CM) diagnostic codes 250.0–250.9 from the IHS patient care computerized system for 2005. The patient care database includes unduplicated case reports for persons who attended an IHS service unit one or more times during 2005. Prevalence was calculated by using the AIAN population that received health-care services at IHS, tribal, or urban facilities at least once during the preceding 3 years.

Sufficient data are not available to derive estimates of the total prevalence of diabetes—both diagnosed and undiagnosed diabetes—for many U.S. minority populations. However, national estimates of diagnosed diabetes are available for some but not all minority groups to allow racial and ethnic comparisons. Resources to obtain data for minority groups at the state or local level include the Behavioral Risk Factor Surveillance System at *www.cdc.gov/brfss/ stateinfo.htm* and the California Health Interview Survey at *www.chis.ucla.edu*.

See the Census glossary for the definition of U.S. racial/ethnic minority groups http://factfinder.census.gov/home/en/epss/ glossary_a.html

Incidence of Diagnosed Diabetes among People Aged 20 Years or Older, United States, 2007

1. 2004–2006 NHIS, National Center for Health Statistics, Centers for Disease Control and Prevention. Available at: www.cdc.gov/nchs/nhis.htm.

2. U.S. Census Bureau, resident population estimates for 11/1/2007. Available at: www.census.gov/popest/national/ asrh/2006_nat_res.html.

Methods: Age-specific estimates of the incidence of diagnosed diabetes in the civilian, noninstitutionalized population aged 20 years or older from the 2004–2006 NHIS were applied to 2007 estimates of the U.S. resident population without diabetes diagnosed in the past year to calculate the number of new cases of diabetes. Incidence was calculated from data on respondents' age at diagnosis and age at interview. Adults who reported being diagnosed with diabetes were asked at what age they were diagnosed. The number of years each person had been diagnosed with diabetes was calculated by subtracting the age at which they were diagnosed from their current age. Adults who had a value of zero were identified as having been diagnosed with diabetes within the last year. In addition, it was assumed that half of the adults who had a value of one were classified as having been diagnosed with diabetes within the last year.

		Type 1		Type 2		Other/Unknown		All Types	
Denominator	**Rate**	**95% CI**	**Rate**	**95% CI**	**Rate**	**95% CI**	**Rate**	**95% CI**
				Age 0–9 Years					
NHW	2,821,150	23.4	(21.7–25.3)	0.1	(0.0–0.3)	0.4	(0.3–0.8)	24	(22.2–25.9)
AA	691,390	13	(10.6–16.0)	0.8	(0.4–1.9)	0.3	(0.1–1.1)	14.1	(11.6–17.2)
H	829,310	12.4	(10.2–15.0)	0.6	(0.3–1.5)	0.4	(0.1–1.1)	13.4	(11.1–16.1)
API	376,650	7.1	(4.9–10.3)	1.1	(0.5–2.8)	0	(0.0–1.1)	8.3	(5.8–11.7)
AI	133,598	4.9	(2.3–0.3)	0	(0.0–2.9)	0.2	(0.0–3.2)	5.1	(2.4–10.6)
All groups	4,852,098	18.3	(17.1–19.5)	0.4	(0.3–0.6)	0.4	(0.2–0.6)	19	(17.8–20.3)
				Age 10–19 Years					
NHW	3,107,250	24.1	(22.4–25.9)	4.3	(3.6–5.1)	1.7	(1.3–2.2)	30.1	(28.2–32.1)
AA	743,360	15.3	(12.8–18.4)	20.9	(17.9–24.5)	3.8	(2.6–5.5)	40	(35.7–44.8)
H	774,192	15.1	(12.6–18.1)	12.7	(10.4–15.5)	2.7	(1.8–4.1)	30.5	(26.8–34.6)
API	403,460	7.6	(5.3–10.8)	17.1	(13.5–21.6)	1.3	(0.6–3.0)	26	(21.5–31.5)
AI	151,528	6	(3.2–11.4)	36.7	(28.3–47.7)	0.2	(0.0–2.9)	42.9	(33.7–54.7)
All groups	5,179,790	19.7	(18.5–20.9)	9.9	(9.1–10.8)	2.1	(1.7–2.5)	31.6	(30.1–33.2)

Source: SEARCH for Diabetes in Youth Study.
NHW=Non-Hispanic whites; AA=African Americans; H=Hispanics; API=Asians/Pacific Islanders;
AI=American Indians

Incidence of Diagnosed Diabetes in People Younger than 20 Years of Age, United States, 2002−2003

1. SEARCH Study Group. SEARCH for Diabetes in Youth: a multicenter study of the prevalence, incidence and classification of diabetes mellitus in youth. *Controlled Clinical Trials*. 2004;25(5):458–471.

2. Writing Group for the SEARCH for Diabetes in Youth Study Group, Dabelea D, Bell RA, D'Agostino RB Jr, Imperatore G, Johansen JM, Linder B, Liu LL, Loots B, Marcovina S, Mayer-Davis EJ, Pettitt DJ, Waitzfelder B. Incidence of diabetes in youth in the United States. *Journal of the American Medical Association*. 2007;297(24): 2716–2724. Available at http://jama.ama-assn.org/cgi/content/full/297/24/2716.

Methods: SEARCH for Diabetes in Youth is a multicenter observational study to examine diabetes at eight locations throughout the United States—more than 5 million, or 6 percent, of all American children younger than 20 years, which is not nationally representative. However, the SEARCH sites were selected for their ability to reach minority populations, making this study group the largest and most racially and geographically diverse group ever involved in a youth diabetes study. It entails conducting population-based ascertainment of cases of physician-diagnosed diabetes in

youth younger than 20 years of age—see *www.cdc.gov/diabetes/pubs/factsheets/search.htm*. New diabetes cases occurring in 2002 and 2003 were identified: a) in geographically defined populations in Ohio, Washington, South Carolina, and Colorado; b) among health plan enrollees in Hawaii through Hawaii Medical Service Association, Med-Quest, Kaiser Permanente Hawaii; and in California through Kaiser Permanente Southern California, excluding San Diego; and c) among American Indian populations in Arizona and New Mexico. The population under observation included noninstitutionalized, civilian youth younger than 20 years of age in the years 2002 and 2003. The population denominator included 10,031,888 persons. Race/ethnicity-specific estimates were pooled across sites using five categories: non-Hispanic white (NHW), Hispanic (H), African American (AA), Asian Pacific Islander (API), and American Indian (AI). The annual total number of new cases of diabetes in persons under 20 years of age was estimated by applying the age-, sex-, and racial/ethnic group-specific incidence estimates from SEARCH to the age-, sex-, and racial/ethnic group-specific U.S. population using bridged-race postcensal population estimates of the July 1 U.S. resident population. Data used in the bullets and the figure were derived from the *Journal of the American Medical Association* issue listed above.

Deaths among People with Diabetes, United States, 2006

1. Heron MP, Hoyert DL, Xu J, Scott C, Tejada-Vera B. Deaths: Preliminary data for 2006. National vital statistics reports; Vol. 56 No. 16. Hyattsville, MD: National Center for Health Statistics. 2008.

2. McEwen LN, Kim C, Haan M, Ghosh D, Lantz PM, Mangione CM, Safford MM, Marrero D, Thompson TJ, Herman WH; TRIAD Study Group. Diabetes reporting as a cause of death: results from the Translating Research Into Action for Diabetes (TRIAD) study. *Diabetes Care*. 2006;29(2):247–253.

3. Saydah SH, Geiss LS, Tierney E, Benjamin SM, Engelgau M, Brancati F. Review of the performance of methods to identify diabetes cases among vital statistics, administrative, and survey data. *Annals of Epidemiology*. 2004;14(7):507–516.

4. Gu K, Cowie CC, Harris MI. Mortality in adults with and without diabetes in a national cohort of the U.S. population, 1971–1993. *Diabetes Care*. 1998;21:1138–1145.

5. Hu FB, Stampfer MJ, Solomon CG, Liu S, Willett WC, Speizer FE, Nathan DM, Manson JE. The impact of diabetes mellitus on mortality from all causes and coronary heart disease in women: 20 years of follow-up. *Archives of Internal Medicine.* 2001;161:1717–1723.

Methods: The number of deaths with diabetes as any listed cause of death among U.S. residents was obtained from the multiple cause-of-death dataset, National Center for Health Statistics, Centers for Disease Control and Prevention.

Complications of Diabetes in the United States

Heart Disease and Stroke

1. Gorina Y, Lentzer H. Multiple causes of death in old age. Aging Trends, No. 9. Hyattsville, MD. National Center for Health Statistics, 2008. Available at: www.cdc.gov/nchs/data/ahcd/agingtrends/09causes.pdf.

Methods: Tables 1–2 in the above reference provide the data for the bullets on heart disease and stroke. A total of 174,130 death certificates in 2004 mentioned diabetes as a cause of death among people aged 65 years or older (Table 1). Among these 174,130 deaths, 117,810 (68 percent) also mentioned heart disease as a cause of death and 27,874 (16 percent) mentioned stroke (Table 2).

High Blood Pressure

1. Ong KL, Cheung B, Wong L, Wat N, Tan K, Lam K. Prevalence, treatment, and control of diagnosed diabetes in the U.S. National Health and Nutrition Examination Survey 1999–2004. *Annals of Epidemiology*. 2008;18:222–229.

Blindness

1. Klein R, Klein BEK. Vision disorders in diabetes. In: National Diabetes Data Group, editors. *Diabetes in America, 2nd ed*. Washington, DC: U.S. Department of Health and Human Services, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. NIH Publication No. 95–1468:293–336, 1995.

2. Will JC, Geiss LS, Wetterhall SF. Diabetic retinopathy [letter]. *New England Journal of Medicine*. 1990;323:613.

Kidney Disease

1. United States Renal Data System, Standard Analysis Files, 2007 [data query online]. Available at: www.usrds.org/odr/xrender_home.asp.

Nervous System Disease

1. Eastman RC. Neuropathy in diabetes. In: National Diabetes Data Group, editors. *Diabetes in America, 2nd ed*. Washington, DC: U.S. Department of Health and Human Services, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. NIH Publication No. 95–1468:339–348, 1995.

2. Gregg EW, Sorlie P, Paulose-Ram R, Gu Q, Eberhardt MS, Wolz M, Burt V, Curtin L, Engelgau M, Geiss L; 1999–2000 national health and nutrition examination survey. Prevalence of lower-extremity disease in the U.S. adult population ≥40 years of age with and without diabetes: NHANES 1999–2000. *Diabetes Care*. 2004;27:1591–1597.

Amputations

1. Centers for Disease Control and Prevention. National Diabetes Surveillance System. Available at: www.cdc.gov/diabetes/statistics/index.htm.

Dental Disease

1. Tsai C, Hayes C, Taylor GW. Glycemic control of type 2 diabetes and severe periodontal disease in the U.S. adult population. *Community Dentistry and Oral Epidemiology*. 2002;30(3):182–192.

2. Personal communication from R.H. Selwitz, D.D.S., National Institute of Dental and Craniofacial Research, Bethesda, MD, concerning unpublished data from the NHANES III 1988–1994.

Complications of Pregnancy

1. Personal communication from Thomas A. Buchanan, M.D., professor, Medicine, Obstetrics and Gynecology, and Physiology and Biophysics, USC Keck School of Medicine, Los Angeles.

Other Complications

1. Fishbein H, Palumbo PJ. Acute metabolic complications in diabetes. In: National Diabetes Data Group, editors. *Diabetes in America, 2nd ed*. Washington, DC: U.S. Department of Health and Human Services, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. NIH Publication No. 95–1468:283–291, 1995.

2. Valdez R, Narayan KM, Geiss LS, Engelgau MM. Impact of diabetes mellitus on mortality associated with pneumonia and influenza among non-Hispanic black and white U.S. adults. *American Journal of Public Health*. 1999;89:1715–1721.

3. Gregg EW, Beckles GL, Williamson DF, Leveille SG, Langlois JA, Engelgau MM, Narayan KM. Diabetes and physical disability among older U.S. adults. *Diabetes Care*. 2000;23(9):1272–1277.

4. Sinclair AJ, Conroy SP, Bayer AJ. Impact of diabetes on physical function in older people. *Diabetes Care*. 2008;31(2):233–235.

Preventing Diabetes Complications

Glucose Control

1. Stratton IM, Adler AI, Neil HA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *British Medical Journal*. 2000;321(7258):405–412.

2. The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *New England Journal of Medicine*. 1993;329:977–986.

3. Nathan DM, Cleary PA, Backlund JY, Genuth SM, Lachin JM, Orchard TJ, Raskin P, Zinman B; Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) Study Research Group. Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes. *New England Journal of Medicine*. 2005;353(25):2643–2653.

Blood Pressure Control

1. Curb JD, Pressel SL, Cutler JA, Savage PJ, Applegate WB, Black H, Camel G, Davis BR, Frost PH, Gonzalez N, Guthrie G, Oberman A, Rutan GH, Stamler J. Effect of diuretic-based antihypertensive treatment on cardiovascular disease risk in older diabetic patients with isolated systolic hypertension. Systolic Hypertension in the Elderly Program Cooperative Research Group. *Journal of the American Medical Association*. 1996;276:1886–1892.

2. Hansson L, Zanchetti A, Carruthers SG, Dahlöf B, Elmfeldt D, Julius S, Ménard J, Rahn KH, Wedel H, Westerling S. Effects of intensive blood-pressure lowering and low-dose aspirin in patients with hypertension: principal results of the Hypertension Optimal Treatment (HOT) randomised trial. HOT Study Group. *Lancet*. 1998;51:1755–1762.

3. UK Prospective Diabetes Study Group. Efficacy of atenolol and captopril in reducing risk of macrovascular and microvascular complications in type 2 diabetes (UKPDS 39). *British Medical Journal*. 1998;317:713–720.

4. Adler AI, Stratton IM, Neil HA, Yudkin JS, Matthews DR, Cull CA, Wright AD, Turner RC, Holman RR. Association of systolic blood pressure with macrovascular and microvascular complications of type 2 diabetes (UKPDS 36): prospective observational study. *British Medical Journal*. 2000;321:412–419.

Control of Blood Lipids

1. Scandinavian Simvastatin Survival Study Group. Randomised trial of cholesterol lowering in 4444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S). *Lancet*. 1994;344:1383–1389.

2. Downs JR, Clearfield M, Weis S, Whitney E, Shapiro DR, Beere PA, Langendorfer A, Stein EA, Kruyer W, Gotto AM. Primary prevention of acute coronary events with lovastatin in men and women with average cholesterol levels: results of the AFCAPS/TexCAPS. Air Force/Texas Coronary Atherosclerosis Prevention Study. *Journal of the American Medical Association*. 1998;279:1615–1622.

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Preventive Care Practices for Eyes, Feet, and Kidneys

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3. Litzelman DK, Slemenda CW, Langefeld CD, Hays LM, Welch MA, Bild DE, Ford ES, Vinicor F. Reduction of lower extremity clinical abnormalities in patients with non-insulin-dependent diabetes mellitus. A randomized, controlled trial. *Annals of Internal Medicine*. 1993;19:36–41.

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5. Brenner BM, Cooper ME, de Zeeuw D, Keane WF, Mitch WE, Parving HH, Remuzzi G, Snapinn SM, Zhang Z, Shahinfar S; RENAAL Study Investigators. Effects of losartan on renal and cardiovascular outcomes in patients with type 2 diabetes and nephropathy. *New England Journal of Medicine*. 2001;345:861–869.

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Estimated Diabetes Costs in the United States in 2007

1. American Diabetes Association. Economic Costs of Diabetes in the U.S. in 2007. *Diabetes Care*. 2008;31(3):596–615.

The estimated costs of diabetes in the United States were based on a study by the Lewin Group, Inc., for the American Diabetes Association and are 2007 estimates of both the direct, which is the cost of medical care and services, and indirect costs, which are the costs of short-term and permanent disability and of premature death, attributable to diabetes. This study used a specific cost-of-disease methodology to estimate the health care costs due to diabetes.

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1 Information Way
Bethesda, MD 20892–3560
Phone: 1–800–860–8747
TTY: 1–866–569–1162
Fax: 703–738–4929
Email: ndic@info.niddk.nih.gov
Internet: www.diabetes.niddk.nih.gov

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