National Diabetes Fact Sheet, 2011

Data Sources, Methods, and References for Estimates of Diabetes and Prediabetes

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Attention:

A Major Change in Methods from the National Diabetes Fact Sheet, 2007

In the *National Diabetes Fact Sheet, 2011*, we defined undiagnosed diabetes and prediabetes based on both fasting glucose and hemoglobin A1c (A1c) levels. This is in contrast to the *National Diabetes Fact Sheet, 2007*, that used fasting glucose levels only.

Diagnosed and undiagnosed diabetes in the United States, all ages, 2010

Methods:

The total number of people with diabetes is the sum of the number of those aged 20 years or older with diagnosed or undiagnosed diabetes and the number of those younger than 20 years with diagnosed diabetes. Detailed methods are available in the next section for those aged 20 years or older and in the following section for those younger than 20 years.

The total number of people with diagnosed diabetes in 2010 is the sum of the estimated numbers of those younger than 20 years and those aged 20 years or older with diagnosed diabetes.

The total number of people with undiagnosed diabetes in 2010 is the estimated number of those aged 20 years or older with undiagnosed diabetes. Estimates of undiagnosed diabetes for people younger than 20 years are not available.

These estimates have some variability due to the limits of the measurements and estimation procedures. The procedures assumed that percentages of adults with diabetes (diagnosed and undiagnosed) in 2010 were the same as they were in earlier time periods (e.g., 2005–2008), and that the 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.

Diagnosed and undiagnosed diabetes among people aged 20 years or older, United States, 2010

Data source:

2005–2008 National Health And Nutrition Examination Survey (NHANES), National Center for Health Statistics, Centers for Disease Control and Prevention. Available at http://www.cdc.gov/nchs/nhanes.htm.

Method:

The percentage of people aged 20 years or older with diabetes (diagnosed or undiagnosed) was obtained using the fasting subsample from the 2005–2008 NHANES data. People who self-reported having been told by a doctor or health professional that they had diabetes were classified as having diagnosed diabetes. Those without a history of diabetes but with a fasting plasma glucose greater than or equal to 126 mg/dl or an A1c level greater than or equal to 6.5% were classified as having undiagnosed diabetes. We used both fasting glucose and A1c levels to define undiagnosed diabetes because these are the tests most frequently used in clinical settings. These tests have limitations in identifying populations with undiagnosed diabetes and the implications of the age and race differences between groups in the estimates of undiagnosed diabetes are not known. Research is ongoing to ascertain the best use of laboratory blood tests to detect people who may have undiagnosed diabetes (see the National Glycosylated Standardization Program at http://www.ngsp.org/) and to improve the understanding of who has undiagnosed diabetes. The estimated percentage of diagnosed or undiagnosed diabetes was then applied to the 2010 U.S. resident population aged 20 years or older to derive the total number of adults with diabetes. These estimates were obtained by age groups (20–44 years, 45–64 years, and 65 years or older), by sex (men and women), and by race/ethnicity (non-Hispanic whites and non-Hispanic blacks). Information on the use of NHANES data to measure diabetes (including diagnosed and

undiagnosed diabetes) is available from the following:

References:

Cowie CC, Rust KF, Ford ES, Eberhardt MS, Byrd-Holt DD, Li C, Williams DE, Gregg EW, Bainbridge KE, Saydah SH, Geiss LS. Full accounting of diabetes and prediabetes in the U.S. population in 1988–1994 and 2005–2006. *Diabetes Care* 2009;32:287–294.

Cowie CC, Rust KF, Byrd-Holt DD, Gregg EW, Ford ES, Geiss LS, Bainbridge KE, Fradkin JE. Prevalence of diabetes and high risk for diabetes using A1C criteria in the U.S. population in 1988–2006. *Diabetes Care* 2010;33:562–568.

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* 2011;34(Suppl. 1):S66–S68. Available at http://care.diabetesjournals.org/content/34/Supplement_1/S62.full.pdf+html.

Herman WH, Cohen RM. Hemoglobin A1c: teaching a new dog old tricks. *Ann Intern Med* 2010;152(12):815–817.

Diagnosed diabetes among people younger than 20 years of age, United States, 2010

Data sources:

2007–2009 National Health Interview Survey (NHIS), National Center for Health Statistics, Centers for Disease Control and Prevention. Available at http://www.cdc.gov/nchs/nhis.htm.

U.S. Census Bureau, resident population estimates for 10/1/2010. Available at http://www.census.gov/popest/national/asrh/2009-nat-res.html.

Methods:

The percentage of people younger than 20 years with diagnosed diabetes was obtained from the 2007–2009 NHIS data. Information on diagnosed diabetes was obtained from a knowledgeable adult family member residing in the household for people younger than 18 years, and was self-reported for people 18–19 years of age. The estimate of diagnosed diabetes was applied to the 2010 U.S. resident population younger than 20 years to derive the number of people with diagnosed diabetes in this age group. Estimates of undiagnosed diabetes for people younger than 20 years are not available.

Racial and ethnic differences in diagnosed diabetes

Data sources:

2007–2009 National Health Interview Survey (NHIS), National Center for Health Statistics, Centers for Disease Control and Prevention. Available at http://www.cdc.gov/nchs/nhis.htm.

Indian Health Service (IHS), National Patient Information Reporting System (NPIRS).

Methods:

With the exception of diagnosed diabetes among American Indians and Alaska Natives (AIsANs), race/ethnicity-specific estimates of diagnosed diabetes were calculated using the 2007–2009 NHIS data. People aged 20 years or older who self-reported having been told by a doctor or health professional that they had diabetes were classified as having diagnosed diabetes. The percentages were age-adjusted — using age groups 20–39, 40–59, and ≥60 — by the direct method to the 2000 U.S. Census standard population. The estimate of diagnosed diabetes 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.

Diagnosed diabetes among AIsANs was calculated using 2009 data from the IHS NPIRS. This system includes patient registration and visit data that are received directly from IHS facilities, tribally operated programs and contract health systems. These health care facilities serve about 1.9 million AIsANs who belong to 564 federally recognized tribes in 35 states. Data for 847,319 active patients aged 20 years or older were used to calculate these estimates. Patients were considered active if they received health care services at the IHS, tribally operated programs, or contract health care facilities during the preceding three years. Diabetes cases among these patients were identified using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnostic codes 250.0–250.93 from the patient visit data. Patients were considered to have a diagnosis of diabetes if they had at least two visits with the ICD 250 diagnosis code reported during fiscal year 2009.

For many U.S. racial/ethnic minority populations, sufficient data are not available to derive total prevalence estimates of diabetes (diagnosed and undiagnosed). However, national estimates of diagnosed diabetes are available for some but not all minority groups. Resources to obtain data for minority groups at the state or local level include the Behavioral Risk Factor Surveillance System http://www.cdc.gov/brfss/stateinfo.htm and the California Health Interview Survey http://www.chis.ucla.edu. For more information on U.S. racial/ethnic minority groups, see the Census glossary http://factfinder.census.gov/home/en/epss/glossary_a.html.

New cases of diagnosed diabetes among people aged 20 years or older, United States, 2010

Data sources:

2007–2009 National Health Interview Survey (NHIS), National Center for Health Statistics, Centers for Disease Control and Prevention. Available at http://www.cdc.gov/nchs/nhis.htm.

U.S. Census Bureau, resident population estimates for 10/1/2010. Available at http://www.census.gov/popest/national/asrh/2009-nat-res.html.

Methods:

The rate of new cases was calculated using 2007–2009 NHIS 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. We calculated the number of years since diagnosis of diabetes for each person 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, we assumed that half of the adults who had a value of one were classified as having been diagnosed with diabetes within the last year. To calculate the rate, we used as the numerator the number of adults who were diagnosed with diabetes within the last year, and the denominator was the estimate of the adult population, excluding adults who had been diagnosed with diabetes for more than one year and adults who on the NHIS were categorized as "refused," "don't know," or who had missing values on the diabetes status question. To estimate the number of new cases of diabetes in each age group in 2010, we applied the age-specific rates of new cases to 2010 estimates of the U.S. resident population without diabetes diagnosed in the past year.

New cases of diagnosed diabetes among people younger than 20 years of age, United States, 2002–2005

Data source:

SEARCH for Diabetes in Youth Study

Methods:

SEARCH is a multicenter observational study to examine diabetes among children and adolescents in the United States (see http://www.cdc.gov/diabetes/projects/diab_children.htm). The youth population being studied in 8 locations throughout the United States—more than 5 million, or 6 percent, of all American children younger than 20 years—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 ascertaining new cases of physician-diagnosed diabetes in noninstitutionalized, civilian people younger than 20 years of age in 2002–2005: a) in geographically defined populations in Ohio, Washington, South Carolina and Colorado; b) among health plan enrollees in Hawaii (Hawaii Medical Service Association, Med-Quest, Kaiser Permanente Hawaii) and California (Kaiser Permanente Southern California excluding San Diego); and c) among American Indian populations in Arizona and New Mexico. Race/ethnicity-specific estimates were pooled across sites using 5 categories: non-Hispanic white (NHW), non-Hispanic black (NHB), Hispanic (H), Asian-Pacific Islander (API), and American Indian (AI). The annual total number of new cases of diabetes in people younger than 20 years of age was estimated by applying the age-, sex-, and racial/ethnic group-specific rates of new cases from SEARCH to the corresponding U.S. resident population. The data presented in the following table were derived from the March 2009 *Diabetes Care* supplement listed in the footnote to the table below; data for AIs were provided by the SEARCH Coordinating Center.

	Type 1		Type 2	
	Rate (per 100,000/year)	95% CI*	Rate (per 100,000/year)	95% CI
Age 0 – 9 Years				
NHW	24.8	(23.5 – 26.1)	0.2	(0.1 – 0.4)
NHB	15.7	(13.7 – 17.9)	1.1	(0.7 – 1.9)
H	14.1	(12.4 – 16.1)	0.5	(0.3 – 1.0)
API	6.4	(4.8 – 8.5)	0.6	(0.3 – 1.5)
AI	4.2	(2.4 – 7.5)	0.4	(0.1 – 2.2)
ALL	19.7	(18.8 – 20.6)	0.4	(0.3 – 0.6)
Age 10 – 19 Years				
NHW	22.6	(21.4 – 23.8)	3.7	(3.2 – 4.2)
NHB	15.7	(13.8 – 17.8)	19.0	(16.9 – 21.3)
H	13.8	(12.1 – 15.8)	11.6	(10.0 – 13.4)
API	7.4	(5.8 – 9.6)	12.1	(9.9 – 14.8)
AI	4.7	(2.8 – 7.8)	32.0	(26.2 – 39.0)
ALL	18.6	(17.8 – 19.4)	8.5	(8.0 – 9.1)

*Confidence interval

References:

The SEARCH for Diabetes in Youth Study Group. The many faces of diabetes in American youth: type 1 and type 2 diabetes in five race and ethnic populations. *Diabetes Care* 2009;32(Suppl 2):S99–S147.

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. *JAMA* 2007;297:2716–2724.

SEARCH Study Group. SEARCH for Diabetes in Youth: a multicenter study of the prevalence, incidence and classification of diabetes mellitus in youth. *Control Clin* Trials 2004;25:458–471.

Prediabetes among people aged 20 years or older, United States, 2010

Data sources:

2005–2008 National Health and Nutrition Examination Survey (NHANES), National Center for Health Statistics, Centers for Disease Control and Prevention. Available at http://www.cdc.gov/nchs/nhanes.htm.

U.S. Census Bureau, resident population estimates for 10/1/2010. Available at http://www.census.gov/popest/national/asrh/2009-nat-res.html.

Methods:

With the exception of American Indians, the percentage of people aged 20 years or older with prediabetes was estimated using the fasting subsample from the 2005–2008 NHANES data. People without diabetes were classified as having prediabetes if they had fasting plasma glucose values of 100 to 125 mg/dL or A1c values of 5.7% to 6.4%. The prediabetes estimate was applied to the 2010 U.S. resident population aged 20 years or older to derive the number of adults with prediabetes. We used both fasting glucose and A1c levels to define prediabetes because these are the tests most frequently used in clinical settings. These tests have limitations in identifying populations with prediabetes and the implications of the age and race differences between groups in the prediabetes estimates are not known.

Research is ongoing to ascertain the best use of laboratory blood tests to detect people who may have prediabetes (see the National Glycosylated Standardization Program at http://www.ngsp.org/CAC2009.asp) and to improve the understanding of who has prediabetes.

References:

Personal communication from B. V. Howard, MD, MedStar Research Institute, Hyattsville, MD, concerning unpublished data from the Strong Heart Study on the estimated age-adjusted percentage of American Indians aged 15 years or older with impaired fasting glucose.

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* 2011;34(Suppl. 1):S66–S68. Available at http://care.diabetesjournals.org/content/34/Supplement_1/S62.full.pdf+html.

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.

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.

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. *Arch Intern Med* 2002;62:209–216.

Selvin E, Steffes MW, Zhu H, Matsushita K, Wagenknecht L, Pankow J, Coresh J, Brancati FL. Glycated hemoglobin, diabetes, and cardiovascular risk in nondiabetic adults. *N Engl J Med* 2010;362:800–811.

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. *N Engl J Med* 2002;346:393–403.

Li G, Zhang P, Wang J, Gregg EW, Yang W, Gong Q, Li H, Li H, Jiang Y, An Y, Shuai Y, Zhang B, Zhang J, Thompson TJ, Gerzoff RB, Roglic G, Hu Y, Bennett PH. The long-term effect of lifestyle interventions to prevent diabetes in the China Da Qing Diabetes Prevention Study: a 20-year follow-up study. *Lancet* 2008;371:1783–1789.

Gestational diabetes in the United States

References:

Hunt KJ, Schuller KL. The increasing prevalence of diabetes in pregnancy. *Obstet Gynecol Clin North Am* 2007;34:173–199.

Ferrara A. Increasing prevalence of gestational diabetes mellitus: a public health perspective. *Diabetes Care* 30 Suppl 2:S141–S146, 2007. Erratum in: *Diabetes Care* 2007;30(12):3154.

International Association of Diabetes and Pregnancy Study Groups Consensus Panel, Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, Damm P, Dyer AR, Leiva A, Hod M, Kitzmiler JL, Lowe LP, McIntyre HD, Oats JJ, Omori Y, Schmidt MI. International association of diabetes and pregnancy study groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. *Diabetes Care* 2010;33(3):676–682.

Coustan DR, Lowe LP, Metzger BE, Dyer AR. International Association of Diabetes and Pregnancy Study Groups. The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study: paving the way for new diagnostic criteria for gestational diabetes mellitus. *Am J Obstet Gynecol* 2010;202(6):654.e1–654.e6.

Kitzmiller JL, Dang-Kilduff L, Taslimi MM. Gestational diabetes after delivery: short-term management and long-term risks. *Diabetes Care* 2007;30:S225–S235.

Kim C, Newton KM, Knopp RH. Gestational diabetes and the incidence of type 2 diabetes: a systematic review. *Diabetes Care* 2002;25:1862–1868.

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* 2011;34(Suppl. 1):S68. Available at http://care.diabetesjournals.org/content/34/Supplement_1/S62.full.pdf+html.

Treatment of diabetes, United States, 2007–2009

Data source:

2007–2009 National Health Interview Survey (NHIS), National Center for Health Statistics, Centers for Disease Control and Prevention. Available at http://www.cdc.gov/nchs/nhis.htm.

Methods:

The distribution percentage of treatment type among civilian, noninstitutionalized adults aged 18 years or older with diagnosed diabetes was calculated using the following treatment questions from the 2007–2009 NHIS: "Are you now taking insulin?" "Are you now taking diabetic pills to lower your blood sugar?"

Deaths among people with diabetes, United States, 2007

Data source:

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, using the *Tenth Revision of the International Classification of Diseases* cause-of-death codes E10–E14.

References:

Xu JQ, Kochanek KD, Murphy SL, Tejada-Vera B. Deaths: Final data for 2007. National Vital Statistics Reports 2010;58(19). Available at http://www.cdc.gov/nchs/data/nvsr/nvsr58/nvsr58_19.pdf.

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;29:247–253.

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. *Ann Epidemiol* 2004;14:507–516.

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.

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. *Arch Intern Med* 2001;161:1717–1723.

Gregg EW, Gu Q, Cheng YJ, Narayan KM, Cowie CC. Mortality trends in men and women with diabetes, 1971 to 2000. *Ann Intern Med* 2007;147:149–155.

Estimated diabetes costs in the United States, 2007

Reference:

American Diabetes Association. Economic Costs of Diabetes in the United States in 2007. *Diabetes Care* 2008;31:596–615.

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 (cost of medical care and services) and indirect costs (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.

Complications of diabetes in the United States

Heart disease and stroke

Reference:

Gorina Y, Lentzer H. *Multiple Causes of Death in Old Age.* Hyattsville: Aging Trends, No.9. National Center for Health Statistics, CDC; 2008.

Available at http://www.cdc.gov/nchs/data/ahcd/agingtrends/09causes.pdf.

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%) also mentioned heart disease as a cause of death and 27,874 (16%) mentioned stroke (Table 2).

Geiss LS, Herman WH, Smith PJ. Mortality in non-insulin-dependent 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, 1995. NIH Publication No. 95-1468. p. 233–257.

Kuller LH. Stroke and 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, 1995. NIH Publication No. 95-1468. p. 449–456.

Hypertension

Data source:

2005–2008 National Health and Nutrition Examination Survey (NHANES), National Center for Health Statistics, Centers for Disease Control and Prevention. Available at http://www.cdc.gov/nchs/nhanes.htm.

Methods:

The percentage of adults aged 20 years or older with self-reported diabetes that have hypertension was estimated based on blood pressure greater than or equal to 140/90 millimeters of mercury or current use of prescription medication for hypertension.

Blindness and eye problems

References:

Zhang X, Saaddine JB, Chou CF, Cotch MF, Cheng YJ, Geiss LS, Gregg EW, Albright AL, Klein BEK, Klein R. Prevalence of diabetic retinopathy in the United States, 2005–2008. *JAMA* 2010;304(6):649–656.

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, 1995. NIH Publication No. 95-1468:293–336.

Kidney disease

Data source:

United States Renal Data System, Renal Data Extraction and Referencing System [online data querying application]. 2010 Annual Data Report dataset. Available at http://www.usrds.org/odr/xrender_home.asp. Accessed December 9, 2010.

Nervous system disease

References:

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, 1995 NIH Publication No. 95-1468:339–348.

Gregg EW, Sorlie P, Paulose-Ram R, Gu Q, Eberhardt MS, Wolz M, Burt V, Curtin L, Engelgau M, Geiss L. Prevalence of lower-extremity disease in the US adult population ≥40 years of age with and without diabetes: 1999–2000 National Health and Nutrition Examination Survey. *Diabetes Care* 2004;27:1591–1597.

Amputations

Data source:

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

Reference:

Li Y, Burrows N, Gregg E, Geiss L. Declining Trends in Hospitalizations for Non-traumatic Lower Extremity Amputation in the Diabetic

Population—United States, 1988–2006 [abstract]. Presented during the 70th Scientific Sessions of the American Diabetes Association. June 2010.

Dental disease

References:

Tsai C, Hayes C, Taylor GW. Glycemic control of type 2 diabetes and severe periodontal disease in the US adult population. *Community Dent Oral Epidemiol* 2002;30:182–192.

Personal communication from R. H. Selwitz, DDS, National Institute of Dental and Craniofacial Research, Bethesda, MD [retired], concerning unpublished data from the third National Health and Nutrition Examination Survey, 1988–1994.

Complications of pregnancy

References:

Personal communication from T. A. Buchanan, MD, Professor of Medicine, Obstetrics and Gynecology, and Physiology and Biophysics, USC Keck School of Medicine, Los Angeles, CA.

Coustan DR. Gestational diabetes. *Diabetes Care* 1993;16(3):8–15.

Kitzmiller JL, Gavin LA, Gin GD, Jovanovic-Peterson L, Main EK, Zigrang WD. Preconception care of diabetes. Glycemic control prevents congenital anomalies. *JAMA* 1991;265:731–736.

Other complications

References:

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.

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 US adults. *Am J Public Health* 1999;89:1715–1721.

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;23:1272–1277.

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

Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. The prevalence of comorbid depression in adults with diabetes: a meta-analysis. *Diabetes Care* 2001;24:1069–1078.

González JS, Peyrot M, McCarl LA, Collins EM, Serpa L, Mimiaga MJ, Safren SA. Depression and diabetes treatment nonadherence: a meta-analysis. *Diabetes Care* 2008;31:2398–2403.

Mezuk B, Eaton WW, Albrecht S, Golden SH. Depression and type 2 diabetes over the lifespan: a meta-analysis. *Diabetes Care* 2008;31:2383–2390.

Egede LE, Ellis C. Diabetes and depression: global perspectives. *Diabetes Res Clin Pract* 2010;87:302–312.

Preventing diabetes complications

Glucose control

References:

Stratton IM, Adler AI, Neil HA, Matthews DR, Manley SE, Cull CA, Hadden D, Turner RC, Holman RR. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BMJ* 2000;321(7258):405–412.

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. *N Engl J Med* 1993;329:977–986.

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. *N Engl J Med* 2005;353:2643–2653.

Blood pressure control

References:

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. *JAMA* 1996;276:1886–1892.

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;351:1755–1762.

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

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. *BMJ* 2000;321:412–419.

Control of blood lipids

References:

Scandinavian Simvastatin Survival Study Group. Randomised trial of cholesterol lowering in 4,444 patients with coronary heart disease: the Scandinavian Simvastatin Survival Study (4S). *Lancet* 1994;344:1383–1389.

Downs JR, Clearfield M, Weis S, Whitney E, Shapiro DR, Beere PA, Langendorfer A, Stein EA, Kruyer W, Gotto AM Jr. 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. *JAMA* 1998;279:1615–1622.,

Sacks FM, Moyé LA, Davis BR, Cole TG, Rouleau JL, Nash DT, Pfeffer MA, Braunwald E. Relationship between plasma LDL concentrations during treatment with pravastatin and recurrent coronary events in the Cholesterol and Recurrent Events trial. *Circulation* 1998;97:1446–1452.

Preventive care practices for eyes, feet, and kidneys

References:

Ferris FL 3rd. How effective are treatments for diabetic retinopathy? *JAMA* 1993;269:1290–1291.

Zhang X, Gregg EW, Cheng YJ, Thompson TJ, Geiss LS, Dueñas MR, Saaddine JB. Diabetes mellitus and visual impairment: national health and nutrition examination survey, 1999–2004. *Arch Ophthalmol* 2008;126:1421–1427.

Bild DE, Selby JV, Sinnock P, Browner WS, Braveman P, Showstack JA. Lower-extremity amputation in people with diabetes. Epidemiology and prevention. *Diabetes Care* 1989;12:24–31.

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. *Ann Intern Med* 1993;119:36–41.

Lewis EJ, Hunsicker LG, Clarke WR, Berl T, Pohl MA, Lewis JB, Ritz E, Atkins RC, Rohde R, Raz I; Collaborative Study Group. Renoprotective effect of the angiotensin-receptor antagonist irbesartan in patients with nephropathy due to type 2 diabetes. *N Engl J Med* 2001;345:851–860.

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. *N Engl J Med* 2001;345:861–869.

Parving HH, Lehnert H, Brochner-Mortensen J, Gomis R, Andersen S, Arner P; Irbesartan in Patients with Type 2 Diabetes and

Microalbuminuria Study Group. The effect of irbesartan on the development of diabetic nephropathy in patients with type 2 diabetes. *N Engl J Med* 2001;345:870–878.

Hostetter TH. Prevention of end-stage renal disease due to type 2 diabetes. *N Engl J Med* 2001;345:910–912.

Lewis EJ, Hunsicker LG, Bain RP, Rohde RD. The effect of angiotensin-converting-enzyme inhibition on diabetic nephropathy. The Collaborative Study Group. *N Engl J Med* 1993;329:1456–1462.

Kunz R, Friedrich C, Wolbers M, Mann JF. Meta-analysis: effect of monotherapy and combination therapy with inhibitors of the renin angiotensin system on proteinuria in renal disease. *Ann Intern Med* 2008;148:30–48.

What is diabetes?

References:
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* 2011;34(Suppl. 1):S62–S66. Available at http://care.diabetesjournals.org/content/34/Supplement_1/S62.full.pdf+html.

Dall TM, Mann SE, Zhang Y, Quick WW, Seifert RF, Martin J, Huang EA, Zhang S. Distinguishing the economic costs associated with type 1 and type 2 diabetes. *Population Health Management* 2009;12:103–110.

Johnson JA, Pohar SL, Majumdar SR. Health care use and costs in the decade after identification of type 1 and type 2 diabetes: a population-based study. *Diabetes Care* 2006;29:2403–2408.

Ng E, Dasgupta K, Johnson JA. An algorithm to differentiate diabetic respondents in the Canadian Community Health Survey. *Health Rep* 2008;19:71–79.

Coustan DR. Gestational diabetes. *Diabetes Care* 1993;16(3):8–15.

Kitzmiller JL, Gavin LA, Gin GD, Jovanovic-Peterson L, Main EK, Zigrang WD. Preconception care of diabetes. Glycemic control prevents congenital anomalies. *JAMA* 1991;265:731–736.

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References:
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. *N Engl J Med* 2002;346:393–403.

Diabetes Prevention Program Research Group, Knowler WC, Fowler SE, Hamman RF, Christophi CA, Hoffman HJ, Brenneman AT, Brown-Friday JO, Goldberg R, Venditti E, Nathan DM. 10-year follow-up of diabetes incidence and weight loss in the Diabetes Prevention Program Outcomes Study. *Lancet* 2009;374:1677–1686.

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.

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;26:2518–2523.

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. *Ann Intern Med* 2005;142:323–332.