MEPS

Research Findings #30

Trends in the Pharmaceutical Treatment of Diabetes, 1997 to 2007

AHRQ Advancing Excellence in Health Care

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ABSTRACT

This report uses nationally representative data from the 1997–2007 Medical Expenditure Panel Survey (MEPS) to examine trends in the use and expenditures for oral anti-diabetic medications, insulin, and non-insulin injectables. We also examine trends for three specific classes of oral medications: sulfonylureas, biguanides and thiazolidinediones. The study sample comprises individuals in the U.S. civilian noninstitutionalized population who reported treatment for diabetes. We find that from 1997 to 2007, the total number of persons reporting treatment for diabetes increased from 9.8 to 18.9 million and the treated prevalence of several comorbidities−cardiovascular disease, hypertension, and hyperlipidemia−increased within this population. We also observe significant changes in patterns of use for anti-diabetic medications. From 1997 to 2007, the proportion of persons reporting treatment for diabetes who used oral anti-diabetic medications increased from 59.9 to 77.3 percent and the proportion using insulin dropped from 38.2 to 24.4 percent. Among specific classes of oral medications, the percentage using sulfonylureas fell from 51.2 to 40.2 percent. In contrast, use of biguanides and thiazolidinediones increased from 1997 to 2007. The proportion using thiazolidinediones increased from 4.7 to 24.6 percent, a more than four-fold increase, while the proportion using biguanides increased from 21.2 to 55.2 percent. After adjusting for inflation, the average annual expenditures per user for anti-diabetic medications for 2006–2007 ($944) was nearly twice that in 1997–1998 ($500, in 2007 dollars), while the average annual out-of-pocket expenditures increased from $221 (2007 dollars) to $273. In addition to aggregate trends, this report also examines trends within and differences across subgroups of persons reporting treatment for diabetes.

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The estimates in this report are based on the most recent data available at the time the report was written. However, selected elements of MEPS data may be revised on the basis of additional analyses, which could result in slightly different estimates from those shown here. Please check the MEPS Web site for the most current file releases.

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The Medical Expenditure Panel Survey (MEPS)

Background

The Medical Expenditure Panel Survey (MEPS) is conducted to provide nationally representative estimates of health care use, expenditures, sources of payment, and insurance coverage for the U.S. civilian noninstitutionalized population. MEPS is cosponsored by the Agency for Healthcare Research and Quality (AHRQ), formerly the Agency for Health Care Policy and Research, and the National Center for Health Statistics (NCHS).

MEPS comprises three component surveys: the Household Component (HC), the Medical Provider Component (MPC), and the Insurance Component (IC). Together these surveys yield comprehensive data that provide national estimates of the level and distribution of health care use and expenditures, support health services research, and can be used to assess health care policy implications.

MEPS is the third in a series of national probability surveys conducted by AHRQ on the financing and use of medical care in the United States. The National Medical Care Expenditure Survey (NMCES) was conducted in 1977, and the National Medical Expenditure Survey (NMES) in 1987. Beginning in 1996, MEPS continues this series with design enhancements and efficiencies that provide a more current data resource to capture the changing dynamics of the health care delivery and insurance system.

The design efficiencies incorporated into MEPS are in accordance with the Department of Health and Human Services (HHS) Survey Integration Plan of June 1995, which focused on consolidating HHS surveys, achieving cost efficiencies, reducing respondent burden, and enhancing analytical capacities. To accommodate these goals, new MEPS design features include linkage with the National Health Interview Survey (NHIS), from which the sample for the MEPS-HC is drawn, and enhanced longitudinal data collection for core survey components. The MEPS-HC augments NHIS by selecting a sample of NHIS respondents, collecting additional data on their health care expenditures, and linking these data with additional information collected from the respondents' medical providers, employers, and insurance providers.

Household Component

The MEPS-HC, a nationally representative survey of the U.S. civilian noninstitutionalized population, collects medical expenditure data at both the person and household levels. The HC collects detailed data on demographic characteristics, health conditions, health status, use of medical care services, charges and payments, access to care, satisfaction with care, health insurance coverage, income, and employment.

The HC uses an overlapping panel design in which data are collected through a preliminary contact followed by a series of five rounds of interviews over a two-and-a-half year period. Using computer-assisted personal interviewing (CAPI) technology, data on medical expenditures and use for two calendar years are collected from each household. This series of data collection rounds is launched each subsequent year on a new sample of households to provide overlapping panels of survey data and, when combined with other ongoing panels, will provide continuous and current estimates of health care expenditures.

The sampling frame for the MEPS-HC is drawn from respondents to NHIS, conducted by NCHS. NHIS provides a nationally representative sample of the U.S. civilian noninstitutionalized population, with oversampling of Hispanics and blacks.

Medical Provider Component

The MEPS-MPC supplements and validates information on medical care events reported in the MEPS-HC by contacting medical providers and pharmacies identified by household respondents. The MPC sample includes all hospitals, hospital physicians, home health agencies, and pharmacies reported in the HC. Also included in the MPC are all office-based physicians:

- Providing care for HC respondents receiving Medicaid.
- Associated with a 75 percent sample of households receiving care through an HMO (health maintenance organization) or managed care plan.
- Associated with a 25 percent sample of the remaining households. Data are collected on medical and financial characteristics of medical and pharmacy events reported by HC respondents, including:
    - Diagnoses coded according to ICD-9 (9th Revision, International Classification of Diseases) and DSMIV (Fourth Edition, Diagnostic and Statistical Manual of Mental Disorders).
    - Physician procedure codes classified by CPT-4 (Current Procedural Terminology, Version 4).
    - Inpatient stay codes classified by DRG (diagnosis related group).
    - Prescriptions coded by national drug code (NDC), medication names, strength, and quantity dispensed.
    - Charges, payments, and the reasons for any difference between charges and payments.

The MPC is conducted through telephone interviews and mailed survey materials.

Insurance Component

The MEPS-IC collects data on health insurance plans obtained through private and public sector employers. Data obtained in the IC include the number and types of private insurance plans offered, benefits associated with these plans, premiums, contributions by employers and employees, and employer characteristics.

Establishments participating in the MEPS-IC are selected through two sampling frames:

- A Bureau of the Census list frame of private sector business establishments.
- The Census of Governments from the U.S. Census Bureau.

Data from these sampling frames are collected to provide annual national and state estimates of the supply of private health insurance available to American workers and to evaluate policy issues pertaining to health insurance. Since 2000, the Bureau of Economic Analysis has used national estimates of employer contributions to group health insurance from the MEPS-IC in the computation of Gross Domestic Product (GDP).

The MEPS-IC is an annual panel survey. Data are collected from the selected organizations through a prescreening telephone interview, a mailed questionnaire, and a telephone follow-up for non-respondents.

Survey Management

MEPS data are collected under the authority of the Public Health Service Act. They are edited and published in accordance with the confidentiality provisions of this act and the Privacy Act. NCHS provides consultation and technical assistance.

As soon as data collection and editing are completed, the MEPS survey data are released to the public in staged releases of summary reports and microdata files. Summary reports are released as printed documents and electronic files. Microdata files are released on CD-ROM and/or as electronic files.

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Trends in the Pharmaceutical Treatment of Diabetes, 1997 to 2007

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Introduction

Diabetes is a chronic and progressive disease associated with significant morbidity, mortality, and costs. According to the American Diabetes Association (ADA), the economic cost of diabetes in the United States in 2007 was estimated at $174 billion, of which, $116 billion and $58 billion were attributed to direct and indirect medical costs, respectively (ADA, 2007).

Generally, individuals diagnosed with type 1 diabetes rely on insulin delivered by injection or an insulin pump to help manage their disease while persons with type 2 diabetes follow a stepwise treatment approach to manage their disease. For persons diagnosed with diabetes, the recommended immediate treatment goals are normal or near-normal glycated hemoglobin A1c (HbA1c) level of < 7 percent (ADA, 2009).

Prior to 1995, sulfonylureas, which were the first class of oral anti-diabetic drugs, were the only non-insulin treatment option for persons diagnosed with type 2 diabetes in the United States (Nichols et al., 2007). However, the availability of new anti-diabetic medications (Alexander et al., 2008; AHRQ-EHC report, 2010) and results from controlled clinical trials, such as the Diabetes Control and Complications Trial (DCCT) in type 1 diabetes and the UK Prospective Diabetes Study (UKPDS) in type 2 diabetes, have since influenced treatment guidelines leading to the recommendation of metformin (a biguanide) as first-line therapy in treating patients with type 2 diabetes.

Currently, the ADA and the European Association for the Study of Diabetes (EASD) consensus guidelines (Nathan et al., 2009) for type 2 diabetes treatment, recommend that persons diagnosed with type 2 diabetes initially start with lifestyle modifications plus metformin, an oral anti-diabetic medication. The consensus guidelines further recommend testing HbA1c levels every three months, and subsequently adding another oral anti-diabetic medication (e.g., a sulfonylurea), or initiating insulin if near-normal glycemic goal is not achieved. These recommendations fall under the tier 1 (well-validated) core therapies strategy. The updated guidelines and consensus algorithm recommend newer agents such as exenatide (a non-insulin injectable drug) or thiazolidinediones (a class of oral drugs) as tier 2 (less-well validated) treatment options.

Given the expansive evidence base resulting from major clinical trials on diabetes treatment, an increasingly complex and aggressive diabetes treatment algorithm, as well as the introduction of newer anti-diabetic medications, it is especially important to understand recent trends in drug utilization and expenditures for anti-diabetic medications. It is also important to understand the characteristics of individuals utilizing the various classes of anti-diabetic medications.

In this report, we use nationally representative data from the Medical Expenditure Panel Survey (MEPS) for the years 1997 through 2007 to examine recent trends in anti-diabetic medication use among the U.S. civilian noninstitutionalized population. We report on trends in use and expenditures for oral anti-diabetic medications, insulin and non-insulin injectables. We also report on trends for the three most commonly used classes of oral medications: sulfonylureas, biguanides, and thiazolidinediones.[1]

We begin by examining the proportion of individuals who reported treatment for diabetes in 1997 and 2007 as well as diabetes-related complications and comorbidities. Then, among persons who reported treatment for diabetes, we examine several measures of drug use and expenditures. First, we examine the percentages of persons who used oral anti-diabetic medications, insulin, and non-insulin injectables. Next, we examine the percentages of individuals who used specific classes of oral anti-diabetic medications. Finally, we examine average annual per capita total expenditures and average annual total and out-of-pocket per user expenditures for specific classes of anti-diabetic medications.

In addition to investigating aggregate trends in drug utilization among persons reporting treatment for diabetes, we examine anti-diabetic medication use in subgroups of this population. In particular, we examine trends within and differences across groups defined by age, race/ethnicity, health insurance, income, and education. Results presented for selected population characteristics and drug expenditures are estimated using pooled data for 1997–1998 and 2006–2007. Use of pooled data increases our sample size and improves our estimates, especially for smaller subgroups.

Since differences across subgroups tend to be fairly stable over time, we present findings from tables 2, 4, and 6 by selected population characteristics only for 2006–2007. Throughout this report only differences in estimates that are statistically significant at the $p < .05$ level are discussed in the text. The Technical Appendix provides details on the sample of persons with diabetes and the definitions of measures used in this report.

[1] An AHRQ-EHC report (2010) currently under review lists 11 classes of diabetes medications that are currently available on the U.S. market. These include insulin, eight classes of oral medications, and two classes of non-insulin injectables. In this study we collapse the two classes of non-insulin injectables (incretin mimetics and amylin analogues) into a single class. Our overall measure of oral medication use includes the six classes listed in the AHRQ report that were available during our study period. However, when we focus on specific classes of oral drugs, we limit reporting to the three most commonly prescribed classes (excluding meglitinides, alpha-glucosidase inhibitors and dipeptidyl peptidase-4 inhibitors; only a small percentage of our study population uses these classes of oral medications).

Findings

Percentage Reporting Diabetes

Overall

Table 1 presents trends from 1997 to 2007 in the proportion and total number of persons with diabetes and selected comorbidities. During the period under review, the total number of persons who reported treatment for diabetes rose from 9.8 to 18.9 million. This represents an increase of 2.7 percentage points in the proportion of persons with diabetes from 3.6 percent of the total U.S. population in 1997 to 6.3 percent in 2007. Diabetes tends to be associated with costly comorbidities and persons with diabetes are at an increased risk of microvascular and macrovascular complications such as cardiovascular disease, hypertension, cerebrovascular disease (stroke), peripheral vascular disease, retinopathy, neuropathy, nephropathy, and hyperlipidemia. Among persons reporting treatment for diabetes, the proportion reporting cardiovascular disease increased from 13.1 percent in 1997 to 17.2 percent in 2007. Similarly, the proportion reporting hypertension increased from 46.1 to 64.8 percent while the proportion reporting hyperlipidemia more than tripled from 15.0 percent in 1997 to 52.8 percent in 2007.

By Selected Population Characteristics

Previous research suggests that the prevalence of diabetes varies by socioeconomic and demographic characteristics such as education, income, age, gender, and race/ethnicity (Saydah and Lochner, 2010; Smith, 2007; National Diabetes fact sheet, 2007; Maty et al., 2005; Robbins et al., 2005). In this report, we find differences in reported treatment for diabetes across groups defined by age and race/ethnicity, income, health insurance status, and education, as well as geographic differences. Table 2 presents the percentage and total number of persons who reported treatment for diabetes in 1997–1998 and 2006–2007 by selected population characteristics. In the time periods under consideration, an average annual total of 10.2 million people reported treatment for diabetes during 1997–1998 compared to 18.2 million persons in 2006–2007.

Age. We find that those 65 years and above were more likely to be treated for diabetes (19.4 percent) during the period 2006–2007 than older adults ages 45–64 (11.0 percent), younger adults ages 18–44 (2.0 percent), or children (0.2 percent). The 15.9 million elderly and older adults who reported treatment for diabetes comprised more than four-fifths (87.4 percent) of all persons who reported treatment for this condition during 2006–2007. Between 1997–1998 and 2006–2007 the proportion of persons reporting treatment for diabetes increased for all age groups in our study.

Race/ethnicity. During the period 2006–2007, non-Hispanic blacks were more likely to be treated for diabetes (7.6 percent) than non-Hispanic whites (6.1 percent) or Hispanics (5.3 percent) and persons of other race/ethnicity groups (5.3 percent). The 12.0 million non-Hispanic whites who reported treatment for diabetes comprised two-thirds (65.9 percent) of all persons who reported treatment for this condition during 2006–2007. Between 1997–1998 and

2006–2007, the proportion of persons reporting treatment for diabetes increased for all race/ethnicity groups.

Income. During 2006–2007, those with high and middle incomes were less likely to report treatment for diabetes (5.4 and 5.8 percent) than the near poor (8.5 percent), those with low income (7.1 percent), or the poor (6.9 percent). From 1997–1998 to 2006–2007, the proportion of the near poor who reported treatment for diabetes more than doubled from 4.2 percent during 1997–1998 to 8.5 percent in 2006–2007 while the proportion of those with middle incomes increased only slightly.

Health insurance status. Among the non-elderly population (less than 65 years) in 2006–2007, those with public insurance (5.5 percent) were more likely to report treatment for diabetes than those with private insurance (4.0 percent) or those without insurance (3.1 percent). In 2006–2007, 38.6 million Americans were without health insurance; of this number 1.2 million reported treatment for diabetes. Among the elderly population (65 years and above) in 2006–2007, those with Medicare-Medicaid were more likely to be treated for diabetes (26.9 percent) than those covered by Medicare only (19.7 percent) or those with a combination of Medicare and private insurance (17.9 percent).

Education. Those with less than a high school education were twice as likely to be treated for diabetes (9.1 percent) as those with at least some college education (4.5 percent). Moreover, those with less than a high school diploma were more likely to be treated for diabetes than those with high school diploma (6.9 percent). Between 1997–1998 and 2006–2007, the proportion of those reporting treatment for diabetes rose for all educational groups.

Metropolitan statistical area (MSA). Those living outside an MSA were more likely to report treatment for diabetes (7.6 percent) than those living within an MSA (5.8 percent) during 2006–2007. About 14.5 million persons living in an MSA reported treatment for diabetes compared to just 3.7 million persons living outside an MSA during 2006–2007. The proportion of both MSA and non-MSA persons reporting treatment for diabetes rose from 1997–1998 to 2006–2007.

Census region. During 2006–2007, persons living in the South were more likely to report treatment for diabetes (6.6 percent) than persons residing in the western parts of the U.S. (5.3 percent). Moreover, persons living in the Northeast (6.3 percent) were more likely to report treatment for diabetes than persons residing in the West. The 7.2 million people from the South who reported treatment for diabetes comprised almost two-fifths (39.6 percent) of all persons who reported treatment for this condition in 2006–2007. Also, the proportion of persons reporting treatment for diabetes rose by more than 2.0 percentage points from 1997–1998 to 2006–2007 for the Northeast, West, and South census regions.

Percentage Using Orals, Insulin, and Non-Insulin Injectable Classes of Anti-Diabetic Medications

Prescription medications are an essential part of managing a chronic disease such as diabetes. The increased treated prevalence of diabetes has been accompanied by an increased complexity of disease management as well as the introduction of new classes of anti-diabetic medications. Although insulin and a non-insulin injectable (pramlintide, a synthetic amylin analogue) remain the primary therapies for persons with type 1 diabetes,[2] persons diagnosed with type 2 diabetes may use one or multiple oral anti-diabetic medications, as well as non-insulin injectables (e.g., incretin mimetics) or insulin to treat their diabetes. The choice of diabetes therapy may depend on many factors such as biochemical assessment of the patient, efficacy and tolerability of the medication, the duration and type of diabetes, age of the person, and medication costs. In this section, we examine patterns of use for the three major classes of anti-diabetic medications: oral medications, insulin, and non-insulin injectables.

Overall

Table 3 presents aggregate trends from 1997 to 2007 in the proportion and total number of persons with diabetes using these major classes of anti-diabetic medications. The measures of use presented are the percentage of persons with diabetes who used a medication from the oral, insulin, or non-insulin injectable classes of anti-diabetic medications. The proportion of persons with diabetes who used oral anti-diabetic medications increased from 59.9 percent in 1997 to 77.3 percent in 2007. By contrast, the proportion using insulin dropped from 38.2 percent in 1997 to 24.4 percent in 2007. The first class of non-insulin injectables was approved by the U.S. Food and Drug Administration (FDA) in 2005. By 2007, 4.1 percent of persons reporting treatment for diabetes used non-insulin injectables. Between 1997 and 2007, the total number of persons with diabetes who reported using oral anti-diabetic medications more than doubled, from 5.9 million to 14.6 million. In comparison, 3.7 million persons who reported treatment for diabetes were using insulin in 1997 and this number grew to 4.6 million in 2007.

By Selected Population Characteristics

Table 4 presents the percentage and total number of persons with diabetes who used oral, insulin, and non-insulin injectables in 2006–2007 by selected population characteristics.

Orals

Currently there are eight classes of oral anti-diabetic medications approved by the FDA for the management of type 2 diabetes. At the time of our study, six classes of oral anti-diabetic medications were approved by the FDA and available in the U.S. Oral anti-diabetic medications generally work to reduce blood glucose concentration. In this report, we find that among persons reporting treatment for diabetes, the proportion of those who reported using oral anti-diabetic medications rose by 12.6 percentage points from 1997–1998 to 2006–2007.

[2] In this report we do not distinguish types of diabetes but previous research suggests that type 1 diabetes comprises about 5–10 percent of all diagnosed cases of diabetes in adults (National Diabetes Statistics Fact Sheet, 2007).

Differences in the utilization of prescribed anti-diabetic medications have been linked to demographic factors such as age (National Diabetes Fact Sheet, 2007) and race/ethnicity. Among persons reporting treatment for diabetes, we find differences in the probability of oral medication use across groups defined by age and race/ethnicity.

Age. During the period 2006–2007, we find that younger adults ages 18–44 were less likely to use oral anti-diabetic medications (62.9 percent) than older adults ages 45–64 (79.8 percent) or those 65 years and above (78.3 percent). The proportion of younger adults ages 18–44 who reported using oral anti-diabetic medications rose by 19.3 percentage points from 1997–1998 to 2006–2007.

Race/ethnicity. During the period 2006–2007, Hispanics were more likely to use oral anti-diabetic medications (81.3 percent) compared to non-Hispanic whites (76.9 percent) and other race/ethnic groups (76.9 percent) or non-Hispanic blacks (72.2 percent). Between 1997–1998 and 2006–2007, the proportion of persons who reported using oral anti-diabetic medications increased for all race/ethnicity groups.

Insulin

Insulin is usually recommended for type 2 diabetes patients after lifestyle modifications plus oral anti-diabetic medications have proved inadequate for glycemic control. For individuals with type 1 diabetes (5–10 percent of diagnosed diabetes) insulin is the primary therapy. The FDA first approved insulin in 1939 and the first recombinant human insulin was approved by the FDA in 1982. Currently, there are more than 20 types of insulin approved for use in the United States. Insulin types are usually classified by how they work in the body (e.g., onset, peak, and duration of action).

Among persons reporting treatment for diabetes, the proportion of those who reported using insulin declined by 10.1 percentage points from 1997–1998 to 2006–2007. We also find differences in the probability of insulin use across groups defined by age, race/ethnicity, and health insurance.

Age. During the period 2006–2007, younger adults ages 18–44 were more likely to use insulin (32.3 percent) than older adults ages 45–64 (23.7 percent) or those 65 years and above (22.3 percent). The proportion of those who reported using insulin dropped for all age groups from 1997–1998 to 2006–2007. For younger adults ages 18–44 the decrease was 14.7 percentage points from 1997–1998 to 2006–2007.

Race/ethnicity. During the period 2006–2007, non-Hispanic blacks were more likely to use insulin (31.8 percent) than non-Hispanic whites (23.4 percent) or Hispanics (21.3 percent). We also find that between 1997–1998 and 2006–2007, the proportion of those who reported using insulin fell for non-Hispanic blacks, non-Hispanic whites, and Hispanics.

Health insurance status. Among the non-elderly population (those less than 65), those with public insurance were more likely to use insulin (35.3 percent) than those with private insurance (23.8 percent) during the period 2006–2007 and those with private insurance were

more likely to use insulin than those without insurance (21.4 percent). Among the elderly population (those 65 years and above) in 2006–2007, those with a combination of Medicare and private insurance were more likely to use insulin (23.9 percent) than those with Medicare-only insurance (19.3 percent). From 1997–1998 to 2006–2007, the proportion of those who reported using insulin declined for those with public insurance, those with private insurance, those without insurance, those with Medicare and private insurance, as well as those with Medicare-only insurance.

Non-Insulin Injectables

There are currently two types of non-insulin injectables: pramlintide for treatment in type 1 diabetes and incretin mimetics (exenatide and liraglutide) for treatment in type 2 diabetes. Non-insulin anti-diabetic injectables (exenatide) were first approved by the FDA in 2005. The updated ADA/EASD guidelines and consensus algorithm recommends the addition of newer and more expensive (Alexander et al., 2008) tier 2 therapies such as exenatide if lifestyle intervention plus oral anti-diabetic medications are insufficient to reach glycemic goals. Thus, non-insulin injectables are used primarily in combination with oral anti-diabetic medications.

Since non-insulin injectables were not available in 1997–1998, we do not present data within group trends in this subsection. We find differences in the probability of non-insulin injectable use across groups defined by age, race/ethnicity, income, health insurance, and education among persons reporting treatment for diabetes.

Age. During the period 2006–2007, older adults ages 45–64 were more likely to use non-insulin injectables (5.6 percent) than younger adults ages 18–44 (2.9 percent) or those 65 years and above (1.9 percent).

Race/ethnicity. During the period 2006–2007, non-Hispanic whites were more likely to use non-insulin injectables (4.6 percent) than non-Hispanic blacks (2.1 percent) or Hispanics (1.2 percent).

Income. During 2006–2007, those with high and middle incomes were more likely to use non-insulin injectables (5.1 and 4.9 percent) than those with low income (2.2 percent), the poor (1.1 percent), or the near poor (0.5 percent).

Health insurance status. Among the non-elderly population (those less than 65), those with private insurance were more likely to use non-insulin injectables (6.5 percent) than those with public insurance (2.2 percent) or those without insurance (0.7 percent) in 2006–2007.

Education. Those with at least some college education were more than four times as likely to use non-insulin injectables (5.2 percent) as those with less than high school diploma (1.2 percent). Moreover, those with high school diploma were more likely to use non-insulin injectables (4.0 percent) than those with less than high school diploma.

Percentage Using Specific Classes of Oral Anti-Diabetic Medications

In this section, we focus on the three most commonly used classes of oral anti-diabetic medications: sulfonylureas, biguanides, and thiazolidinediones. Although each of these classes of oral anti-diabetic medications generally works to reduce blood glucose concentration, each class of oral anti-diabetic medications has a unique mechanism of action, safety profile, and associated costs. Any of these factors may affect the choice or usage of oral anti-diabetic medications by persons with diabetes.

Overall

Table 5 presents aggregate trends from 1997 to 2007 on the proportion and total number of persons who used each of the three most commonly prescribed classes of oral anti-diabetic medications among persons who reported treatment for diabetes. The total number of persons who used these classes of oral anti-diabetic medications in 1997 and 2007 are as follows: sulfonylureas (5.0 and 7.6 million), biguanides (2.1 and 10.4 million), thiazolidinediones (0.5 and 4.6 million). As these totals indicate within the oral classes of anti-diabetic medications, we find that prescribing trends were shifting away from sulfonylureas towards the use of biguanides and thiazolidinediones. In particular, sulfonylureas (51.2 percent) were the most widely used class of oral anti-diabetics in 1997 compared to biguanides (21.2 percent) or thiazolidinediones (4.7 percent). By 2007, the proportion of persons treated with sulfonylureas had declined to 40.2 percent compared with an increase in the percentage of persons with diabetes using biguanides (55.2 percent) or thiazolidinediones (24.6 percent).

By Selected Population Characteristics

Table 6 presents the percentage and total number of persons with diabetes who used oral anti-diabetic medications in 2006–2007 by selected population characteristics.

Sulfonylureas

Sulfonylureas which include chlorpropamide, glimepiride, glyburide, and glipizide were first approved by the FDA for the treatment of type 2 diabetes in 1955. Sulfonylureas are currently recommended for type 2 diabetes treatment when metformin plus lifestyle modifications are deemed insufficient to reach glycymic goals.

Among persons reporting treatment for diabetes, the proportion of those who reported using sulfonylureas declined by 12.8 percentage points between 1997–1998 and 2006–2007. Among persons reporting treatment for diabetes we find differences in the probability of sulfonylureas use across groups defined by age, race/ethnicity, sex, health insurance status, and education.

Age. Those ages 65 years and above were more likely to be prescribed sulfonylureas (46.2 percent) than older adults ages 45–64 (40.5 percent) and younger adults ages 18–44 (27.1 percent) in 2006–2007. There was a large decrease in the proportion of those 65 years and above and older adults ages 45–64 who reported using sulfonylureas from 1997–1998 to 2006–

2007, but the proportion of younger adults ages 18–44 who reported using sulfonylureas declined only slightly.

Race/ethnicity. Non-Hispanic blacks were less likely to be prescribed sulfonylureas (36.6 percent) than Hispanics (45.6 percent) in 2006–2007. Between 1997–1998 and 2006–2007, the proportion of Hispanics who reported using sulfonylureas dropped just slightly.

Sex. Among those reporting treatment for diabetes, men were more likely to be prescribed sulfonylureas (44.4 percent) than women (37.7 percent) in 2006–2007. We also find a similar drop in the proportion of both men and women who reported using sulfonylureas from 1997–1998 to 2006–2007.

Health insurance status. Among the elderly population (those 65 years and above) in 2006–2007, those covered by Medicare only were more likely to be prescribed sulfonylureas (52.9 percent) than those with a combination of Medicare and private insurance (41.6 percent). Between 1997–1998 and 2006–2007, the proportion of those with a combination of Medicare and private insurance who reported using sulfonylureas declined by 21.0 percentage points while those with Medicare-only declined by 9.1 percentage points.

Education. In 2006–2007, those with less than a high school education and those who graduated from high school were both more likely to be prescribed sulfonylureas (44.0 and 42.6 percent) than those with at least some college education (37.3 percent). Between 1997–1998 and 2006–2007, the proportion of those prescribed sulfonylureas declined for all categories of education in our study.

Biguanides

Biguanides (metformin) were first approved by the FDA for the treatment of type 2 diabetes in 1995 and are currently recommended as first-line therapy for the treatment of type 2 diabetes when lifestyle modifications are deemed insufficient to reach glycemic goals.

Among persons reporting treatment for diabetes, the proportion of those who reported using biguanides rose by 29.9 percentage points between 1997–1998 and 2006–2007. In general, there was an increase in the proportion of persons using biguanides within all subpopulation groups. Among persons reporting treatment for diabetes we find differences in the probability of biguanides use across groups defined by age, race/ethnicity, income, and health insurance status.

Age. Older adults ages 45–64 were more likely to be prescribed biguanides (60.7 percent) in 2006–2007 than younger adults ages 18–44 (48.0 percent) or those 65 years and above (47.6 percent). Between 1997–1998 and 2006–2007, the proportion of younger adults ages 18–44 who reported using biguanides rose by 29.9 percentage points while those 65 years and above rose by 26.3 percentage points.

Race/ethnicity. Non-Hispanic blacks were less likely to be prescribed biguanides (47.4 percent) than Hispanics (56.6 percent), persons of other race/ethnicity groups (56.6 percent), or non-

Hispanic whites (54.2 percent). The proportion of those who reported using biguanides rose between 1997–1998 and 2006–2007 for all race/ethnicity groups.

Income. The poor were less likely to be prescribed biguanides (47.1 percent) than those with high incomes (57.1 percent) or middle incomes (55.2 percent). The proportion of those who reported using biguanides rose from 1997–1998 to 2006–2007; however, the trends were not markedly different within income strata.

Health insurance status. Among the non-elderly population (those less than 65) in 2006–2007, those with private insurance (59.0 percent) were more likely to be prescribed biguanides than those with public insurance (52.1 percent). Among the elderly population (those 65 years and above) in 2006–2007, those covered by a combination of Medicare and private insurance (49.5 percent) were more likely to be prescribed biguanides than those with public insurance (41.0 percent). Between 1997–1998 and 2006–2007, the proportion of those with public and private insurance who reported using biguanides edged upwards but the trends were somewhat similar. The same can be said for the non-elderly population.

Thiazolidinediones

Thiazolidinediones (pioglitazone and rosaglitazone) were first approved by the FDA for the treatment of type 2 diabetes in 1997. Thiazolidinediones are currently recommended as tier 2 treatment options for persons with type 2 diabetes.

Among persons reporting treatment for diabetes, the proportion of those who reported using thiazolidinediones rose by 20.2 percentage points between 1997–1998 and 2006–2007. Among persons reporting treatment for diabetes, we find differences in the probability of thiazolidinediones use across groups defined by age, health insurance status, education, and location.

Age. Older adults ages 45–64 were more likely to be prescribed thiazolidinediones (29.1 percent) in 2006–2007 than younger adults ages 18–44 (20.8 percent). Between 1997–1998 and 2006–2007, the proportion of those 65 years and above and older adults ages 45–64 who reported using thiazolidinediones climbed by 21.2 and 20.3 percentage points respectively, while the proportion of younger adults ages 18–44 rose by 15.4 percentage points.

Health insurance status. Among the non-elderly population (those less than 65) in 2006–2007, those with private insurance were more likely to be prescribed thiazolidinediones (28.7 percent) than those without insurance (19.4 percent). Among the elderly population (those 65 years and above), those with Medicare and private insurance were more likely to be prescribed thiazolidinediones (27.9 percent) than those with Medicare-only insurance (20.8 percent). Between 1997–1998 and 2006–2007, the proportion of those who reported using thiazolidinediones climbed by more than 13.0 percentage points for those with private insurance and those without insurance, as well as those with a combination of Medicare and private insurance and those with private insurance.

Education. Those who graduated from high school were more likely to be prescribed thiazolidinediones (28.9 percent) than those with less than high school education (23.7 percent) in 2006–2007. The proportion of those with less than high school education and those with high school education who reported using thiazolidinediones increased from 1997–1998 to 2006–2007.

Metropolitan statistical area (MSA). Those living within an MSA were less likely to be prescribed thiazolidinediones (25.0 percent) than those living outside an MSA (32.2 percent). The proportion of those living within an MSA and those living outside an MSA who reported using thiazolidinediones increased from 1997–1998 to 2006–2007.

Census region. In 2006–2007, persons with diabetes residing in the southern parts of the U.S. were more likely to be prescribed thiazolidinediones (29.1 percent) than those living in the western parts of the U.S. (23.0 percent). Also, the proportion of those living in the South and West of the U.S. who reported using thiazolidinediones increased during the periods under consideration.

Average Annual Expenditures for Anti-Diabetic Medications

Table 7 presents trends from 1997–1998 to 2006–2007 in per capita, per user, and out-of-pocket expenditures for the classes of anti-diabetic medications in our study. Although the anti-diabetic medications discussed in the previous section act in different ways to control hyperglycemia, they may be used in combination. For example, a biguanide and a sulfonylurea may be used as oral combinations. Thus, in addition to the three major classes of anti-diabetic medications, we present estimates for medications that contain a combination of active ingredients from any two of the oral classes in this section. Expenditures on anti-diabetic medications for all years are expressed in constant dollars by inflating them to 2007 U.S. dollars using the Consumer Price Index-All Urban Consumers for all items averaged across all U.S. cities (CPI-U).

Per Capita Expenditures

In table 7, the top row of the first panel shows that the average annual per capita expenditures on prescribed anti-diabetic medications for 2006–2007 was $838 compared to $439 in 1997–1998. The average annual per capita expenditure for sulfonylureas declined from $160 in 1997–1998 to $77 in 2006–2007. In contrast, the average annual per capita expenditure for insulin rose from $114 in 1997–1998 to $224 in 2006–2007. Similarly, the average annual per capita expenditure for biguanides and thiazolidinediones rose from $90 and $63 in 1997–1998 to $141 and $268 in 2006–2007, respectively. In 2006–2007, the average annual per capita expenditures on incretin mimetics and oral combinations were $48 and $53, respectively.

Per User Expenditures

The middle panel in table 7 presents per user average total expenditures for anti-diabetic medications. The average annual expenditures per user across all types of prescribed anti-diabetic medications for 2006–2007 ($944) was nearly twice that in 1997–1998 ($500). The

middle panel of table 7 also shows that average annual expenditures per user for insulin in 2006–2007 ($918) were more than two-and-half times that in 1997–1998 ($331). In contrast, average annual expenditures per user for sulfonylureas and biguanides declined from $298 and $381 in 1997–1998 to $211 and $297 in 2006–2007, respectively. In 2006–2007, average annual expenditures per user for non-insulin injectables and oral combinations of anti-diabetic drugs were $1,297 and $577, respectively.

Out-of-Pocket Expenditures

The bottom panel in table 7 provides information on per user annual out-of-pocket expenditures for anti-diabetic medications. The average annual out-of-pocket expenditures for all prescribed anti-diabetic medications grew 23.5 percent from $221 in 1997–1998 to $273 in 2006–2007. The bottom panel of table 7 also indicates that out-of-pocket expenditures for insulin nearly doubled for the period, rising from $132 in 1997–1998 to $257 in 2006–2007. During the same period, out-of-pocket expenditures on thiazolidinediones rose from $190 in 1997–1998 to $250 in 2006–2007. In contrast, out-of-pocket expenditures on sulfonylureas and biguanides fell from $167 and $174 in 1997–1998 to $89 and $116 in 2006–2007, respectively. In 2006–2007, out-of-pocket expenditures on non-insulin injectables were $258 and $179 for combination anti-diabetic medications.

Summary and Conclusions

Trends in utilization and expenditures on prescribed anti-diabetic medications are an important health care research concern. [3] This report uses nationally representative data from the MEPS to examine trends in the use of anti-diabetic medications from 1997 through 2007. The sample for our study comprised individuals in the U.S. civilian noninstitutionalized population who reported that they utilized any health services to treat diabetes during the year. [4]

We begin by examining the proportion of individuals who reported treatment for diabetes in 1997 and 2007 as well as diabetes-related complications and comorbidities. We find a large increase in the proportion and total number of persons treated for diabetes in the U.S. We also find increases in several comorbidities, in particular, cardiovascular disease, hypertension, and hyperlipidemia among persons with diabetes. Between 1997–1998 and 2006–2007 the proportion of persons reporting treatment for diabetes increased for all subpopulation groups in our study.

Next, we examine the percentages of persons who used oral anti-diabetic medications, insulin, and non-insulin injectables. Several new classes of anti-diabetic medications (e.g., incretin mimetics and dipeptidyl peptidase-4 inhibitors) were introduced during the period of our study. The introduction of these new classes of anti-diabetic medications expanded the therapeutic options for persons with diabetes, especially for persons with type 2 diabetes. During the period under consideration there was an increase in the proportion and total number of persons using oral anti-diabetic medications which were the most prescribed class of anti-diabetic medications when compared to insulin and non-insulin injectables. Moreover, we find a decrease in the proportion but little change in the number of persons using insulin from 1997 to 2007. This decline may be attributed to the availability of newer classes of anti-diabetic medications such as incretin mimetics or perhaps the increased use of newer and existing oral anti-diabetic medications.

Next, we examine individuals who used at least one of the three most commonly prescribed classes of oral anti-diabetic medications. Beginning in 1995, therapeutic options for persons with type 2 diabetes expanded when biguanides became available in the United States. We find during the study period that prescribing trends have shifted away from sulfonylureas towards the use of biguanides and thiazolidinediones. These trends in anti-diabetic medication usage are somewhat consistent with the changing diabetes treatment paradigm based on the ADA/EASD consensus guidelines algorithm which favors a more aggressive diabetes treatment with biguanides as first-line therapy.

In addition to investigating aggregate trends in drug utilization, we examine differences in anti-diabetic medication use across subgroups of the U.S. diabetes population by pooling data for

[3] Fairly recent studies on diabetes drugs trends include Alexander et al., 2008 and Devin et al., 2009. However, our study differs from these studies in that we are able to present detailed information by socioeconomic, demographic, and geographic factors using nationally representative data.

[4] Health services utilization refers to the following: home health, inpatient hospital stays, outpatient, office-based, emergency room visits, and prescribed medicines.

1997–1998 and 2006–2007. We find that those with public insurance, those with less than high school education, and persons 65 years or older, were more likely to report treatment for diabetes. There were no statistically significant differences between males and females during the 2006–2007 period. We also find that persons with more years of education and persons with high and middle incomes were more likely to use the newer classes of anti-diabetic medications.

Finally, we examine average annual per capita, per user, and out-of-pocket expenditures for each class of anti-diabetic medication using pooled data for 1997–1998 and 2006–2007. We find that average annual expenditures on anti-diabetic medication nearly doubled for the period of our analysis. Average annual out-of-pocket expenditures on prescribed anti-diabetic medications increased only slightly between 1997–1998 and 2006–2007. The increased expenditures on anti-diabetic medications for the period under review could be attributed partly to increased utilization of existing anti-diabetic medication or simply technological innovations; availability and increasing use of combination therapy as well as the availability and increasing use of newer and more expensive classes of anti-diabetic medications.

A limitation of our study is that in our analysis of trends in prescribed anti-diabetic medication we do not distinguish between the different types of diabetes. Evidence suggests that anti-diabetic medication usage and expenditures between individuals with type 1 and type 2 diabetes may not be similar (Johnson et al., 2006; Dall et al., 2009). Understanding these differences in anti-diabetic medications trends could be useful in customizing or making appropriate policy recommendations in this disease area.

Despite this limitation, our study provides an improved picture of national trends in anti-diabetic medication utilization and expenditures. It highlights the growing shift away from sulfonylureas towards the use of biguanides to treat hyperglycemia. Our report also provides information on the swift diffusion of the newer and relatively expensive classes of anti-diabetic medications such as incretin mimetics. Given upward trends in the prevalence of diabetes, demographic shifts, increasingly complex disease management, as well as anticipated newer and more expensive anti-diabetic technologies, it seems likely that the importance of trends in utilization and expenditures on anti-diabetic medications will continue to grow.

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Table 1: Percentage and total number of persons reporting treatment for diabetes and comorbid conditions, 1997 to 2007

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Population size (millions)	271.3	273.5	276.4	278.4	284.2	288.2	290.6	293.5	296.2	299.3	301.3
Population reporting diabetes											
Percentage	3.6	3.9	4.1	4.2	4.4	4.7	4.8	5.3	5.6	5.9	6.3
Number in millions	9.8	10.6	11.4	11.7	12.6	13.6	13.8	15.5	16.5	17.6	18.9
Among persons reporting diabetes, percentage reporting:											
Cardiovascular disease	13.1	12.4	12.3	12.5	10.3	11.4	13.1	11.4	12.4	12.4	17.2
Hypertension	46.1	46.6	48.2	50.5	49.7	54.4	57.1	57.5	59.2	59.9	64.8
Cerebrovascular disease	5.3	3.6	4.8	4.5	3.5	3.8	3.9	3.9	3.9	3.3	4.4
Peripheral vascular disease	0.3	0.1	0.1	0.1	0.2	0.3	0.1	0.3	0.6	0.5	0.8
Nephropathy	1.4	1.0	1.1	0.9	1.3	1.8	1.8	2.5	2.2	1.9	1.3
Retinopathy	1.7	1.7	1.3	1.5	1.4	1.8	2.4	2.2	2.1	2.4	2.1
Hyperlipidemia	15.0	15.9	20.2	24.7	26.2	31.5	35.7	40.0	43.5	45.3	52.8

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

Table 2: Percentage and total number of persons reporting treatment for diabetes, by selected population characteristics, 1997–1998 and 2006–2007

	1997-1998			2006-2007		
	Total population (in millions)	Total reporting diabetes (in millions)	Percentage reporting diabetes	Total population (in millions)	Total reporting diabetes (in millions)	Percentage reporting diabetes
Total	272.4	10.2	3.8	300.3	18.2	6.1
Age in years						
0 to 17	72.2	0.1	0.1	74.0	0.1	0.2
18 to 44	108.8	1.3	1.2	111.1	2.2	2.0
45 to 64	57.2	4.1	7.3	76.9	8.5	11.0
65 and over	34.2	4.7	13.7	38.3	7.4	19.4
Race/ethnicity[1]						
White	195.7	7.4	3.8	197.3	12.0	6.1
Black	34.3	1.5	4.3	36.5	2.8	7.6
Other	10.9	0.3	2.4	20.7	1.1	5.3
Hispanic	31.6	1.1	3.6	45.8	2.4	5.3
Sex						
Male	133.1	4.8	3.6	147.3	8.9	6.0
Female	139.3	5.4	3.9	153.0	9.4	6.1
Income						
Poor/negative	35.9	1.6	4.4	37.8	2.6	6.9
Near poor	11.9	0.5	4.2	13.5	1.1	8.5
Low income	37.8	1.9	5.1	40.5	2.9	7.1
Middle income	89.2	3.5	3.9	93.3	5.4	5.8
High income	97.7	2.8	2.8	115.2	6.2	5.4
Health insurance status						
Less than 65						
Any private	177.0	3.7	2.1	182.7	7.4	4.0
Public only	28.3	1.2	4.1	40.6	2.2	5.5
Uninsured	32.8	0.7	2.0	38.6	1.2	3.1
65 and over						
Medicare only	9.3	1.2	13.1	12.4	2.4	19.7
Medicare and private	20.6	2.7	13.1	20.9	3.7	17.9
Medicare and other public	3.8	0.7	19.0	4.4	1.2	26.9
Education						
Less than high school	47.2	3.5	7.4	53.1	4.8	9.1
High school	87.1	3.4	4.0	88.7	6.1	6.9
At least some college	137.5	3.2	2.3	156.6	7.1	4.5
Metropolitan statistical area (MSA)						
MSA	217.3	7.6	3.5	251.5	14.5	5.8
Non-MSA	52.4	2.3	4.4	48.7	3.7	7.6
Census region						
Northeast	52.4	1.8	3.5	54.7	3.5	6.3
Midwest	63.5	2.2	3.5	66.0	3.8	5.8
South	95.2	4.4	4.6	109.7	7.2	6.6
West	61.3	1.8	3.0	69.8	3.7	5.3

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

[1] Beginning in 2002, the data reflect whether the respondents wanted to identify with multiple races. The race/ethnicity characteristics for 2003 actually reflect Hispanic; non-Hispanic, white, no other race indicated; non-Hispanic, black, no other race indicated; and non-Hispanic, other single races and multiple races. Hence, estimates by race/ethnicity for 2003 are not directly comparable to those in previous years (i.e., 1997–2001 versus 2002–2007).

Table 3: Percentage of persons using oral medications, insulin, or non-insulin injectables, among persons reporting treatment for diabetes, 1997–2007

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Population reporting diabetes (millions)	9.8	10.6	11.4	11.7	12.6	13.6	13.8	15.5	16.5	17.6	18.9
Among persons reporting diabetes, percentage using:											
Orals[1]	59.9	68.3	68.4	69.8	70.2	70.5	72.8	72.9	73.6	76.3	77.3
Insulin[2]	38.2	31.2	33.2	33.7	32.3	30.7	29.4	28.4	27.2	24.5	24.4
Non-insulin Injectables[3]									0.6	3.3	4.1

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

[1]Oral medications include sulfonylureas, biguanides, thiazolidinediones, meglitinides, alpha-glucosidase inhibitors, and dipeptidyl peptidase-4 inhibitors.

[2]Insulins include all types of insulin.

[3]Non-insulin injectables such as incretin mimetics or glucagon-like peptide analogues and agonists include exenatide, liraglutide, and pramlintide. These were first approved for the treatment of diabetes by the U.S. Food and Drug Administration in 2005.

Table 4: Percentage of persons using oral medications, insulin, or non-insulin injectables, among persons reporting treatment for diabetes, by selected population characteristics, 1997–1998 and 2006–2007

	Orals[1]		Insulin[2]		Non-insulin Injectables[3]	
	1997-1998	2006-2007	1997-1998	2006-2007	1997-1998	2006-2007
Total	64.2	76.8	34.5	24.4		3.7
Age in years						
0 to 17	a	a	a	a		a
18 to 44	43.6	62.9	47.0	32.3		2.9
45 to 64	67.5	79.8	35.0	23.7		5.6
65 and over	68.4	78.3	29.5	22.3		1.9
Race/ethnicity[4]						
White	66.2	76.9	32.5	23.4		4.6
Black	54.5	72.2	46.2	31.8		2.1
Other	75.6	76.9	25.5	23.5		3.0
Hispanic	61.5	81.3	34.5	21.3		1.2
Sex						
Male	68.0	77.6	31.4	25.1		3.0
Female	60.9	76.0	37.3	23.8		4.4
Income						
Poor/negative	53.3	73.9	44.9	27.7		1.1
Near poor	62.5	72.0	34.9	25.5		0.5
Low income	63.7	77.6	35.9	24.7		2.2
Middle income	67.5	77.7	32.0	24.2		4.9
High income	67.1	77.8	30.7	22.9		5.1
Health insurance status						
Less than 65						
Any private	62.8	77.0	34.6	23.8		6.5
Public only	52.5	71.6	51.6	35.3		2.2
Uninsured	63.6	76.4	39.7	21.4		0.7
65 and over						
Medicare only	69.7	79.6	27.6	19.3		1.8
Medicare and private	69.1	78.7	28.9	23.9		1.9
Medicare and other public	63.8	75.1	35.3	23.9		2.0
Education						
Less than high school	65.2	75.9	34.8	24.0		1.2
High school	65.6	78.4	34.7	26.4		4.0
At least some college	61.5	75.9	34.4	23.0		5.2
Metropolitan statistical area (MSA)						
MSA	66.5	76.6	31.5	24.5		3.7
Non-MSA	61.5	77.6	43.0	24.3		3.9
Census region						
Northeast	72.2	77.6	28.1	24.1		3.5
Midwest	58.9	73.7	40.3	27.1		2.8
South	63.3	77.9	34.4	23.7		4.2
West	65.1	77.2	34.0	23.4		3.9

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

[a] Insufficient data to support reliable estimates.

[1] Oral medications include sulfonylureas, biguanides, thiazolidinediones, meglitinides, alpha-glucosidase inhibitors and dipeptidyl peptidase-4 inhibitors.

[2] Insulins include all types of insulin.

[3] Non-insulin injectables such as incretin mimetics or glucagon-like peptide analogues and agonists include exenatide, liraglutide, and pramlintide. These were first approved for the treatment of diabetes by the U.S. Food and Drug Administration in 2005.

[4] Beginning in 2002, the data reflect whether the respondents wanted to identify with multiple races. The race/ethnicity characteristics for 2003 actually reflect Hispanic; non-Hispanic, white, no other race indicated; non-Hispanic, black, no other race indicated; and non-Hispanic, other single races and multiple races. Hence, estimates by race/ethnicity for 2003 are not directly comparable to those in previous years (i.e., 1997–2001 versus 2002–2007).

Table 5: Percentage of persons using specific classes of oral medications[1], among persons reporting treatment for diabetes, 1997 to 2007

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Population reporting diabetes (millions)	9.8	10.6	11.4	11.7	12.6	13.6	13.8	15.5	16.5	17.6	18.9
Among persons reporting diabetes, percentage using:											
Sulfonylureas	51.2	56.2	54.1	48.2	46.7	44.8	45.6	43.3	42.5	41.8	40.2
Biguanides	21.2	25.9	32.1	38.0	36.0	41.8	46.7	47.6	47.6	52.0	55.2
Thiazolidinediones	4.7	7.7	8.4	16.4	18.6	19.7	24.2	26.0	26.9	28.5	24.6

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

[1] Specific classes of oral medications refers to the three most commonly used therapeutic classes: sulfonylureas, biguanides, and thiazolidinediones.

Table 6: Percentage of persons using specific classes of oral medications[1], among persons reporting treatment for diabetes, by selected population characteristics, United States, 1997–1998 and 2006–2007

	Sulfonylureas		Biguanides		Thiazolidinediones	
	1997-1998	2006-2007	1997-1998	2006-2007	1997-1998	2006- 2007
Total	53.8	41.0	23.7	53.6	6.3	26.5
Age in years						
0 to 17	a	a	a	a	a	a
18 to 44	30.1	27.1	18.1	48.0	5.4	20.8
45 to 64	53.5	40.5	28.6	60.7	8.8	29.1
65 and over	61.8	46.2	21.3	47.6	4.4	25.6
Race/ethnicity[2]						
White	56.3	40.8	24.7	54.2	6.5	26.9
Black	42.6	36.6	16.3	47.4	7.9	26.1
Other	70.1	43.8	34.8	56.6	a	23.4
Hispanic	48.3	45.6	23.4	56.6	4.2	26.3
Sex						
Male	58.3	44.4	24.0	53.9	6.9	26.7
Female	49.9	37.7	23.4	53.4	5.7	26.3
Income						
Poor/negative	42.5	41.9	18.5	47.1	6.3	24.9
Near poor	52.1	43.2	19.1	48.1	3.1	25.4
Low income	55.9	44.1	22.8	51.2	4.0	23.5
Middle income	58.2	41.0	25.8	55.2	7.2	27.4
High income	53.7	38.7	25.4	57.1	7.2	28.0
Health insurance status						
Less than 65						
Any private	48.6	36.7	28.3	59.0	8.7	28.7
Public only	39.7	37.0	19.9	52.1	6.6	26.0
Uninsured	51.8	42.2	21.3	60.6	5.7	19.4
65 and over						
Medicare only	62.0	52.9	14.6	48.0	4.4	20.8
Medicare and private	62.6	41.6	24.9	49.5	4.4	27.9
Medicare and other public	57.8	48.2	18.9	41.0	4.2	27.8
Education						
Less than high school	55.1	44.0	21.4	52.1	5.4	23.7
High school	55.7	42.6	26.0	53.3	5.1	28.9
At least some college	50.0	37.3	24.1	55.2	8.5	26.4
Metropolitan statistical area (MSA)						
MSA	55.3	41.3	25.3	53.8	6.0	25.0
Non-MSA	52.5	39.7	19.8	52.8	7.5	32.2
Census region						
Northeast	62.0	39.4	26.1	52.4	6.6	26.8
Midwest	49.6	41.9	22.7	52.8	6.6	24.5
South	51.8	41.4	22.6	53.0	6.3	29.1
West	55.8	40.8	25.0	56.7	5.4	23.0

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

[a] Insufficient data to support reliable estimates.

[1] Specific classes of oral medications refers to the three most commonly used therapeutic classes: sulfonylureas, biguanides, and thiazolidinediones.

[2] Beginning in 2002, the data reflect whether the respondents wanted to identify with multiple races. The race/ethnicity characteristics for 2003 actually reflect Hispanic; non-Hispanic, white, no other race indicated; non-Hispanic, black, no other race indicated; and non-Hispanic, other single races and multiple races. Hence, estimates by race/ethnicity for 2003 are not directly comparable to those in previous years (i.e., 1997–2001 versus 2002–2007).

Table 7: Average per capita, per user, and out-of-pocket expenditures[1] for anti-diabetic drugs among persons reporting treatment for diabetes, United States, 1997–1998 and 2006–2007

	1997-1998	2006-2007
Population reporting diabetes (millions)	10.2	18.2
	Per capita total expenditures	
Drug Class		
All therapeutic classes[2]	$439	$838
Sulfonylureas	$160	$77
Biguanides	$90	$141
Thiazolidinediones	$63	$268
Insulin	$114	$224
Non-insulin injectables[3]	$0	$48
Combinations[4]	$0	$53
	Per user total expenditures	
Drug Class		
All therapeutic classes[2]	$500	$944
Sulfonylureas	$298	$211
Biguanides	$381	$297
Thiazolidinediones	$1,013	$1,121
Insulin	$331	$918
Non-insulin injectables [3]	a	$1,297
Combinations[4]	a	$577
	Out-of-pocket expenditures	
Drug Class		
All therapeutic classes[2]	$221	$273
Sulfonylureas	$167	$89
Biguanides	$174	$116
Thiazolidinediones	$190	$250
Insulin	$132	$257
Non-insulin injectables [3]	a	$258
Combinations[4]	a	$179

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality; Medical Expenditure Panel Survey, 1997–2007

[a] Insufficient data to support reliable estimates.

[1] Drug expenditures for all years are CPI-U adjusted to 2007 U.S. dollars.

[2] In addition to the classes in the table, all therapeutic classes include meglitinides, alpha-glucosidase inhibitors and dipeptidyl peptidase-4 inhibitors.

[3] Non-insulin injectables such as incretin mimetics or glucagon-like peptide analogues and agonists include exenatide, liraglutide, and pramlintide. These were first approved for the treatment of diabetes by the U.S. Food and Drug Administration in 2005.

[4] Combination drugs include two or more of the listed oral classes.

Technical Appendix

The data used in this report were obtained from interviews conducted as part of the Household Component of the Medical Expenditure Panel Survey (MEPS) for 1997–2007. MEPS is an ongoing, annual survey of the U.S. civilian noninstitutionalized population. MEPS collects detailed information on health care use and expenditures (including sources of payment); health insurance; and health status, access, and quality. It also collects detailed demographic and economic information on the persons and households surveyed. More information about MEPS can be found at http://www.meps.ahrq.gov. For a detailed description of the survey and its methodology, also see J. Cohen (1997) and S. Cohen (1997, 2000).

Survey Design

Each year, the MEPS sample is drawn from households that completed the prior year's National Health Interview Survey (NHIS). Households selected for participation in the 1996 MEPS completed interviews in the 1995 NHIS, the 1997 MEPS sample was drawn from the 1996 NHIS, and so on. Because NHIS is used as a sampling frame, the MEPS design is not only nationally representative of the U.S. civilian noninstitutionalized population but also includes an oversampling of Hispanics and blacks. MEPS collects data in an overlapping panel design. Each household completes five interviews ("rounds" of data collection) over a period of two-and-a-half years, providing data for two full calendar years of estimates. Data from Rounds 1, 2, and 3 provide information for the first year of estimation, and data from Rounds 3, 4, and 5 provide data for the second year of estimates. For example, estimates for 2001 are derived by combining Rounds 3, 4, and 5 of the 2000 panel and Rounds 1, 2, and 3 of the 2001 panel.

Definitions

Persons with diabetes and diabetes-related conditions: Individuals with diabetes and related complications/comorbidities were identified using the 1997 through 2007 MEPS Condition Files and the three-digit ICD-9-CM diagnosis condition variable (ICD9CODX) to construct indicator variables for specified conditions.

Conditions	ICD-9-CM Diagnosis
Diabetes Mellitus	ICD-9 codes 249, 250
Cardiovascular Disease	ICD-9 codes 412, 413, 414, 427, and 428
Hypertension	ICD-9 code 401
Cerebrovascular Disease	ICD-9 codes 430, 431, 432, 433, 434, 435, 436, and 437
Peripheral Vascular Disease	ICD-9 code 443
Nephropathy	ICD-9 codes 585, 586, and 587
Retinopathy	ICD-9 code 362
Hyperlipidemia	ICD-9 code 272

Persons reporting treatment for diabetes: We identified persons who reported treatment for diabetes within our sample by tying the diabetes diagnosis to reported health services utilization (i.e., home health, inpatient hospital stays, outpatient, office-based, emergency room visits, and prescribed medicines) for the condition during the year.

Anti-diabetic medications: Each drug that was listed as purchased or otherwise obtained in the MEPS Prescribed Medicines (PMED) Files was assigned to therapeutic classes by linking the PMED file to the Multum Lexicon database, a product of Cerner Multum, Inc. The Multum therapeutic classification system is designed to replicate the type of organizational schemes used in practice by physicians and pharmacists. This information was used to identify the three major therapeutic classes of anti-diabetic medications considered in the report. That is orals (sulfonylureas, biguanides, thiazolidinediones, meglitinides, alpha-glucosidase inhibitors, dipeptidyl peptidase-4 inhibitors), insulin, incretin mimetics as well as combinations of oral therapies.

Utilization: Indicator variables were created to identify people who received each of the three major therapeutic classes of anti-diabetic medications, the top three classes of oral anti-diabetic medications and their combinations. If combination therapy was indicated, the drug names were examined and the person was identified as having had each medication comprising the combination therapy. For example, if a person had combination therapy and the agents were of the sulfonylurea and biguanide classes, the person was identified as having had each of the individual oral medications. Utilization estimates are presented as the proportion of persons receiving each of the classes of anti-diabetic medication.

Expenditures: Expenditures include all amounts paid for each drug purchase from any source including payments by individuals and their families and payments by private insurance, Medicaid, Medicare, and other types of insurance. Payments for over-the-counter drugs, indirect payments not related to specific medical events, such as Medicaid Disproportionate Share and Medicare Direct Medical Education subsidies, are excluded from the MEPS total expenditures. Expenditures for each year were adjusted using the Consumer Price Index (CPI) and all estimates in this report are reported in 2007 dollars.

Age: In this report, age is the last available age for the sampled person.

Race/ethnicity: Classification by race and ethnicity was based on information provided by the household respondent for each household member. From 1997 to 2001, the respondent was asked if each person's race was best described as black, white, Asian or Pacific Islander, American Indian, or Alaska Native. Beginning in 2002, the respondent was able to describe each person's race by specifying any combination of races that applied (i.e., multiracial). In all years, respondents were asked if each person's main national origin or ancestry was Puerto Rican, Cuban, Mexican, Mexicano, Mexican American, or Chicano; other Latin American; or other Spanish. Persons claiming a main national origin or ancestry in one of these Hispanic groups, regardless of racial background, were classified as Hispanic. Since the Hispanic grouping can include persons of any race, the race categories of black, white, and

other exclude Hispanics. The other category includes people with single races other than white and black as well as people who report multiple races.

Education: All adults (those ages 19 and older) were assigned the number of years of education completed and reported in the MEPS. All children (those ages 18 and under) were assigned the highest education level within the family, based on Health Insurance Eligibility Units (HIEU). HIEUs comprise adults, their spouses, and their unmarried natural/adoptive children age 18 and under as well as children under age 24 who are full-time students (living at home or away from home), who would typically be eligible for coverage under the adults' private health insurance family plans.

Income: In MEPS, personal income from all household members is summed to create family income. Potential sources of income include annual earnings from wages, salaries, bonuses, tips, and commissions; business and farm gains and losses; unemployment and Workers' Compensation payments; interest and dividends; alimony, child support, and other private cash transfers; private pensions; individual retirement account (IRA) withdrawals; Social Security and Department of Veterans Affairs payments; Supplemental Security Income and cash welfare payments from public assistance, TANF (Temporary Assistance for Needy Families; formerly known as Aid to Families with Dependent Children, or AFDC); gains or losses from estates, trusts, partnerships, S corporations, rent, and royalties; and a small amount of "other" income.

Individuals were classified according to their family's income in terms of poverty status. In this report, poverty status is the ratio of the family's income to the Federal poverty thresholds, which control for the size of the family and the age of the head of the family. The following classification of poverty status was used:

- *Poor or negative income*: Persons in families with income of 100 percent of the poverty line or less, including those who reported negative income.
- *Near poor*: Persons in families with income from over 100 percent through 125 percent of the poverty line or less.
- *Low income*: Persons in families with income from over 125 percent through 200 percent of the poverty line.
- *Middle income*: Persons in families with income from over 200 percent through 400 percent of the poverty line.
- *High income*: Persons in families with income over 400 percent of the poverty line.

Health insurance status: Individuals under age 65 were classified in the following three insurance categories, based on household responses to health insurance status questions:

- *Any private health insurance*: Individuals who, at any time during the year, had insurance that provides coverage for hospital and physician care (other than Medicare, Medicaid, or other public hospital/physician coverage) were classified as having private insurance. Coverage by TRICARE (Armed Forces–related coverage) was also included as private health insurance. Insurance that provides coverage for a single service only, such as dental or vision coverage, was not included.

- *Public coverage only*: Individuals were considered to have public coverage only if they met both of the following criteria: 1) they were not covered by private insurance at any time during the year, and 2) they were covered by one of the following public programs at any point during the year: Medicare, Medicaid, or other public hospital/physician coverage.
- *Uninsured*: The uninsured were defined as people not covered by private hospital/physician insurance, Medicare, TRICARE, Medicaid, or other public hospital/physician programs at any time during the entire year or period of eligibility for the survey.

For individuals 65 and older, the following insurance categories were used:

- *Medicare plus private (including TRICARE)*: Individuals who at any time during the year were covered by TRICARE or a supplemental private insurance policy in addition to Medicare.
- *Medicare plus other public coverage*: Individuals were considered to have Medicare plus other public coverage if they met both of the following criteria: 1) they were not covered by TRICARE or a supplemental private policy at any time during the year 2) they were covered by Medicaid or other public hospital/physician coverage in addition to Medicare.
- *Medicare HMO/Medicare only*: This group includes adults who did not report any private or public supplemental insurance coverage and were enrolled in Medicare HMOs or had Medicare fee-for-service coverage only. For analytic purposes this classification also includes a very small number of persons ages 65 and over who did not report Medicare coverage.

Metropolitan statistical area (MSA): Individuals were identified as residing either inside or outside an MSA as designated by the U.S. Office of Management and Budget, which applied 1990 standards using population counts from the 1990 U.S. Census. An MSA is a large population nucleus combined with adjacent communities that have a high degree of economic and social integration with the nucleus. Each MSA has one or more central counties containing the area's main population concentration. In New England, metropolitan areas consist of cities and towns rather than whole counties.

Census region: Each MEPS sampled person was classified as living in one of the following four regions as defined by the U.S. Census Bureau:

- *Northeast*: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania.
- *Midwest*: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, South Dakota, North Dakota, Nebraska, and Kansas.
- *South*: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas.

- *West*: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, and Hawaii.

Sample Design and Accuracy of Estimates

The statistics presented in this report are affected by both sampling error and sources of non-sampling error, which include non-response bias, respondent reporting errors, interviewer effects, and data processing misspecifications. The MEPS person-level estimation weights include non-response adjustments and post-stratification adjustments to population estimates derived from the Current Population Survey based on cross-classifications by region, MSA, age, race/ethnicity, and sex. The overall MEPS response rate reflects response to both the MEPS and NHIS interviews. The sample size and annual response rates are below.

Calendar year	Sample size	Pooled annual response rate
1997	32,636	66.4
1998	22,953	67.9
1999	23,565	64.3
2000	23,839	65.8
2001	32,122	66.3
2002	37,418	64.7
2003	32,681	64.5
2004	32,737	63.1
2005	32,320	61.3
2006	32,577	58.3
2007	29,370	56.9

Rounding

Because of rounding and some missing data, some of the subpopulation estimates presented in the tables will not sum exactly to the overall population total. Standard errors are presented in tables **A–G**.

Standard Error Tables

Table A: Standard errors for percentage and total number of persons reporting treatment for diabetes and comorbid conditions, 1997 to 2007

Corresponds to Table 1

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Population size (millions)	6.8	8.2	14.6	12.1	10.2	6.9	7.5	8.4	8.5	8.9	6.5
Population reporting diabetes											
Percentage	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Number in millions	0.4	0.5	0.7	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.6
Among persons reporting diabetes, percent reporting:											
Cardiovascular disease	1.1	1.4	1.4	1.1	0.9	0.8	1.0	1.0	1.0	1.0	1.1
Hypertension	1.9	2.0	1.6	1.7	1.6	1.4	1.5	1.5	1.5	1.5	1.3
Cerebrovascular disease	0.7	0.8	0.8	0.8	0.6	0.5	0.5	0.6	0.5	0.5	0.6
Peripheral vascular disease	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2
Nephropathy	0.3	0.3	0.4	0.3	0.3	0.4	0.4	0.5	0.5	0.3	0.3
Retinopathy	0.5	0.5	0.4	0.5	0.3	0.4	0.4	0.4	0.4	0.5	0.4
Hyperlipidemia	1.3	1.5	1.6	1.6	1.5	1.5	1.4	1.6	1.5	1.5	1.3

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

Table B: Standard errors for percentage and total number of persons reporting treatment for diabetes, by selected population characteristics, 1997–1998 and 2006–2007

Corresponds to Table 2

	1997-1998			2006-2007		
	Total population (in millions)	Total reporting diabetes (in millions)	Percentage reporting diabetes	Total population (in millions)	Total reporting diabetes (in millions)	Percentage reporting diabetes
Total	7.1	0.4	0.1	7.3	0.5	0.1
Age in years						
0 to 17	2.0	0.0	0.0	2.2	0.0	0.0
18 to 44	3.2	0.1	0.1	3.1	0.1	0.1
45 to 64	1.8	0.2	0.4	1.9	0.3	0.3
65 and over	1.1	0.3	0.6	1.0	0.3	0.7
Race/ethnicity[1]						
White	6.0	0.4	0.2	5.5	0.5	0.2
Black	1.8	0.1	0.4	1.5	0.2	0.4
Other	1.0	0.1	0.5	1.3	0.1	0.5
Hispanic	2.0	0.1	0.3	2.3	0.2	0.3
Sex						
Male	3.7	0.3	0.2	3.6	0.3	0.2
Female	3.5	0.3	0.2	3.8	0.3	0.2
Income						
Poor/negative	1.5	0.1	0.3	1.2	0.1	0.3
Near poor	0.6	0.0	0.4	0.5	0.1	0.6
Low income	1.3	0.1	0.3	1.2	0.2	0.4
Middle income	2.6	0.2	0.2	2.6	0.2	0.2
High income	3.5	0.2	0.2	3.9	0.3	0.2
Health insurance status						
Less than 65						
Any private	5.4	0.2	0.1	5.2	0.3	0.1
Public only	1.2	0.1	0.3	1.3	0.1	0.3
Uninsured	1.2	0.1	0.2	1.3	0.1	0.2
65 and over						
Medicare only	0.4	0.1	1.1	0.5	0.2	1.2
Medicare and private	0.8	0.2	0.8	0.7	0.2	0.8
Medicare and other public	0.3	0.1	2.0	0.2	0.1	1.9
Education						
Less than high school	1.8	0.2	0.4	1.7	0.2	0.4
High school	2.3	0.2	0.2	2.3	0.3	0.3
At least some college	4.5	0.2	0.2	4.8	0.3	0.2
Metropolitan statistical area (MSA)						
MSA	6.7	0.4	0.2	7.3	0.5	0.2
Non-MSA	2.5	0.2	0.3	2.8	0.3	0.4
Census region						
Northeast	2.6	0.2	0.4	2.4	0.2	0.3
Midwest	2.8	0.2	0.2	3.1	0.2	0.3
South	4.1	0.3	0.3	4.2	0.4	0.3
West	4.3	0.2	0.3	4.3	0.2	0.2

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

[1] Beginning in 2002, the data reflect whether the respondents wanted to identify with multiple races. The race/ethnicity characteristics for 2003 actually reflect Hispanic; non-Hispanic, white, no other race indicated; non-Hispanic, black, no other race indicated; and non-Hispanic, other single races and multiple races. Hence, estimates by race/ethnicity for 2003 are not directly comparable to those in previous years (i.e., 1997–2001 versus 2002–2007).

Table C: Standard errors for percentage of persons using oral medications, insulin, or non-insulin injectables among persons reporting treatment for diabetes, 1997–2007

Corresponds to Table 3

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Population reporting diabetes (millions)	0.4	0.5	0.7	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.6
Among persons reporting diabetes, percentage using:											
Orals[1]	1.7	1.9	1.7	1.5	1.5	1.2	1.5	1.3	1.3	1.0	1.0
Insulin[2]	1.7	1.8	1.7	1.8	1.5	1.4	1.5	1.3	1.2	1.2	1.1
Non-insulin injectables [3]									0.2	0.6	0.7

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

[1]Oral medications include sulfonylureas, biguanides, thiazolidinediones, meglitinides, alpha-glucosidase inhibitors and dipeptidyl peptidase-4 inhibitors.

[2]Insulins include all types of insulin.

[3] Non-insulin injectables such as incretin mimetics or glucagon-like peptide analogues and agonists include exenatide, liraglutide, and pramlintide. These were first approved for the treatment of diabetes by the U.S. Food and Drug Administration in 2005.

Table D: Standard errors for percentage of persons using oral medications, insulin, or non-insulin injectables among persons reporting treatment for diabetes, by selected population characteristics, 1997–1998 and 2006–2007

Corresponds to Table 4

	Orals[1]		Insulin[2]		Non-insulin Injectables[3]	
	1997-1998	2006-2007	1997-1998	2006-2007	1997-1998	2006-2007
Total	1.5	0.8	1.5	1.0		0.6
Age in years						
0 to 17	a	a	a	a		a
18 to 44	3.8	2.9	3.9	2.7		1.0
45 to 64	2.0	1.2	2.2	1.4		1.0
65 and over	2.1	1.5	2.1	1.4		0.5
Race/ethnicity[4]						
White	1.8	1.1	1.9	1.3		0.8
Black	3.2	1.8	3.5	2.0		0.7
Other	6.8	3.8	7.2	3.9		1.3
Hispanic	2.8	1.8	2.9	2.0		0.4
Sex						
Male	1.9	1.3	2.1	1.5		0.6
Female	2.1	1.3	2.1	1.2		0.8
Income						
Poor/negative	3.0	2.2	3.0	1.9		0.4
Near poor	5.2	3.3	5.2	3.2		0.3
Low income	3.4	1.9	3.5	2.0		0.7
Middle income	2.4	1.6	2.6	1.5		0.9
High income	2.7	1.4	2.8	1.7		1.1
Health insurance status						
Less than 65						
Any private	2.4	1.3	2.3	1.5		1.1
Public only	3.4	2.5	3.5	2.5		0.7
Uninsured	5.6	3.1	5.9	3.1		0.5
65 and over						
Medicare only	3.7	2.5	3.8	2.0		1.0
Medicare and private	2.9	1.9	2.7	2.3		0.7
Medicare and other public	4.5	3.1	4.9	2.6		1.0
Education						
Less than high school	2.4	1.7	2.1	1.6		0.3
High school	2.2	1.4	2.8	1.6		0.8
At least some college	2.9	1.5	2.9	1.8		1.1
Metropolitan statistical area (MSA)						
MSA	1.6	1.0	1.6	1.1		0.7
Non-MSA	3.0	1.9	3.5	2.1		1.0
Census region						
Northeast	2.8	2.3	2.9	2.6		1.3
Midwest	3.0	1.9	3.6	2.0		0.7
South	2.4	1.2	2.3	1.5		1.0
West	3.0	1.9	3.2	1.7		1.2

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

[a] Insufficient data to support reliable estimates.

[1] Oral medications include sulfonylureas, biguanides, thiazolidinediones, meglitinides, alpha-glucosidase inhibitors, and dipeptidyl peptidase-4 inhibitors.

[2] Insulins include all types of insulin.

[3] Non-insulin injectables such as incretin mimetics or glucagon-like peptide analogues and agonists include exenatide, liraglutide, and pramlintide. These were first approved for the treatment of diabetes by the U.S. Food and Drug Administration in 2005.

[4] Beginning in 2002, the data reflect whether the respondents' wanted to identify with multiple races. The race/ethnicity characteristics for 2003 actually reflect Hispanic; non-Hispanic, white, no other race indicated; non-Hispanic, black, no other race indicated; and non-Hispanic, other single races and multiple races. Hence, estimates by race/ethnicity for 2003 are not directly comparable to those in previous years (i.e., 1997–2001 versus 2002–2007).

Table E: Standard errors for percentage of persons using specific classes of oral anti-diabetic medications[1] among persons reporting treatment for diabetes, 1997 to 2007

Corresponds to Table 5

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Population reporting diabetes (millions)	0.4	0.5	0.7	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.6
Among persons reporting diabetes, percentage using:											
Sulfonylureas	1.6	2.1	1.9	1.8	1.8	1.5	1.6	1.4	1.4	1.3	1.2
Biguanides	1.5	1.7	1.6	1.6	1.5	1.3	1.5	1.5	1.5	1.3	1.3
Thiazolidinediones	0.8	1.0	1.0	1.2	1.1	1.2	1.3	1.3	1.3	1.2	1.0

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

[1]Specific classes of oral anti-diabetic medications restricted to the three most commonly used therapeutic classes: sulfonylureas, biguanides, and thiazolidinediones.

Table F: Standard errors for percentage of persons using specific classes of oral anti-diabetic medications[1] among persons reporting treatment for diabetes, by selected population characteristics, United States, 1997–1998 and 2006–2007

Corresponds to Table 6

	Sulfonylureas		Biguanides		Thiazolidinediones	
	1997-1998	2006-2007	1997-1998	2006-2007	1997-1998	2006- 2007
Total	1.5	1.0	1.4	1.1	0.7	0.9
Age in years						
0 to 17	a	a	a	a	a	a
18 to 44	3.3	2.7	3.4	2.9	1.7	2.6
45 to 64	2.2	1.6	2.2	1.5	1.3	1.6
65 and over	2.2	1.8	2.1	1.9	0.9	1.5
Race/ethnicity[2]						
White	1.9	1.4	1.7	1.5	1.0	1.3
Black	3.7	2.2	2.0	2.3	1.7	2.4
Other	7.4	4.5	10.8	3.9	a	3.6
Hispanic	2.9	2.4	2.7	2.5	1.2	2.5
Sex						
Male	2.1	1.5	2.1	1.4	1.1	1.5
Female	2.1	1.5	1.7	1.5	0.9	1.2
Income						
Poor/negative	3.2	2.1	2.5	2.5	1.6	2.1
Near poor	5.1	3.5	4.1	3.7	1.5	2.8
Low income	3.8	2.4	2.5	2.3	1.1	2.1
Middle income	2.5	2.1	2.6	1.8	1.3	1.8
High income	2.8	1.9	2.7	1.9	1.4	1.7
Health insurance status						
Less than 65						
Any private	2.4	1.7	2.6	1.6	1.4	1.7
Public only	3.6	2.5	2.6	2.7	1.7	2.6
Uninsured	5.5	3.8	4.6	3.7	3.2	2.9
65 and over						
Medicare only	3.8	2.9	3.3	3.1	1.9	2.5
Medicare and private	3.0	2.4	2.9	2.6	1.2	2.1
Medicare and other public	4.8	3.8	4.2	3.4	1.6	3.0
Education						
Less than high school	2.3	1.9	2.1	1.9	0.9	1.7
High school	2.6	1.8	2.6	2.0	1.1	1.7
At least some college	3.1	1.7	2.5	1.8	1.6	1.6
Metropolitan statistical area (MSA)						
MSA	1.7	1.2	1.6	1.2	0.8	1.0
Non-MSA	3.1	2.5	2.9	2.5	1.8	2.3
Census region						
Northeast	3.0	2.5	3.4	3.0	1.9	2.0
Midwest	2.9	2.3	2.4	2.2	1.6	2.2
South	2.5	1.8	2.4	1.6	1.1	1.6
West	3.5	1.9	2.7	2.2	1.7	1.8

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality, Medical Expenditure Panel Survey, 1997–2007

[a] Insufficient data to support reliable estimates.

[1] Specific classes of oral anti-diabetic medications restricted to the three most commonly used therapeutic classes: sulfonylureas, biguanides, and thiazolidinediones.

[2] Beginning in 2002, the data reflect whether the respondents wanted to identify with multiple races. The race/ethnicity characteristics for 2003 actually reflect Hispanic; non-Hispanic, white, no other race indicated; non-Hispanic, black, no other race indicated; and non-Hispanic, other single races and multiple races. Hence, estimates by race/ethnicity for 2003 are not directly comparable to those in previous years (i.e., 1997–2001 versus 2002–2007).

Table G: Standard errors for average per capita, per user, and out-of-pocket expenditures[1] for anti-diabetic medications among persons reporting treatment for diabetes, United States, 1997–1998 and 2006–2007

Corresponds to Table 7

	1997-1998	2006-2007
Population reporting diabetes (millions)	0.4	0.5
	Per capita total expenditures	
Drug Class		
All therapeutic classes[2]	$21	$26
Sulfonylureas	$8	$5
Biguanides	$7	$6
Thiazolidinediones	$13	$15
Insulin	$7	$17
Non-insulin injectables [3]	$0	$8
Combinations[4]	$0	$5
	Per user total expenditures	
Drug Class		
All therapeutic classes[2]	$23	$28
Sulfonylureas	$12	$13
Biguanides	$22	$9
Thiazolidinediones	$156	$45
Insulin	$16	$56
Non-insulin injectables [3]	a	$143
Combinations[4]	a	$34
	Out-of-pocket expenditures	
Drug Class		
All therapeutic classes[2]	$12	$11
Sulfonylureas	$9	$6
Biguanides	$16	$6
Thiazolidinediones	$39	$13
Insulin	$8	$25
Non-insulin injectables [3]	a	$51
Combinations[4]	a	$18

Source: Center for Financing, Access, and Cost Trends, Agency for Healthcare Research and Quality; Medical Expenditure Panel Survey, 1997–2007

[a] Insufficient data to support reliable estimates.

[1] Drug expenditures for all years are CPI-U adjusted to 2007 U.S. dollars.

[2] In addition to the classes in the table, all therapeutic classes include meglitinides, alpha-glucosidase inhibitors, and dipeptidyl peptidase-4 inhibitors.

[3] Non-insulin injectables such as incretin mimetics or glucagon-like peptide analogues and agonists include exenatide, liraglutide, and pramlintide. These were first approved for the treatment of diabetes by the U.S. Food and Drug Administration in 2005.

[4] Combination drugs include two or more of the listed oral classes.