

Trends in the Financial Burden of Medical Care for Nonelderly Adults with Diabetes, 2001 to 2009

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Diabetes has been widely recognized as a large and growing public health challenge in the United States. The number of adults with diagnosed diabetes increased 75% between 2000 and 2010 (to about 21 million by 2010), while the percentage of adults with diabetes increased from 6% to 9% during this same period.¹

The increasing prevalence of diabetes not only has profound consequences for the health of the US population, but also for healthcare costs. The direct medical costs of diabetes were estimated to be \$116 billion in 2007.² Average medical expenditures for persons with diabetes are about 2.3 times higher than for people without diabetes, in part because complications of the disease often lead to other medical conditions, including heart disease and stroke, hypertension, eye problems, kidney disease, and nervous system disease.³

In addition, the high costs for treatment of diabetes and comorbid conditions often impose a high financial burden on individuals and their families, which itself can be a barrier to regular monitoring of the disease and adhering to treatment regimens.⁴ Development of treatment guidelines and new antidiabetic drugs has increased the intensity of treatment, which also increases the potential financial burden on people with diabetes.⁵

On the other hand, the greater availability and use of generic medicines has reduced the out-of-pocket costs and financial burden of prescription medications for many patients. As the percent of prescription drugs filled using generic drugs has increased, out-of-pocket spending on prescription drugs declined sharply for the US population, from an annual average of \$215 in 2001 to \$162 in 2009.⁶ For persons with diabetes, the availability of frequently prescribed antidiabetic medications in generic form—such as metformin—is also likely to reduce the financial burden of medical care for people with diabetes and their families.

This paper has 2 objectives: (1) to examine trends in out-of-pocket spending and medical cost burdens for persons with diabetes between 2001 and 2009, focusing especially on trends in prescription drug spending; and (2) to examine trends in the percentage of people with diabetes using diabetes-related medications, overall access to prescription drugs, and use of hospital care for persons with diabetes. To the extent that

diabetes treatment has become more affordable over the past decade, we would expect to see more people with diabetes using diabetes-related medications, and fewer reporting that they were unable to receive needed prescription drugs.

Objectives: To examine trends in out-of-pocket spending and the financial burden of care for persons with diabetes between 2001 and 2009, and to examine whether these trends are consistent with trends in access to prescription drugs and utilization of hospital services.

Study Design and Methods: Data are from the 2001 to 2009 Medical Expenditure Panel Survey (MEPS). The sample includes persons aged 18 to 64 years with diagnosed diabetes. The primary outcome variable is the percent of people with out-of-pocket spending on insurance premiums and services that exceed 10% of family income. Secondary outcome measures include the percent with diabetes-related prescription drug use, perceived access to prescription drugs, hospital inpatient stays, and emergency department use in the past 12 months. Multiple regression analysis is used to control for changes in comorbid chronic conditions and other characteristics of persons with diabetes.

Results: Both out-of-pocket spending and the percent with high financial burden decreased markedly for persons with diabetes between 2001 to 2003 and 2007 to 2009. The decrease in spending was driven primarily by a decrease in spending on prescription drugs, including diabetes-related prescriptions. The shift from brand name drugs to generics accounts for much of this decline, although decreases in out-of-pocket spending for both brand name and generic drugs also contributed. During the same period, utilization of and access to diabetes-related prescriptions increased, and hospital use decreased.

Conclusions: Although the prevalence of diagnosed diabetes continues to increase, treatment is becoming more affordable, especially prescription drugs. This may offset some of the costs to the healthcare system of higher prevalence by reducing complications of uncontrolled diabetes that result in more costly hospital use.

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Take-Away Points

- Patients receiving treatment for diabetes and related comorbidities often incur a substantial financial burden due to the out-of-pocket costs of care they receive. However, despite increased prevalence, the financial burden of diabetes care to patients decreased markedly over the past decade, due primarily to lower spending on prescription drugs.
- Increased use of generics explains much of the decrease in spending on prescription drugs, although other factors—possibly including increased use of mail order and value-based health plans—may also be reducing costs for patients.
- Reduced financial burden was accompanied by fewer people with diabetes reporting that they had problems accessing prescription drugs, and fewer who had hospital inpatient stays and emergency department visits.

As prior research has established that greater adherence to diabetes drugs is related to lower hospital emergency department (ED) use and inpatient stays, decreases in hospital use over the past decade among people with diabetes would also be consistent with greater affordability and access to treatment.⁷

METHODS

Data Source

We used data from the 2001 to 2009 Medical Expenditure Panel Survey, Household Component (MEPS HC). The survey is based on a large nationally representative sample of the civilian noninstitutionalized population and is conducted annually by the federal Agency for Healthcare Research and Quality (2009 is the latest year for which data are publicly available at the time of this study). The MEPS sample is based on a subsample of the National Health Interview Survey (NHIS), conducted annually by the Centers for Disease Control and Prevention (CDC). The survey collects detailed information on healthcare expenditures, use of services, insurance coverage, health status, medical conditions, and other sociodemographic details of individuals and their families during 3 rounds of interviewing during the calendar year. Sample sizes range from between 33,000 to 37,000 for each year.

Cumulative response rates for the 9 years of the survey used in this analysis averaged around 60%. Cumulative response rates combine the initial response rate to the NHIS (the sample frame), as well as response rates in each of the 3 rounds of data collection for the MEPS sample. Survey weights used in this analysis calibrate population estimates to be consistent with the Current Population Survey conducted by the US Census Bureau, and adjust for differences in nonresponse by US census region, metro versus rural residence, income, age, gender, and family income.

The sample for this survey includes persons aged 18 to 64 years who, in response to a question in the survey, reported that a physician or other health provider had told them that they had diabetes, which is identical to the methods used by the CDC to assess diagnosed diabetes prevalence in the popu-

lation.⁸ Annual samples of nonelderly adults with diabetes ranged from about 900 to 1100. To increase the statistical precision of estimates, samples from multiple years were pooled. The study compares annual estimates for the years 2001 to 2003 (N = 2747); 2004 to 2006 (N = 3096); and 2007 to 2009 (N = 3439). Persons aged 65 years and older were excluded because most have Medicare coverage, and therefore financial

burden is likely to differ considerably from that of the under-65-years adult population.

Outcomes

Expenditures for each medical encounter for each sample respondent are collected during 3 rounds of survey interviews during the calendar year. Expenditures are reported separately for office-based medical provider visits, hospital inpatient, outpatient, and ED care, prescribed medicines, home healthcare, dental services, and vision aids. For each visit/event, total expenditures are reported (ie, from all payer sources), as well as the amounts paid by third-party payers and out-of-pocket by the patient. To improve the quality and accuracy of expenditure reporting, the MEPS Medical Provider Component collects data from a sample of medical providers and pharmacies used by sample persons, which are used to either supplement or replace patient-reported data on expenditures.⁹ All expenditure data are inflated to reflect 2009 dollars, based on the Consumer Price Index.

The study also examines trends in the percent of persons with diabetes who live in families with “high financial burden.” This is defined similarly to previous studies using the MEPS, as the ratio of total out-of-pocket spending on health services and health insurance premiums to total family income.^{4,6,7} For this measure, out-of-pocket spending is defined at the family level (ie, summed across all members in the family, typically defined as the nuclear family). Each individual is assigned the family level burden measure. Individuals who live in families that spend more than 10% of family income on healthcare are defined as individuals with high financial burden.

More detailed analysis of spending on prescription drugs is also included. Respondents were asked to supply the name of any prescribed medicine they obtained. For each prescribed medicine, information was collected on the name, medical conditions (coded based on ICD-9 classification), spending, and source of payment information. In the analysis, we distinguish between prescriptions related to diabetes versus prescriptions for other conditions based on the class of drug.

We also distinguish between “brand name” and “generic” prescriptions by linking the MEPS to Lexicomp, a database that identifies and distinguishes brand name and generic medications.¹⁰ National Drug Codes were used to link MEPS prescription drug records with Lexicomp data. However, data on generic versus brand name are available only for the years 2005 to 2009 because of changes in methods used to assign National Drug Codes to prescription drug records.

To assess perceived access to prescription drugs, MEPS also asks respondents whether there was a time in the previous year when they were unable to obtain prescription drugs they or a doctor thought necessary. For hospital use, MEPS obtains information on all visits for inpatient stays and ED visits made in the prior year.

Statistical Analysis

For the analysis of trends in spending and medical cost burdens, the analysis compares means and percentages for pooled samples of persons aged 18 to 64 years for the years 2001 to 2003, 2004 to 2006, and 2007 to 2009. All spending estimates reflect annual averages. Tests of statistical significance are computed for the change between 2001 to 2003 and 2007 to 2009 and between 2004 to 2006 and 2007 to 2009. All estimates are weighted to be nationally representative of the US civilian noninstitutionalized population with diagnosed diabetes.

For measures of the likelihood of having high financial burden, any use of diabetes-related prescriptions in the past year, access to prescription drugs, and use of hospital care, we use logistic regression analysis to examine whether changes between the three time periods are statistically significant, even after accounting for other changes in the aggregate characteristics of diabetics, including their age, gender, race/ethnicity, number of comorbid chronic conditions, body mass index, limitations in daily activities, family income relative to the US poverty level, educational attainment, and health insurance coverage.

The regressions are estimated by pooling all 9 years of data into a single model. The models include the covariates mentioned above, as well as binary indicators for the 2001 to 2003 sample and the 2004 to 2006 sample. Coefficients for the 2001 to 2003 and 2004 to 2006 indicators show the difference with the 2007 to 2009 sample (the omitted group) on the dependent variable after controlling for changes in all other characteristics in the model. Standard errors for these coefficients are used to assess whether the change between 2007 and 2009 and prior years is statistically significant.

Given the number of regressions, we show the results only for the 2001 to 2003 and 2004 to 2006 variables—presented as odds ratios—which are the main interest in this study. Full

regression results are available in [eAppendices A through E](#) at www.ajmc.com. Also, we use the results of the regression to compute adjusted means and percentages for the dependent variables, based on predicted values for the 3 time periods.

RESULTS

Characteristics of Persons With Diabetes

The percentage of the US population aged 18 to 64 years with diagnosed diabetes increased from 4.6% in the 2001 to 2003 period to 6.2% in 2007 to 2009 (findings not shown). Among persons with diabetes, the percentage with 3 or more comorbid conditions increased from 53.1% in 2001 to 2003 to 62.7% in 2007 to 2009 ($P < .001$) ([Table 1](#)). A higher percentage were obese in 2007 to 2009 compared with 2001 to 2003, although there were fewer who reported being limited in daily activities in 2007 to 2009 compared with 2001 to 2003. There were no changes in family income (relative to the US poverty level) during the 3 periods, while the percent uninsured increased from 11% in 2001 to 2003 to 13% in 2007 to 2009 ($P < .05$).

Trends in Healthcare Expenditures

In 2007 to 2009, total personal spending on healthcare for persons with diabetes was almost 3 times higher than spending for all persons aged 18 to 64 years. Total spending on healthcare increased for persons with diabetes between 2001 to 2003 and 2007 to 2009, as it did for all persons aged 18 to 64 years ([Table 2](#)). For persons with diabetes, total spending (from all sources and for all health conditions) increased from an average of \$8746 in 2001 to 2003 to \$10,327 in 2007 to 2009 ($P < .01$), representing an 18% increase over this period. The rate of increase in spending is similar for all persons aged 18 to 64 years.

Out-of-pocket spending on healthcare for persons with diabetes was more than double that for all persons aged 18 to 64 years. Average out-of-pocket spending on services decreased for persons with diabetes, mostly between 2004 to 2006 and 2007 to 2009. On average, persons with diabetes spent \$1373 out-of-pocket on medical care in 2007 to 2009 compared to \$1624 in 2004 to 2006 ($P < .001$), a 15% decrease. Out-of-pocket spending did not decrease significantly for the general population during the study period.

Persons with diabetes are more likely to be in families that spend more than 10% of family income on healthcare compared with all persons aged 18 to 64 years (18.6% vs 7.8%, $P < .001$). Despite an increase in comorbid conditions and no change in income, the percentage of persons with diabetes with high financial burden decreased, from 23.9% in 2001 to 2003 to 18.6% in 2007 to 2009 ($P < .001$). There was no stm-

■ **Table 1.** Characteristics of Adults Aged 18 to 64 Years With Diabetes, 2001 to 2009 (Standard Errors in Parentheses)

	2001-2003	2004-2006	2007-2009
Age			
18-34 y	7.9 (0.6)	6.7 (0.5)	6.0 (0.5) ^a
35-44 y	15.3 (0.8)	16.0 (0.8)	15.6 (0.8)
45-64 y	76.9 (1.0)	77.3 (0.9)	78.4 (0.9)
Number of comorbid chronic conditions			
None	13.1 (0.8)	11.4 (0.7)	9.1 (0.6) ^c
1	16.5 (0.8)	15.7 (0.8)	12.6 (0.7) ^c
2	17.3 (0.9)	18.3 (0.9)	15.6 (0.8)
3 or more	53.1 (1.1)	54.6 (1.1)	62.7 (1.0) ^c
Body mass index			
Normal/underweight	14.9 (0.8)	12.3 (0.7) ^a	12.4 (0.7) ^a
Overweight	27.8 (1.0)	27.4 (1.0)	26.4 (1.0)
Obese	57.3 (1.1)	60.3 (1.1) ^a	61.2 (1.1) ^a
Has activity limitation			
	25.2 (1.0)	26.6 (0.9)	22.2 (0.9) ^a
Family income			
<100% of poverty	14.0 (0.7)	15.7 (0.7)	15.5 (0.7)
100-200% of poverty	18.7 (0.8)	18.9 (0.8)	18.5 (0.8)
200-400% of poverty	30.7 (1.1)	30.1 (1.0)	30.8 (1.0)
≥400% of poverty	36.5 (1.2)	35.2 (1.1)	35.2 (1.1)
Insurance status			
Any private	67.6 (1.0)	64.7 (1.0) ^a	65.1 (1.0) ^a
Public only	21.5 (0.9)	23.7 (0.9)	21.9 (0.8)
Uninsured	11.0 (0.7)	11.6 (0.6)	13.0 (0.7) ^a

^aChange since 2001-2003 is statistically significant at .05 level.

^bChange since 2001-2003 is statistically significant at .01 level.

^cChange since 2001-2003 is statistically significant at .001 level.

Source: 2001-2009 Medical Expenditure Panel Survey, Household Component.

tistically significant decrease in high financial burden for all persons aged 18 to 64 years during the same period.

Trends in Spending by Type of Service

Overall, spending on prescription drugs accounted for more than half of all out-of-pocket spending for persons with diabetes in 2007 to 2009 (Table 3). However, out-of-pocket spending on prescription drugs decreased sharply, from \$1095 in 2001 to 2003 to \$763 in 2007 to 2009 ($P < .001$). For diabetes-related prescriptions, out-of-pocket spending began to decrease in the 2004 to 2006 period, while for non-diabetes-related prescriptions, the decrease occurred in the 2007 to 2009 period. Out-of-pocket spending also decreased for other medical expenses (eg, eyeglasses, hearing aids, other medical equipment), but either did not change or increased (dental care) for all other types of services.

More Generics, Lower Copayments

Generic drugs accounted for 52.9% of all diabetes-related prescriptions in 2007 to 2009, up from 46.9% in the 2005 to 2006 period (data on brand name vs generic that could be linked to the MEPS were not available prior to 2005). Both total spending and out-of-pocket spending per prescription are considerably lower for generic medications than they are for brand name prescriptions. More than two-thirds of generic prescriptions involved a copayment of \$10 or less, compared with about one-third of brand name prescriptions (Table 4).

For non-diabetes prescriptions, the percent generic statistic increased from 48.7% in 2005 to 2006 to 58.7% in 2008 to 2009. Similar to diabetes-related prescriptions, both total and out-of-pocket spending were dramatically lower for generics in 2007 to 2009 compared with brand name prescriptions.

To estimate how much of the increase in generic utilization accounts for decreases in out-of-pocket spending for pre-

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Table 2. Average Annual Total and Out-of-Pocket Expenditures for Persons With Diabetes Compared With the General US Population Aged 18 to 64 Years (Standard Errors in Parentheses)

	2001-2003	2004-2006	2007-2009
Average annual total expenditures			
Persons with diabetes	8746 (336)	9399 (329)	10,327 (411) ^b
All persons aged 18-64 years	3093 (64)	3470 (61) ^c	3631 (58) ^c
Average annual out-of-pocket expenditures			
Persons with diabetes	1647 (52)	1624 (65)	1373 (51) ^c
All persons aged 18-64 years	626 (7)	695 (12) ^c	618 (8)
Out-of-pocket expenditures in family are greater than 10% of family income			
Persons with diabetes	23.9 (1.0)	21.5 (0.9)	18.6 (0.8) ^c
All persons aged 18-64 years	7.9 (0.1)	8.5 (0.2) ^b	7.8 (0.2)

^aChange since 2001-2003 is statistically significant at .05 level.
^bChange since 2001-2003 is statistically significant at .01 level.
^cChange since 2001-2003 is statistically significant at .001 level.
Source: 2001-2009 Medical Expenditure Panel Survey, Household Component.

Table 3. Average Annual Out-of-Pocket Expenditures by Type of Service for Persons With Diabetes Aged 18 to 64 Years (Standard Errors in Parentheses)

	2001-2003	2004-2006	2007-2009
Average annual out-of-pocket expenditures			
Hospital inpatient	53 (8)	65 (13)	54 (8)
Hospital outpatient department	40 (5)	50 (7)	57 (8)
Hospital emergency department	20 (4)	32 (11)	27 (4)
Office-based visits	233 (15)	245 (26)	250 (17)
Dental care	117 (11)	113 (10)	163 (16) ^b
Home health	11 (5)	8 (4)	11 (5)
Other medical expenses ^a	46 (3)	45 (3)	34 (2) ^b
Prescription drugs	1095 (41)	1046 (45)	763 (37) ^d
Diabetic drugs or supplies	327 (19)	271 (9) ^b	246 (12) ^d
Non-diabetic drugs	777 (40)	776 (43)	517 (34) ^d

^aIncludes purchases of eyeglasses, hearing aids, prostheses, other medical equipment.
^bChange since 2001-2003 is statistically significant at .05 level.
^cChange since 2001-2003 is statistically significant at .01 level.
^dChange since 2001-2003 is statistically significant at .001 level.
Source: 2001-2009 Medical Expenditure Panel Survey, Household Component.

scription drugs, we simulate out-of-pocket spending for 2007 to 2009 assuming the same proportion of generic versus brand name scripts as in 2005 to 2006. For diabetes prescriptions, average out-of-pocket spending for generic and brand name prescriptions combined decreased from about \$26 per prescription in 2005 to 2006 to \$23 in 2007 to 2009 (findings not shown). If the percent generic statistic were the same in 2007 to 2009 as in 2005 to 2006, average out-of-pocket spending per prescription in 2007 to 2009 would have been \$25.50. Thus, of the \$3 decrease in average out-of-pocket spending, the increase in generic scripts accounts for \$2.50, or 83% of the decrease.

For non-diabetes prescriptions, the increase in generic scripts accounts for only about one-third of the decrease in average out-of-pocket costs per prescription (from \$25 in 2005-2006 to \$16 in 2007-2009). Most of the decrease in out-of-pocket spending for non-diabetes-related prescriptions reflects decreased out-of-pocket spending among both generic and brand name prescriptions.

Regression Analysis

Table 5 summarizes the results of the regression analysis, as well as the adjusted percentages derived from the regression analysis. The results for the trends in high financial burden are

Table 4. Prescription Drug Spending for Persons With Diabetes, Aged 18 to 64 Years, 2007 to 2009 (Standard Errors in Parentheses)

	Brand Name	Generic
Diabetes-related prescriptions		
% of all diabetes-related prescriptions	47.1 (0.9)	52.9 (0.9) ^e
Average total expenditure	\$185 (\$4)	\$22 (\$1) ^e
Average out-of-pocket expenditure	\$40 (\$2)	\$9 (\$1) ^e
% with \$0 copay	11.7 (1.0)	12.0 (0.8)
% with \$0-5 copay	16.0 (1.1)	32.8 (1.3) ^e
% with \$5-10 copay	10.0 (0.9)	27.4 (1.2) ^e
% with \$10-20 copay	14.6 (1.2)	21.1 (1.1) ^e
% with \$20-50 copay	29.5 (1.5)	5.6 (0.5) ^e
% with ≥\$50 copay	18.1 (1.1)	1.1 (0.2) ^e
Nondiabetic drug prescriptions		
% of all non-diabetes-related prescriptions	37.2 (0.7)	58.7 (0.7) ^e
Average total expenditure	\$140 (\$4)	\$28 (\$2) ^e
Average out-of-pocket expenditure	\$30 (\$1)	\$8 (\$0) ^e
% with \$0 copay	13.5 (0.9)	19.4 (1.0) ^e
% with \$0-5 copay	16.4 (0.9)	34.4 (1.1) ^e
% with \$5-10 copay	10.2 (0.6)	23.9 (0.9) ^e
% with \$10-20 copay	13.9 (0.7)	15.1 (0.8)
% with \$20-50 copay	31.5 (1.1)	5.7 (0.3) ^e
% with ≥\$50 copay	14.6 (0.7)	1.5 (0.2) ^e

^aDifference with brand name prescriptions is statistically significant at .05 level.
^bDifference with brand name prescriptions is statistically significant at .01 level.
^cDifference with brand name prescriptions is statistically significant at .001 level.
 Source: 2007-2009 Medical Expenditure Panel Survey, Household Component.

consistent with the descriptive results in Table 2: the percentage of persons with diabetes with high financial burden decreased sharply between 2001 to 2003 and 2007 to 2009, after accounting for changes in prevalence of comorbid conditions, obesity, insurance coverage, and other patient characteristics.

Consistent with the decrease in financial burden are an increase in the percent with diabetes-related prescription use in the past year and a decrease in the percent reporting they were unable to obtain prescription drugs in the past year. Also, the percent with any hospital stays or ED visits in the prior year also decreased, despite the increase in comorbid conditions among people with diabetes.

LIMITATIONS

Some limitations with the study should be noted. First, MEPS does not include information on changes in the severity of diabetes which could affect spending, treatment, and access trends. However, the analysis of trends in financial burden,

prescription drug use, access, and hospital use controlled for changes in comorbidities, obesity levels, and other factors that are likely to be correlated with type and severity of diabetes.

A second limitation is that measures of expenditures, diabetes prevalence, and other medical conditions are based in part on the self-report of MEPS respondents, rather than clinical or claims data. This is mitigated to some extent by the use of standard questions on diabetes and other medical conditions used in surveys by the CDC.¹¹ MEPS also uses a short recall period (typically 3-6 months) to augment reliability of utilization and expenditure data,¹² and MEPS findings on healthcare utilization and prescription use have been validated in prior studies.^{13,14} Also, follow-up surveys to medical providers (including pharmacists) are used by the MEPS to verify and edit medical expenditure information reported by survey respondents.

DISCUSSION

The concerns faced by patients about the management of diabetes, in particular the role of prescription drugs, evolved during the period of our analysis, with potential implications for patients' expenditures.

Along with increased prevalence of diabetes, there were also slight increases in the proportion of people with diabetes reporting comorbidities such as cardiovascular disease, hypertension and lipid disorders. Prevalence of treatment among patients with diabetes has also increased, especially among those treated with 2 or more injectable medications, or combinations of injectable and oral medications.⁵

Changes in the role of prescription drugs for diabetes reflect in part larger trends in prescription medications. Overall prescription drug use has been rising steadily from 1999 to 2008. Utilization has risen for a wide range of patients, ranging from those who use only 1 or 2 medications daily to those who use 5 or more. Two of the most widely used drugs among nonelderly adults were cholesterol-lowering drugs and antihypertensives, both of which are commonly taken by patients with diabetes.¹⁵

Despite increased use of prescription drugs for the treatment of diabetes, as well as increases in the usual and customary prices for a number of important diabetes drugs,^{6,16}

Table 5. Results of Regression Analysis for Changes in Diabetes Treatment, Access to Prescription Drugs, and Hospital Use

	2001-2003	2004-2006	2007-2009 (reference year)
Had high financial burden			
Odds ratios (CIs)	1.86 (1.54-2.26) ^a	1.38 (1.15-1.66) ^a	—
Adjusted percentages	25.0	21.4	
Unable to get prescription drug in past year			
Odds ratios (CIs)	1.40 (1.07-1.83) ^c	1.37(1.07-1.76) ^a	—
Adjusted percentages	7.4	7.3	5.4
Had diabetes-related prescription drug use			
Odds ratios (CIs)	0.69 (0.55-0.86) ^a	0.88 (0.73-1.07)	—
Adjusted percentages	84.1	87.1	88.5
Had overnight hospital stay in past year			
Odds ratios (CIs)	1.41 (1.17-1.69) ^a	1.06 (0.88-1.28)	—
Adjusted percentages	18.1	14.8	13.9
Had hospital emergency department visit in past year			
Odds ratios (CIs)	1.20 (1.04-1.40) ^c	1.03 (0.89-1.20)	—
Adjusted percentages	23.5	21.3	20.5

CI indicates confidence interval.

^aDifference with reference year is statistically significant at $P < .001$.

^bDifference with reference year is statistically significant at $P < .01$.

^cDifference with reference year is statistically significant at $P < .05$.

Results are based on logistic regression analysis that pool all 9 years of data into a single model for each dependent variable. Odds ratios shown above are based on binary indicators for the 2001 to 2003 and 2004 to 2006 samples. Other covariates in the model include age, gender, race/ethnicity, number of comorbid chronic conditions, body mass index, limitations in daily activities, family income relative to the US poverty level, educational attainment, and health insurance coverage. Adjusted percentages are computed based on the regression results. Full model results are available in the appendix.

the costs to patients have decreased, in part due to increased availability of generic medications. Several generic alternatives to popular diabetes medications were released during the period of our study, lowering the costs for these drugs. For example, 4 generic metformin and metformin-combination drugs were released between 2000 and 2009.¹⁷

In addition to the shift to generics, further analysis shows that out-of-pocket spending decreased among all prescriptions—including generic medications—and especially among non-diabetes-related medications (findings not shown). The reason for this decrease is uncertain, although it may reflect, in part, changes in comorbidities among patients, prescribing behavior among physicians, or changes in the way that patients obtain prescription medications, such as through lower-cost mail order sources or through large discount chain stores that offer very low prices for selected generic drugs.

Some of the decrease in spending in our study may also reflect movement toward value-based benefits in health insurance design, including the use of very low cost sharing for certain prescription drugs to encourage their use. A number of major purchasers of care and health plans have reduced copayments associated with medications for selected conditions, including diabetes.^{18,19} Among individuals with employer-

sponsored insurance, cost-sharing for prescription drugs evolved during the period of our analysis, with substantially more enrollees having 3 or 4 copayment tiers at the end of the decade.²⁰ These tiers are typically designed to encourage consumers to prioritize certain medications (eg, generics or medications important for preventive care). While cost-sharing amounts may be considerably higher for prescriptions in the higher tiers—which may be for brand-name, nonpreferred drugs, or experimental drugs—cost sharing may be reduced for drugs that are included in the lower tiers.

Although the study did not determine whether decreases in financial burden of medical care caused an improvement in access to diabetes care and treatment, trends in prescription drug use and access are consistent with increased affordability. Lowering the costs of diabetes drugs has been shown to decrease the patients' costs and utilization overall, including rates of ED visits.²¹ Other research—not specific to diabetes—has shown more definitively that financial stress resulting from high out-of-pocket spending is strongly related to people putting off or not getting needed care.²²

The decrease in use of hospital inpatient or ED may also reflect improved treatment as a result of better access to prescription drugs. Decreasing use of hospital care may also

reflect a more general trend of increasing emphasis on outpatient versus inpatient management of the disease, which is at least facilitated by improved access to and affordability of prescription drugs. Care delivery innovations such as disease management have also been developed, which could lead to decreases in hospital utilization, although overall evidence for disease management programs is inconclusive.²³

In sum, the results indicate that although the prevalence of diabetes has increased over the past decade, the financial burden associated with diabetes treatment—especially for prescription drugs—has decreased. Increases in the use of generic medications, and perhaps further discounts achieved through value-based health benefits and changes in where people obtain their prescriptions, have increased affordability of treatment. Although the overall costs to the healthcare system of treating people with diabetes will increase along with increased prevalence of the disease, more affordable access to prescription drugs and treatment may offset some of these higher costs if complications of diabetes that result in hospital inpatient stays and ED visits can be avoided.

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Financial Burden of Diabetes Care

■ eAppendix A. Logistic Regression Results: Likelihood of Having High Financial Burden, Persons Aged 18 to 64 Years With Diagnosed Diabetes

	Logistic Regression Coefficient	Standard Error
Intercept	-5.24 ^c	0.27
Age 18-34 years	0.35	0.18
Age 35-44 years (reference)	0.0	—
Age 45-64 years	0.64 ^c	0.12
Male	-0.02	0.08
White, non-Hispanic (reference)	0.0	—
Hispanic	-0.46 ^c	0.12
Black	-0.31 ^b	0.09
Asian	-0.01	0.15
Poor	3.43 ^c	0.16
Low income	2.44 ^c	0.15
Middle income	1.48 ^c	0.14
High income (reference)	0.0	—
Less than high school education	-0.20 ^a	0.10
High school graduate (reference)	0.0	—
Some college	0.09	0.12
College graduate	0.10	0.14
Employer-sponsored private insurance (reference)	0.0	—
Nongroup private insurance	1.26 ^c	0.25
Public coverage	-0.23 ^a	0.11
Uninsured	1.03 ^c	0.12
0 comorbid chronic conditions (reference)	0.0	—
1 comorbid chronic condition	0.67 ^c	0.18
2 comorbid chronic conditions	0.77 ^c	0.18
3 or more comorbid chronic conditions	1.51 ^c	0.18
BMI: Underweight	0.40	0.45
BMI: Normal weight (reference)	0.0	—
BMI: Overweight	0.14	1.12
BMI: Obese	-0.04	0.11
Is limited in daily activities	0.38 ^c	0.09
Survey years 2001-2003	0.62 ^c	0.10
Survey years 2004-2006	0.32 ^c	0.09
Survey years 2007-2009 (reference)	0.0	—

BMI indicates body mass index.
^a*P* < .05.
^b*P* < .01.
^c*P* < .001.
Source: 2001-2009 Medical Expenditure Panel Survey, Household Component.

■ **eAppendix B.** Logistic Regression Results: Likelihood of Not Being Able to Get Prescription Drug in Past Year, Persons Aged 18 to 64 Years With Diagnosed Diabetes

	Logistic Regression Coefficient	Standard Error
Intercept	-3.95 ^c	0.38
Age 18-34 years	0.15	0.26
Age 35-44 years (reference)	0.0	—
Age 45-64 years	-0.37 ^a	0.17
Male	-0.44 ^c	0.12
White, non-Hispanic (reference)	0.0	—
Hispanic	-0.50 ^b	0.17
Black	-0.26	0.18
Asian	-1.21	0.66
Poor	0.96 ^c	0.24
Low income	0.98 ^c	0.20
Middle income	0.65 ^c	0.21
High income (reference)	0.0	—
Less than high school education	0.14	0.15
High school graduate (reference)	0.0	—
Some college	-0.14	0.16
College graduate	0.13	0.19
Employer-sponsored private insurance (reference)	0.0	—
Nongroup private insurance	0.61	0.33
Public coverage	0.13	0.16
Uninsured	0.84 ^c	0.17
0 comorbid chronic conditions (reference)	0.0	—
1 comorbid chronic condition	0.16	0.28
2 comorbid chronic conditions	0.46	0.29
3 or more comorbid chronic conditions	0.67 ^a	0.26
BMI: Underweight	-0.41	0.59
BMI: Normal weight (reference)	0.0	—
BMI: Overweight	0.11	0.20
BMI: Obese	0.06	0.18
Is limited in daily activities	0.73 ^c	0.13
Survey years 2001-2003	0.34 ^a	0.14
Survey years 2004-2006	0.31 ^a	0.13
Survey years 2007-2009 (reference)	0.0	—

BMI indicates body mass index.
^a*P* < .05.
^b*P* < .01.
^c*P* < .001.
Source: 2001-2009 Medical Expenditure Panel Survey, Household Component.

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■ eAppendix C. Logistic Regression Results: Likelihood of Having Diabetes-Related Prescription Drug Use, Persons Aged 18 to 64 Years With Diagnosed Diabetes

	Logistic Regression Coefficient	Standard Error
Intercept	1.69 ^c	0.26
Age 18-34 years	-0.26	0.19
Age 35-44 years (reference)	0.0	—
Age 45-64 years	0.26	0.13
Male	0.21	0.11
White, non-Hispanic (reference)	0.0	—
Hispanic	0.30 ^a	0.12
Black	0.39 ^c	0.11
Asian	0.43	0.25
Poor	-0.01	0.17
Low income	-0.01	0.14
Middle income	-0.03	0.12
High income (reference)	0.0	—
Less than high school education	0.06	0.12
High school graduate (reference)	0.0	—
Some college	-0.06	0.12
College graduate	-0.33 ^a	0.15
Employer-sponsored private insurance (reference)	0.0	—
Nongroup private insurance	-0.12	0.33
Public coverage	-0.15	0.17
Uninsured	-0.29 ^a	0.14
0 comorbid chronic conditions (reference)	0.0	—
1 comorbid chronic condition	-0.38 ^a	0.19
2 comorbid chronic conditions	-0.11	0.20
3 or more comorbid chronic conditions	-0.18	0.19
BMI: Underweight	-0.24	0.51
BMI: Normal weight (reference)	0.0	—
BMI: Overweight	0.11	0.14
BMI: Obese	0.46 ^c	0.14
Is limited in daily activities	-0.01	0.13
Survey years 2001-2003	-0.38 ^b	0.11
Survey years 2004-2006	-0.13	0.10
Survey years 2007-2009 (reference)	0.0	—

BMI indicates body mass index.

^a*P* < .05.

^b*P* < .01.

^c*P* < .001.

Source: 2001-2009 Medical Expenditure Panel Survey, Household Component.

■ **eAppendix D.** Logistic Regression Results: Likelihood of Having Overnight Hospital Stay in Past Year, Persons Aged 18 to 64 Years With Diagnosed Diabetes

	Logistic Regression Coefficient	Standard Error
Intercept	-3.04 ^c	0.28
Age 18-34 years	0.32	0.18
Age 35-44 years (reference)	0.0	—
Age 45-64 years	-0.18	0.11
Male	-0.03	0.09
White, non-Hispanic (reference)	0.0	—
Hispanic	-0.26 ^b	0.10
Black	0.14	0.10
Asian	0.06	0.14
Poor	0.58 ^c	0.14
Low income	0.43 ^c	0.12
Middle income	0.30 ^b	0.11
High income (reference)	0.0	—
Less than high school education	0.13	0.10
High school graduate (reference)	0.0	—
Some college	-0.17	0.11
College graduate	-0.20	0.14
Employer-sponsored private insurance (reference)	0.0	—
Nongroup private insurance	-0.94 ^b	0.33
Public coverage	-0.23 ^a	0.11
Uninsured	-0.56 ^c	0.13
0 comorbid chronic conditions (reference)	0.0	—
1 comorbid chronic condition	0.19	0.21
2 comorbid chronic conditions	0.58 ^b	0.19
3 or more comorbid chronic conditions	1.36 ^c	0.18
BMI: Underweight	0.20	0.48
BMI: Normal weight (reference)	0.0	—
BMI: Overweight	-0.27 ^a	0.12
BMI: Obese	-0.13	0.12
Is limited in daily activities	1.01 ^c	0.10
Survey years 2001-2003	0.34 ^c	0.09
Survey years 2004-2006	0.06	0.10
Survey years 2007-2009 (reference)	0.0	—

BMI indicates body mass index.

^a*P* < .05.

^b*P* < .01.

^c*P* < .001.

Source: 2001-2009 Medical Expenditure Panel Survey, Household Component.

Financial Burden of Diabetes Care

■ eAppendix E. Logistic Regression Results: Likelihood of Having Emergency Department Visit in Past Year, Persons Aged 18 to 64 Years With Diagnosed Diabetes

	Logistic regression coefficient	Standard error
Intercept	-2.10 ^c	0.20
Age 18-34	0.48 ^c	0.13
Age 35-44 (reference)	0.0	—
Age 45-64	-0.33 ^c	0.09
Male	-0.19 ^a	0.07
White, non-Hispanic (reference)	0.0	—
Hispanic	-0.23 ^b	0.09
Black	0.15	0.09
Asian	-0.05	0.13
Poor	0.51 ^c	0.11
Low Income	0.24 ^b	0.09
Middle Income	0.10	0.09
High income (reference)	0.0	—
Less than high school education	0.10	0.08
High school graduate (reference)	0.0	—
Some college	-0.13	0.09
College graduate	-0.12	0.11
Employer-sponsored private insurance (reference)	0.0	—
Nongroup private insurance	-0.11	0.22
Public coverage	0.14	0.09
Uninsured	0.12	0.11
0 comorbid chronic conditions (reference)	0.0	—
1 comorbid chronic condition	0.16	0.16
2 comorbid chronic conditions	0.40 ^a	0.16
3 or more comorbid chronic conditions	1.00 ^c	0.14
BMI: Underweight	-0.65	0.44
BMI: Normal weight (reference)	0.0	—
BMI: Overweight	-0.05	0.11
BMI: Obese	-0.04	0.10
Is limited in daily activities	0.65 ^c	0.08
Survey years 2001-2003	0.19 ^a	0.08
Survey years 2004-2006	0.03	0.08
Survey years 2007-2009 (reference)	0.0	—

BMI indicates body mass index.
^a*P* < .05.
^b*P* < .01.
^c*P* < .001.
Source: 2001-2009 Medical Expenditure Panel Survey, Household Component.