Changes in Health Insurance Coverage Under the Affordable Care Act: A National Sample of U.S. Adults With Diabetes, 2009 and 2016

Sarah S. Casagrande,[1] Laura N. McEwen,[2] and William H. Herman[2,3]

OBJECTIVE

To assess national changes in health insurance coverage and related costs before and after implementation of the Affordable Care Act (ACA) among U.S. adults with diabetes.

RESEARCH DESIGN AND METHODS

Data were cross-sectional from the 2009 and 2016 National Health Interview Surveys (NHIS). Participants were adults age ≥18 years with a previous diagnosis of diabetes who self-reported on their health insurance coverage, demographic information, diabetes-related factors, and amount spent on medical expenses and insurance premiums (*N* = 6,220).

RESULTS

Among adults with diabetes age 18–64 years, health insurance coverage increased from 84.7% in 2009 to 90.1% in 2016 (*P* < 0.001). Coverage remained near universal for those age ≥65 years (99.5%). For adults age 18–64 years, coverage increased for almost all subgroups and significantly for men; non-Hispanic whites, non-Hispanic blacks, and Hispanics; those who were married; those with less than or more than a high school education, family income <$35,000, or diabetes duration <5 or >15 years; and those taking oral agents (*P* < 0.05 for all). Among adults age 18–64 years, Medicaid coverage significantly increased between 2009 and 2016 (19.4% vs. 24.3%, *P* = 0.006), and for those with private insurance, 7.8% acquired their plan through HealthCare.gov. For adults age ≥65 years, private insurance decreased and Medicare Part D increased (*P* < 0.007 for both). Among those age 18–64 years with an income <$35,000, the proportion of income spent on family medical costs decreased (6.3% vs. 4.8% for 2009 vs. 2016, respectively; *P* = 0.004).

CONCLUSIONS

Health insurance coverage among adults with diabetes age 18–64 years increased significantly after implementation of the ACA, and medical costs to families decreased among those with lower incomes.

[1]*Social & Scientific Systems, Inc., Silver Spring, MD*
[2]*Division of Metabolism, Endocrinology and Diabetes, University of Michigan, Ann Arbor, MI*
[3]*Department of Epidemiology, University of Michigan, Ann Arbor, MI*

Corresponding author: Sarah S. Casagrande, scasagrande@s-3.com.

In 2009, 15% of adults with diabetes age 18–64 years were uninsured, representing ~2 million uninsured adults with diabetes (1). Diabetes is associated with many costly complications, including cardiovascular disease, retinopathy, nephropathy, and neuropathy (2). Health insurance coverage is especially important for people with diabetes who need regular checkups, laboratory studies, and prescription medications to optimally manage and control their diabetes. A previous national study showed that uninsured adults with diabetes were less likely to report annual eye examinations, foot examinations, and hemoglobin A_{1c} testing compared with those with health insurance coverage (3). Other national studies have shown that uninsured people with diabetes were more likely to skip needed health care because of costs and more often reported not having a standard place for medical care (4,5). Thus, health insurance coverage is important for people with diabetes for disease management, and lack of health insurance coverage is likely to increase out-of-pocket costs for patients. Delays in medical care or treatment or, ultimately, no medical care for people with diabetes substantially affect the economy (6).

In 2010, the Affordable Care Act (ACA) was enacted to improve access, affordability, and quality of medical care in the U.S. Important components of the ACA related to diabetes care include ending denial of coverage on the basis of preexisting conditions, keeping young adults covered under their parents' or guardians' plans until age 26 years, ending lifetime limits on coverage, and requiring public reviews for premium increases (7). However, little is known about the impact of the ACA on insurance coverage among adults with diabetes. This study assessed changes in health insurance coverage and costs of medical expenses and insurance premiums before and after implementation of the ACA by demographic and diabetes-related factors among a national sample of adults with diabetes.

RESEARCH DESIGN AND METHODS

Data Source
The data source for this study was the National Health Interview Survey (NHIS), a cross-sectional household interview that has been conducted annually since 1957 across the U.S. The survey is implemented by the National Center for Health Statistics and uses a multistage area probability design among the noninstitutionalized U.S. population. Details of the survey methods have been described elsewhere (8).

Study Participants
Participants (*N* = 6,220) were adults age ≥18 years who completed the NHIS 2009 or 2016 adult sample questionnaire and indicated a physician diagnosis of diabetes on the basis of the question "[If female, other than during pregnancy] have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?" Demographic factors (age, sex, race/ethnicity, education, family income, marital status) and diabetes-related factors (diabetes duration, diabetes medication use, hypertension, heart conditions, failing kidneys, vision problems, health care access) were self-reported.

Health Insurance Coverage
Participants were asked to report current health insurance coverage status and the type of coverage. The latter included private insurance, Medicare, Medicaid or other public insurance (state-sponsored health plan, other government insurance, or state Children's Health Insurance Program), and/or military benefits. Adults with Medicare reported whether they had Part A only (hospital coverage), Part B only (medical coverage), both Part A and Part B, and/or Part D (prescription coverage). Among those with private insurance, participants reported the type of private insurance. These included HMO/independent practice organization, preferred provider organization (PPO), point-of-service plans, and fee-for-service plans. Type of health insurance coverage (e.g., private, Medicare) and type of private insurance were not mutually exclusive. Participants with single-disease coverage only (e.g., dental insurance) or Indian Health Service coverage only were considered uninsured (4). The amount spent on family medical costs in the past year, excluding premium costs, was self-reported as one of six categories: $0, <$500, $500–$1,999, $2,000–$2,999, $3,000–$4,999, and ≥$5,000. Participants with private insurance reported the amount spent on out-of-pocket private insurance premiums in the past year, with values capped at $20,000.

In 2009 and 2016, participants reported their source of private insurance, which included employer/workplace, purchased directly, or other. In 2016, participants reported whether private health insurance or Medicaid were obtained through the ACA on HealthCare.gov.

Statistical Analysis
Descriptive statistics (means, percentages, SEs) were used to show characteristics of the participants, health insurance coverage, types of coverage, and sources of coverage by age (18–64 years and ≥65 years) and study year (2009 and 2016). Estimates also were stratified by demographic characteristics and diabetes-related factors. Differences in means and proportions were tested by two-tailed large-sample *z* tests with no adjustment for multiple comparisons. Multivariable logistic regression was used to determine whether participants with certain characteristics were more likely to show changes in coverage over time. Models included independent variables for study year, the variable of interest (e.g., duration of diabetes), and an interaction term (study year × variable of interest).

To determine the proportion of income spent on family medical costs, the midpoints of self-reported cost categories were divided by the midpoints of family income categories ($0–$34,999, $35,000–$49,999, $50,000–$74,999, $75,000–$99,999, ≥$100,000 [coded as $100,000]). To determine the proportion of income spent on private insurance premiums, median costs were divided by the midpoint of the family income category.

Although this study focuses on the years 2009 and 2016 (immediately before the ACA was signed into law in 2010 and 2 years after most ACA mandates became effective in 2014), overall coverage in the intervening years of 2012 and 2014 are also shown. In addition, coverage and costs were determined for individuals without diabetes for comparison. All statistical analyses used sample weights and accounted for the cluster design with the use of SUDAAN release 9.2 software (Research Triangle Institute).

RESULTS

Participant Characteristics
Among adults with diabetes age 18–64 years, the distribution of sex, diabetes medication use, and prevalence of comorbidities and health care access were similar in 2009 and 2016 (Supplementary Table 1). Among adults age 18–64 years, fewer reported non-Hispanic white race,

and education levels were higher in 2016 than in 2009. More adults age 18–64 years were never married, and fewer had a duration of diabetes <5 years in 2016 than in 2009.

In 2016, among adults with diabetes age 18–64 years, those without health insurance were more likely to be younger (age 18–39 years), women, and Hispanic; to have less education; and to have lower income than those with health insurance (Supplementary Table 2). In addition, those without health insurance were less likely to have visited a physician or an eye doctor in the past year than those with insurance.

Among adults age ≥65 years, education, family income, and duration of diabetes were greater in 2016 than in 2009 (Supplementary Table 1).

Prevalence of Health Insurance
Among adults age 18–64 years, 90.1% had health insurance coverage in 2016 compared with 84.7% in 2009 ($P < 0.001$) (Table 1); this translates to 770,000 more adults with diabetes age 18–64 years having health insurance in 2016. Health insurance coverage was relatively stable between 2009 and 2012 but was higher in 2014 and 2016 (Fig. 1).

Health insurance coverage improved for nearly all demographic and diabetes-related subgroups (Table 1). Among adults age 18–64 years, health insurance coverage significantly increased for those age 50–59 years and for men ($P < 0.02$ for both). It generally increased for all race/ethnic groups and increased significantly for non-Hispanic whites, non-Hispanic blacks, and Hispanics ($P < 0.05$ for all). Coverage increased significantly for both those with less than a high school education and those with more than a high school education ($P < 0.03$ for both) and for those with an income <$35,000 ($P < 0.001$). Coverage significantly increased in persons who were married or living with a partner ($P = 0.04$) and for those with a shorter or longer duration of diabetes (<5 or >15 years; $P < 0.04$ for both). Coverage increased for all diabetes medication treatment groups but significantly for those taking oral medications ($P = 0.003$). Coverage significantly increased for those with hypertension and for those without a heart condition/disease, kidney disease, or vision problems ($P < 0.02$ for all). Coverage significantly increased for those who visited a physician in the past year and for those who had not seen an

eye or foot doctor in the past year ($P < 0.05$ for all).

Among adults age 18–64 years, logistic regression analysis revealed no significant interactions among study year, participant characteristics, and health insurance coverage with the exception of heart conditions. Those without a heart condition were significantly more likely to have insurance in 2016 than in 2009, but there was little change in coverage for those with a heart condition/disease.

Because of universal coverage by Medicare, health insurance coverage remained high and unchanged for adults with diabetes age ≥65 years (99.5% in 2016) (Table 1 and Fig. 1).

Type of Health Insurance
Among adults age 18–64 years, 56.3% had private insurance, 24.3% had Medicaid/other public insurance, 14.3% had Medicare, and 3.3% had military benefits in 2016 (not mutually exclusive) (Fig. 2). Medicaid/other public coverage significantly increased between 2009 and 2016 (19.4% vs. 24.3%; $P = 0.006$). In 2016, 20.5% of persons age 18–64 years with Medicaid reported acquiring their plan through HealthCare.gov (data not shown).

Among adults age ≥65 years, 94.7% had Medicare, 45.0% had private insurance, 12.2% had Medicaid/other public insurance, and 10.4% had military benefits in 2016. The prevalence of private insurance significantly decreased from 50.6% in 2009 to 45.0% in 2016 ($P = 0.029$). Although most adults age ≥65 years with Medicare continued to have both Part A and Part B coverage (90.2% in 2016), more adults had Part D coverage in 2016 than in 2009 (55.7% vs. 46.7%; $P < 0.001$ [data not shown]). In 2016, 7.1% of persons age ≥65 years with Medicaid reported acquiring their plan through HealthCare.gov.

Type of Private Insurance
Among adults age 18–64 years with private insurance, the most common type in 2016 was a PPO (64.4%) followed by an HMO/independent practice organization (29.0%) (not mutually exclusive) (Supplementary Fig. 1). No significant change in type of private plan was found between 2009 and 2016. In 2016, 7.8% of persons age 18–64 years with private insurance reported acquiring their plan through HealthCare.gov (data not shown).

Similarly, among adults age ≥65 years with private insurance, the most common

type in 2016 was a PPO (52.2%). The prevalence of fee-for-service plans decreased between 2009 and 2016 (12.1% vs. 6.2%; $P = 0.014$). In 2016, 2.3% of persons age ≥65 years with private insurance reported acquiring their plan through HealthCare.gov.

Health Care Costs
In 2016, among adults age 18–64 years, the overall proportion of family income spent on family medical costs during the past year was 3.6%; the proportion decreased with increasing income (Table 2). For those with an income <$35,000, the proportion of income spent on family medical costs decreased significantly from 6.3% in 2009 ($1,103) to 4.8% in 2016 ($840; $P = 0.004$). A similar relationship was observed for those age ≥65 years ($P = 0.027$).

Among adults age 18–64 years with private insurance in 2016, the overall proportion of income spent on out-of-pocket private insurance premiums during the past year was 4.5% (Table 2). The proportion for those with income <$35,000 was 10.0%, which was lower, but not significantly, than the proportion in 2009 (12.2%).

Adults Without Diabetes
Adults without diabetes age 18–64 years were younger, attained a higher level of education, had a higher family income, and had fewer comorbidities than their counterparts with diabetes (data not shown). The prevalence of health insurance increased from 78.3% in 2009 to 88.3% in 2016 ($P < 0.001$), which was a similar trend to those with diabetes (Fig. 1). The prevalence of health insurance significantly increased for all demographic subgroups and health-related factors (Supplementary Table 3). The prevalence of Medicare, private insurance, and Medicaid/other public coverage significantly increased ($P < 0.05$ for all), whereas for those with diabetes, only Medicaid/other public coverage significantly increased (Supplementary Table 4). Type of private insurance for persons without diabetes was similar to those with diabetes, and no change occurred between 2009 and 2016 (Supplementary Table 5).

Adults age ≥65 years without diabetes were more often women and non-Hispanic white, had a higher education, and had fewer comorbidities than their counterparts with diabetes. The prevalence of health insurance remained unchanged

(99.2% in 2016) and was similar to those with diabetes. A significant decrease was found in the prevalence of private insurance (58.6% vs. 49.3%; $P < 0.001$), which also was shown among persons with diabetes. Type of private insurance for adults without diabetes age $\geq$65 years was similar to those with diabetes.

Similar to adults with diabetes, the proportion of income spent on family medical costs decreased significantly for those without diabetes and an income <$35,000, regardless of age (Supplementary Table 6). The proportion of income spent on medical costs was slightly lower for those without diabetes than for those with diabetes. The proportion of income spent on private insurance premiums was similar in 2009 and 2016.

CONCLUSIONS

To our knowledge, national changes in health insurance coverage before and after implementation of the ACA among U.S. adults with diabetes have not been examined previously. Among adults with diabetes age 18–64 years, the prevalence of health insurance coverage increased by 5.4% between 2009 and 2016. This figure represents 770,000 more adults with diabetes age 18–64 years having health insurance coverage in 2016. An increase in coverage was observed by virtually all demographic groups and diabetes-related characteristics, with the largest increases in coverage for Hispanics and for those with less than a high school education, family income <$35,000, duration of diabetes <5 years, and who did not see a physician in the past year. The large increase in coverage among Hispanics and those with lower income and education is important because these subgroups are disproportionately affected by diabetes. In addition, the large increase in coverage among those with a new diagnosis increases the likelihood that these patients will receive care early in the natural history of their disease. Previous research has shown that tight diabetes control during the first 5 years after diagnosis can induce metabolic memory and reduce the risk of future complications (9). Any future loss of coverage could have dramatic effects related to diabetes management for these subgroups. Results from this study should inform policymakers for discussions on health care reform as it relates to the access and affordability of medical care among people with diabetes.

Table 1—Health insurance coverage among adults with diabetes by age, 2009 and 2016

	Prevalence of health insurance coverage			
	Age 18–64 years		Age ≥65 years	
	2009	2016	2009	2016
n	1,581	1,723	1,120	1,796
Total	84.7 (1.37)	90.1 (1.03)*	99.7 (0.19)	99.5 (0.19)
Age (years)				
18–39	78.2 (3.81)	84.5 (3.20)	NA	NA
40–49	84.4 (2.74)	89.5 (2.71)	NA	NA
50–59	85.9 (1.79)	91.0 (1.63)†	NA	NA
60–64	87.0 (2.74)	92.7 (1.43)	NA	NA
65–74	NA	NA	99.5 (0.30)	99.3 (0.30)
≥75	NA	NA	99.8 (0.20)	99.9 (0.11)
Sex				
Male	84.8 (1.80)	92.8 (1.22)*	99.8 (0.19)	99.5 (0.27)
Female	84.7 (1.71)	87.6 (1.65)	99.5 (0.33)	99.5 (0.28)
Race/ethnicity				
Non-Hispanic white	87.6 (1.83)	92.6 (1.27)†	100.0 (0.0)	99.9 (0.06)
Non-Hispanic black	85.4 (2.27)	91.4 (1.94)†	99.8 (0.15)	99.8 (0.16)
Hispanic	72.0 (3.63)	81.9 (3.52)†	98.3 (1.51)	96.9 (1.48)
Mexican American	71.6 (4.22)	78.9 (4.87)	97.5 (2.48)	94.8 (2.44)
Non-Hispanic Asian	91.3 (4.28)	95.1 (4.20)	96.5 (2.43)	100.0
Non-Hispanic other	68.3 (13.4)	73.0 (6.36)	100.0	100.0
Education				
Less than high school	71.4 (3.78)	86.4 (2.49)*	99.6 (0.31)	98.2 (0.83)
High school graduate	86.2 (2.02)	86.1 (2.48)	99.4 (0.53)	100.0
Greater than high school education	89.6 (1.40)	93.4 (1.13)†	99.9 (0.06)	99.9 (0.08)
Family income ($)				
<35,000	75.7 (2.34)	86.0 (2.00)*	99.8 (0.10)	99.3 (0.35)
35,000–49,999	76.7 (4.44)	85.0 (3.82)	100.0	99.3 (0.62)
50,000–74,999	90.6 (2.15)	88.5 (2.63)	100.0	99.3 (0.74)
75,000–99,999	94.9 (2.07)	97.6 (1.59)	97.5 (2.48)	100.0
≥100,000	96.0 (1.53)	96.1 (2.01)	98.7 (1.27)	100.0
Marital status				
Married or living with partner	86.2 (1.81)	90.7 (1.36)†	99.6 (0.31)	99.5 (0.30)
Divorced or separated	82.7 (3.11)	88.9 (1.92)	99.8 (0.17)	99.1 (0.58)
Widowed	85.0 (5.34)	95.3 (2.19)	99.9 (0.11)	99.8 (0.17)
Never married	80.2 (3.53)	88.2 (2.59)	98.4 (1.14)	99.6 (0.40)
Diabetes duration (years)				
<5	80.8 (2.34)	89.9 (1.73)*	99.8 (0.15)	98.5 (0.97)
5–15	87.3 (1.58)	88.7 (1.77)	99.5 (0.40)	100.0
>15	87.6 (3.08)	94.7 (1.21)†	99.7 (0.28)	99.5 (0.29)
Diabetes medication				
Insulin only	85.6 (3.38)	92.5 (1.87)	100.0	100.0
Oral only	84.4 (1.74)	90.1 (1.48)†	99.6 (0.28)	99.3 (0.32)
Insulin and oral	90.7 (2.50)	95.1 (1.33)	99.3 (0.66)	99.9 (0.13)
None	80.5 (2.92)	83.1 (3.41)	99.8 (0.15)	99.5 (0.37)
Hypertension				
Yes	86.7 (1.53)	91.4 (1.06)†	99.9 (0.06)	99.6 (0.18)
No	81.2 (2.21)	87.4 (2.30)	98.6 (0.99)	99.1 (0.68)
Heart condition/disease‡				
Yes	90.5 (1.91)	93.1 (2.29)	100.0	99.8 (0.11)
No	83.1 (1.58)	89.2 (1.13)*	99.4 (0.32)	99.4 (0.30)
Weak or failing kidneys§				
Yes	86.4 (4.73)	93.4 (2.08)	100.0	98.9 (1.07)
No	84.6 (1.36)	89.9 (1.10)*	99.6 (0.21)	99.6 (0.17)
Vision problems‖				
Yes	81.7 (3.43)	89.0 (2.45)	99.5 (0.46)	99.5 (0.40)
No	85.3 (1.35)	90.4 (1.20)*	99.7 (0.21)	99.5 (0.22)

Table 1—Continued

	Prevalence of health insurance coverage			
	Age 18–64 years		Age ≥65 years	
	2009	2016	2009	2016
Visited physician in past 12 months				
Yes	87.6 (1.29)	92.3 (0.98)*	99.7 (0.20)	99.7 (0.16)
No	68.8 (3.95)	78.2 (3.51)	99.3 (0.51)	97.6 (1.68)
Visited eye doctor in past 12 months				
Yes	93.0 (0.99)	94.5 (0.89)	99.8 (0.14)	99.7 (0.17)
No	75.3 (2.43)	84.9 (1.93)*	99.3 (0.50)	99.0 (0.53)
Visited foot doctor in past 12 months				
Yes	94.0 (2.86)	93.0 (1.90)	99.3 (0.62)	99.9 (0.13)
No	82.8 (1.41)	89.4 (1.21)*	99.8 (0.14)	99.4 (0.27)

Data are % (SE). NA, not applicable. *P < 0.01, 2016 vs. 2009. †P < 0.05, 2016 vs. 2009. ‡Includes coronary heart disease, angina pectoris, heart attack, and other heart conditions. §Weak or failing kidneys does not include kidney stones, bladder infections, or incontinence. ‖Trouble seeing even with glasses or contact lenses.

Among adults with diabetes age 18–64 years, the prevalence of Medicaid/other public insurance coverage significantly increased between 2009 and 2016. A provision of the ACA was to expand Medicaid coverage by creating a higher Medicaid income eligibility level across the country to allow more Americans to qualify. In 2012, the U.S. Supreme Court ruled that each state has the authority to decide whether to expand Medicaid, and by 2016, only 32 states elected to expand Medicaid coverage. Nevertheless, people age 18–64 years with an income <$35,000 had a 10.3% increase in health insurance coverage between 2009 and 2016. Thus, the ACA seems to be helping lower income people with diabetes to gain access to health insurance, likely through Medicaid.

The prevalence of private insurance decreased and the prevalence of Medicare Part D (prescription coverage) increased between 2009 and 2016 for adults with diabetes age ≥65 years. As part of the ACA, participants enrolled in Medicare Part D can save money on brand-name drugs once they reach the plan coverage limit (or have a coverage gap) (10). Therefore, the prescription drug coverage offered under the ACA Medicare plan may offer greater flexibility and reduce out-of-pocket costs compared with private insurance for those eligible for Medicare.

Among all adults with diabetes, 600,000 (8.0%) did not have health insurance in 1989, 2.03 million did not have health insurance in 2009 (9.9%), and 1.35 million did not have insurance in 2016 (5.8%) (1,11). These figures represent a 41%

reduction in the percentage of uninsured adults with diabetes between 2009 and 2016. Soon after the institution of the ACA, it was already clear that more adults with diabetes had health insurance and the percentage without insurance had decreased, despite an increase in diabetes prevalence (12). Nevertheless, in 2016, among adults with diabetes age 18–64 years, those without health insurance were younger and more likely to be women and Hispanic and to have less education and lower family income than those with health insurance. Despite improvements in coverage rates, these subgroups remain vulnerable to the effects of being uninsured.

There are substantial health care and financial risks if, as a result of changes to the ACA, the uninsured population again expands (13). However, further assessment is needed to determine how insurance coverage translates to prevention of diabetes-related complications or comorbidities. Results from a prior national study among adults with diabetes found that lack of health insurance was associated with worse glycemic control, higher blood pressure, and poorer cholesterol levels (14). In the current study, among adults age 18–64 years with diabetes, the prevalence of health insurance coverage significantly increased not only for those with diabetes comorbidities but also for those without, suggesting that healthier adults with diabetes are acquiring health insurance. In addition, even those who had not seen a specialist doctor in the past year had a significant increase in insurance coverage. These findings raise the likelihood that more people with diabetes may receive the preventive services that can delay or prevent the development of complications and comorbidities.

The financial burden of diabetes is substantial. In 2012, the estimated total cost of diabetes in the U.S. was $245 billion, and people with diagnosed diabetes had average medical expenditures 2.3 times higher than those without diabetes (15). Health insurance coverage needs to be affordable to improve access to health care and, consequently, reduce diabetes-related complications. A recent national study showed that lower-income adults with diabetes who had high-deductible insurance plans had significantly lower service use for primary care and specialty visits than lower-income adults with no
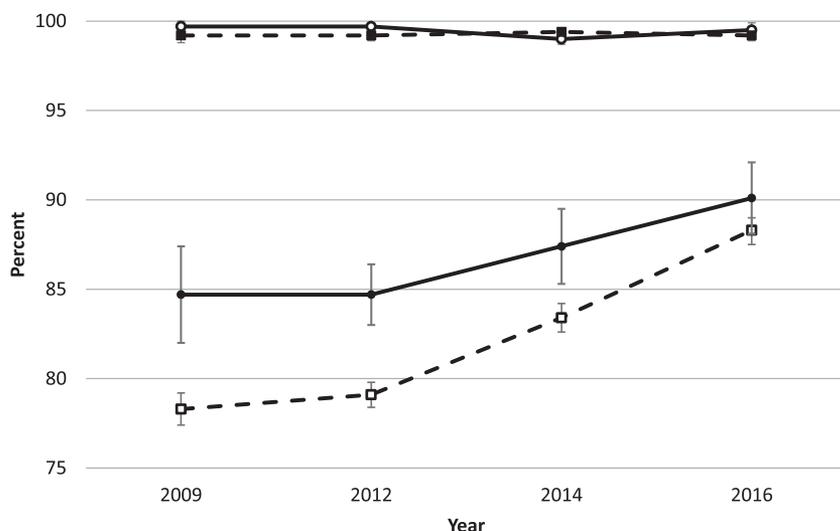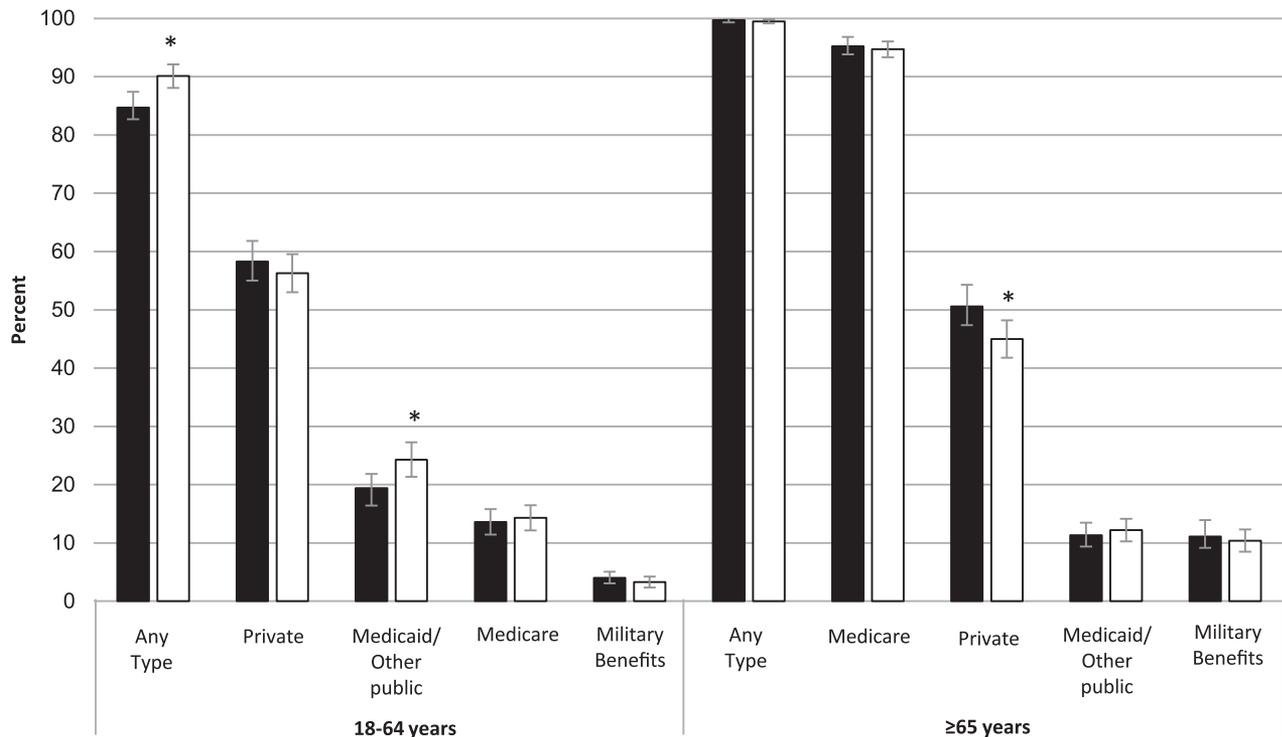
Figure 1—Prevalence of health insurance coverage between 2009 and 2016 by age and diabetes status. ●, diabetes, age 18–64 years; ○, diabetes, age ≥65 years; □, no diabetes, age 18–64 years; ■, no diabetes, age ≥65 years.

Figure 2—Percentage of health insurance coverage and type of coverage among adults with diabetes by age. Black bars, 2009; white bars, 2016. Error bars represent 95% CIs. *$P < 0.05$, 2016 vs. 2009.

deductible or a low deductible (16). In the current study, the percentage of income spent on family medical costs significantly decreased over the study period among those with the lowest income, regardless of age; family medical costs were out-of-pocket expenses for medical and dental care and excluded premiums, over-the-counter drugs, and reimbursed costs. These results highlight a major achievement of the ACA to reduce the out-of-pocket cost of health care, especially for those with limited income, and may translate to more use of medical services. We estimate that family medical costs were reduced from $1,103 to $840 per year for a family earning <$35,000. This cost analysis should be interpreted as an initial estimate because the granularity of the data is limited. Family medical costs and family income were reported as a categorical variable, which necessitated the use of the midpoint of the cost and income categories. Nevertheless, the ACA must address health care costs to be sustainable because government subsidies, which could be eliminated, currently account for the reduced costs to patients.

A strength of this study is the use of nationally representative data that allow generalization to the U.S. adult noninstitutionalized population. Limitations were that we could not distinguish between type 1 and type 2 diabetes and that health insurance was self-reported. However, previous work has shown that self-report

Table 2—Income spent on medical costs in past year among adults with diabetes, 2009 and 2016

	Family medical costs†				Private insurance premiums‡			
	Age 18–64 years		Age ≥65 years		Age 18–64 years		Age ≥65 years	
	2009	2016	2009	2016	2009	2016	2009	2016
n	1,581	1,723	1,120	1,796	520	587	337	468
Overall	4.1 (0.18)	3.6 (0.14)*	5.2 (0.25)	4.2 (0.19)*	3.8 (0.20)	4.5 (0.21)	7.8 (0.52)	5.0 (0.32)*
Family income ($)§								
0–34,999	6.3 (0.40)	4.8 (0.30)*	7.1 (0.40)	5.8 (0.34)*	12.2 (2.28)	10.0 (1.47)	12.8 (0.58)	11.0 (1.13)
35,000–49,999	3.8 (0.24)	3.8 (0.32)	3.7 (0.34)	3.8 (0.31)	4.0 (0.80)	6.8 (1.11)	5.5 (0.71)	5.5 (0.37)
50,000–74,999	2.7 (0.16)	3.7 (0.32)	2.7 (0.25)	2.8 (0.20)	4.1 (0.47)	4.3 (0.66)	3.1 (0.34)	4.1 (0.39)
75,000–99,999	2.1 (0.20)	2.4 (0.22)	2.3 (0.33)	2.0 (0.21)	2.7 (0.38)	3.4 (0.41)	4.5 (0.95)	3.1 (0.61)
≥100,000	1.9 (0.16)	2.2 (0.13)	2.3 (0.27)	2.1 (0.19)	3.0 (0.29)	3.9 (0.31)	2.5 (0.66)	2.4 (0.37)

Data are % (SE). *$P < 0.05$ for 2016 vs. 2009 within each age strata. †Family medical costs are the midpoint of the following categories: $0, <$500, $500–$1,999, $2,000–$2,999, $3,000–$4,999, ≥$5,000. Values ≥$5,000 are coded as $5,000. Family medical costs include out-of-pocket costs for medical and dental care and exclude health insurance premiums, over-the-counter drugs, and reimbursed costs. ‡Among those with private insurance. Private insurance premiums are median costs. Values ≥$20,000 are coded as $20,000. §Denominators are the midpoint of family income category.

of insurance coverage performs well in cognitive testing (17). Sample size was small for some subgroups, which may have limited our ability to detect significant differences in coverage for these groups. Furthermore, we could not assess changes in diabetes severity and its association with changes in family medical costs. Although the ACA was signed into law in 2010, many of the provisions did not go into effect until 2014 or later. Thus, additional studies are needed to see how health care laws fully affect health insurance coverage in the U.S. Although we assumed that the observed changes in health insurance coverage that occurred between 2009 and 2016 were due to implementation of the ACA, other unmeasured factors also may have contributed to the increase in coverage. Finally, because of the design of the NHIS, we could not assess state-level changes in Medicaid coverage to compare coverage in states with Medicaid expansion with states without Medicaid expansion.

To our knowledge, this study is the first to demonstrate that the ACA has resulted in an increase in health insurance coverage among adults with diabetes in the U.S. and the first to show that those with the lowest family incomes had a reduction in the proportion of income spent on family medical costs. Health insurance coverage is a first step toward access to care, disease management, and prevention of complications and comorbidities. Given the national economic burden that diabetes imposes, especially as the U.S. population ages, results from this study should inform current discussions on health care reform. The assessment of how any future changes in the ACA affect health insurance coverage and health outcomes among Americans with diabetes will be important.

References

1. Stark Casagrande S, Cowie CC. Health insurance coverage among people with and without diabetes in the U.S. adult population. Diabetes Care 2012;35:2243–2249

2. Centers for Disease Control and Prevention. *National Diabetes Statistics Report, 2014*. Atlanta, National Center for Chronic Disease Prevention and Health Promotion, Division of Diabetes Translation, 2014

3. Nelson KM, Chapko MK, Reiber G, Boyko EJ. The association between health insurance coverage and diabetes care; data from the 2000 Behavioral Risk Factor Surveillance System. Health Serv Res 2005;40:361–372

4. Centers for Disease Control and Prevention (CDC). Vital signs: health insurance coverage and health care utilization— United States, 2006–2009 and January-March 2010. MMWR Morb Mortal Wkly Rep 2010;59:1448–1454

5. Wilper AP, Woolhandler S, Lasser KE, McCormick D, Bor DH, Himmelstein DU. A national study of chronic disease prevalence and access to care in uninsured U.S. adults. Ann Intern Med 2008;149:170–176

6. Casagrande SS, Cowie CC. Health insurance and diabetes. In *Diabetes in America*. 3rd ed. Cowie CC, Casagrande SS, Menke A, et al., Eds. Bethesda, MD, National Institutes of Health, 2017 (NIH Pub. No. 17-1468)

7. Department of Health and Human Services. Health care: about the Affordable Care Act [Internet], 2015. Available from https://www.hhs.gov/healthcare/about-the-law/index.html. Accessed 3 January 2017

8. Centers for Disease Control and Prevention; U.S. Department of Health and Human Services. *NHIS Survey Description*. Hyattsville, MD, National Center for Health Statistics, 2010

9. Writing Team for the Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications Research Group. Effect of intensive therapy on the microvascular complications of type 1 diabetes mellitus. JAMA 2002;287:2563–2569

10. Centers for Medicare & Medicaid Services. Your Medicare coverage choices [Internet], 2012. Available from https://www.medicare.gov/sign-up-change-plans/decide-how-to-get-medicare/your-medicare-coverage-choices.html. Accessed 30 January 2017

11. Harris MI, Cowie CC, Eastman R. Health-insurance coverage for adults with diabetes in the U.S. population. Diabetes Care 1994;17:585–591

12. Menke A, Casagrande S, Geiss L, Cowie CC. Prevalence of and trends in diabetes among adults in the United States, 1988-2012. JAMA 2015;314:1021–1029

13. Eltorai AE, Eltorai MI. The risk of expanding the uninsured population by repealing the Affordable Care Act. JAMA 2017;317:1407–1408

14. Zhang X, Bullard KM, Gregg EW, et al. Access to health care and control of ABCs of diabetes. Diabetes Care 2012;35:1566–1571

15. McEwen LN, Herman WH. Health care utilization and costs of diabetes. In *Diabetes in America*. 3rd ed. Cowie CC, Casagrande SS, Menke A, et al., Eds. Bethesda, MD, National Institutes of Health, 2017 (NIH Pub. No. 17-1468)

16. Rabin DL, Jetty A, Petterson S, Saqr Z, Froehlich A. Among low-income respondents with diabetes, high-deductible versus no-deductible insurance sharply reduces medical service use. Diabetes Care 2017;40:239–245

17. Scanlon P. The National Health Interview Survey family health insurance section and proposed Affordable Care Act-related questions: 2014 cognitive interviewing results. Hyattsville, MD, National Center for Health Statistics, 2014