Published in final edited form as:

J Affect Disord. 2016 May ; 195: 119–126. doi:10.1016/j.jad.2016.02.011.

Impact of diagnosed depression on healthcare costs in adults with and without diabetes: United States, 2004–2011

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Abstract

Objective—This study used the Medical Expenditures Panel Survey (MEPS) to estimate the cost of diabetes, depression, and comorbid diabetes and depression over 8 years.

Methods—An 8-year pooled dataset was created using the household and medical provider components of MEPS. Medical expenditures were adjusted to a common 2014 dollar value. Analyses used responses of 147,095 individuals 18 years of age for the years 2004–2011. The dependent variable in this study was total healthcare expenditure and the primary independent variables were diabetes and depression status. A two-part (probit/GLM) model was used to estimate the annual medical spending and marginal effects were calculated for incremental cost.

Results—In the pooled sample, after adjusting for socio-demographic factors, comorbidities and time trend covariates, the incremental cost of depression only was \$2,654 (95% CI 2,343–2,966), diabetes was \$2,692 (95% CI 2,338–3,046), and both was \$6,037 (CI 95% 5,243–6,830) when compared to patients with none. Based on the unadjusted mean, annual average aggregate cost of depression only was estimated at \$238.3 billion, diabetes only \$150.1 billion and depression and diabetes together was \$77.6 billion.

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Conflict of Interest: The authors report no potential conflicts of interest relevant to this article.

Disclaimer: This article represents the views of the authors and not those of NIH, VHA or HSR&D.

Conflicts of Interest and Source of Funding: No financial, consultant, institutional or other conflicts of interest.

Author Contributions: LEE obtained funding for the study. LEE, KB, RJW, and CED designed the study and developed the analysis. KB and LEE acquired and analyzed the data. LEE, KB, RJW, and CED contributed to interpretation and critically revised the manuscript for important intellectual content. All authors approved the final manuscript.

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Conclusion—Costs at both the individual and aggregate level are significant, with comorbid diagnoses resulting in higher incremental costs than the sum of the costs for each diagnosis alone. In addition, while the cost of depression increased over time, the cost of diabetes decreased over time, much due to decreased inpatient costs. This study highlights the tremendous cost savings possible through more aggressive screening, diagnosis, and treatment of depression.

Keywords

diabetes; depression; cost; comorbidities; expenditures

INTRODUCTION

Individuals with diabetes are at an increased risk of severe complications including blindness, kidney failure, stroke and amputation, while at the same time facing medical expenditures 2.3 times higher than those without diabetes. (1) The total cost to the United States was estimated in 2007 to be \$174 billion, including \$116 billion in medical expenditures and \$58 billion in absenteeism and reduced productivity. (2) When compared to those without diabetes, hospital inpatient stay, prescription medicine, and office-based visits were 2.6, 3.4 and 1.9 higher, respectively, and increased expenditures persisted over time. (3) Given the growing prevalence of diabetes, currently impacting 9.3% of the United States populations, these healthcare costs are significant factors in the economic burden of healthcare. (1)

Depression is the second leading cause of years lived with disability globally, increasing 53% between 1990 and 2013. (4) In the United States alone, 7.6% of the population older than 12 years report symptoms of depression during the preceding 2 weeks. (5) The economic burden of individuals with depression rose 21.5% between 2005 and 2010, with an estimated total cost of \$210.5 billion in 2010. (6) Much of the increase was attributed to higher direct medical cost, which accounts for 50% of the total costs. (6) However, for every dollar of direct costs, \$6.60 is spent on comorbidities and workplace costs. (6) In fact, comorbid conditions are attributed with the largest portion of the economic burden of depression. (6) Costs for a sample of Medicare patients were significantly higher for those with depression as those without, with only a small portion of those costs going towards specialty mental health care. (7)

Diabetes and depression are highly prevalent, with 11% of those with diabetes diagnosed with major depression. (8) Compounding this, many patients with diabetes have undiagnosed depression, increasing the need for improved diagnosis. (9) These comorbid conditions have been associated with increased mortality, lost work productivity, increased disability, decreased quality of life, and increased healthcare costs. (10) Economic burden includes increased hospitalization, outpatient visits, emergency department visits, and medication costs. (11–14) Overall, total costs for patients with diabetes and depression are 2 to 4.5 times higher than patients who are not depressed, with costs increasing as depressive symptom severity increased. (15–17)

Given the growing burden of both diabetes and depression and the increased costs associated with these medical diagnoses, an understanding of the economic burden over time is

warranted. As a result, this study used the Medical Expenditures Panel Survey (MEPS) to estimate the economic burden of diabetes, depression, and comorbid diabetes and depression in the United States using an 8-year pooled dataset.

METHODS

Data Source and Sample

We analyzed the responses of 147,095 (weighted sample of 190,212,167) individuals 18 years of age from the Medical Expenditure Panel Survey (MEPS) for the years 2004–2011. MEPS is an ongoing national household survey for the civilian non-institutionalized U.S. population. (18,19) The data are collected through in-person interviews and include information on the respondents' health status, demographic and socio-economic characteristics, employment, missed workdays, access to care and satisfaction with healthcare. The survey collects comprehensive data on healthcare utilization and expenditure and has a complex survey design, which includes multistage sampling, clustering and stratification with oversampling of minorities. (20) Information on the Household Component (HC) is collected by self-report. (21) For the Medical Provider Component (MPC), data is collected on medical and financial variables from all types of health care providers in order to validate and supplement information received from the MEPS-HC respondents. (21) Diagnoses coded according to ICD-9-CM (International Classification of Disease, Ninth Revision, Clinical Modification) are also collected as part of the MPC. The medical conditions and procedures reported by the MEPS-HC related to diagnosed depression was recorded by the interviewer as verbatim text and then converted by professional coders to ICD-9-CM codes. (21) The error rate for any coder did not exceed 2.5% on verification. (21) To protect the confidentiality of respondents, fully specified ICD-9-CM codes were collapsed to three digits (19).

For each year, we merged data from the HC survey of the medical condition files and full-year consolidated files using the unique person identifier (DUPERSID) on a one-to-one match (19). To ensure sufficient sample size and robust estimation for our analysis (22), we pooled the 8-year MEPS data. We adjusted the analytic sampling weight variable by dividing it by the number of years being pooled. The sum of these adjusted weights represents the average annual population size for the pooled period. (23) The 2004–2011 medical expenditures were adjusted to a common 2014 dollar value using the consumer price index obtained from the Bureau of Labor Statistics (BLS). (24)

Measures

The dependent variable in this study was total healthcare expenditure, defined as the sum of direct payments for office-based medical, hospital inpatient (including zero night stays) and outpatient, emergency department, pharmacy, dental, home health and other medical care. (20) The primary independent variables were diabetes and depression status. Presence of diabetes was defined as a positive response to “Has person X ever been told by a health professional that person has diabetes (except during pregnancy?)”. Presence of depression was defined by diagnosis: identified by ICD-9-CM codes of 296, 300, 309 and 311 recorded in the MPC file. (25)

Covariates

All controlled covariates used for analysis were based on self-report. Binary indicators of co-morbidities were based on a positive response to a question “Have you ever been diagnosed with...” Cardio Vascular Disease (CVD) indicates a positive response to a question “Have you ever been diagnosed with coronary heart disease or angina or myocardial infarction or other heart diseases?” Previous studies showed that the binary indicator of disease is more effective in accounting for disease burden. (26, 27) Race/ethnic groups are categorized as: Non-Hispanic White (NHW), Non-Hispanic Black (NHB), Hispanic or others. Education was categorized as: less than high school (grade 11), high school (grade 12) and college or more (grade 13). Marital status was coded as: married, non-married (widowed/divorced/separated) and never married. Gender was dichotomized and age was coded into three age groups: 18–44, 45–64 and 65 years. Census region was coded as: Northeast, Midwest, South and West. Metropolitan Statistical Areas (MSA) was dichotomized based on population as of end of the year. Health insurance was coded as: private, public only and uninsured at all time in the year. The income level was defined as a percentage of the poverty level and grouped in to four categories: poor or negative (<125%), low income (125% to less than 200%), middle income (200% to less than 400%) and high income (400%). Calendar year was grouped into 2004/05, 2006/07, 2008/09, 2010/11 for the pooled data.

Statistical Analysis

Unadjusted means were used to compare the total healthcare expenditure by depression and diabetes categories. Unadjusted analyses were also conducted on costs by different categories. Standard pairwise comparison methods of Sidak, Scheffe, Bonferroni and Tukey were used to compare the pooled unadjusted total mean expenditures among none, depression only, diabetes only, and depression/diabetes categories. (28,29) Tests were consistent across the four methods.

A two-part model was then used to estimate the annual medical spending. (30–36) The distribution of annual medical care expenditures has two important characteristics: it has a mass point at zero (many people with zero medical care costs in a given year) and it is right skewed (few individuals have very expensive medical expenditures). (3, 36) To address this problem we followed Manning and Mullahy’s recommendation of a two-part generalized linear model that allows for mixed discrete-continuous variables (32). A probit model for the probability of observing a zero versus positive medical expenditure, and then a generalized linear model (GLM) to estimate the adjusted association of total medical expenditures conditional on a positive medical expenditure was used. (30–36) The two-part model can accommodate the complex survey design by taking into account the sampling weight, variance estimation stratum, and primary sampling unit (clustering) to generalize the study results to the US population. (3) The use of GLM in the second part of the model has an advantage over log Ordinary Least Squares (OLS) since it relaxes the normality and homoscedasticity assumptions and avoids bias associated with retransforming to the raw scale. (34) Of note is that the two-part model allows users to leverage the capabilities of the margins command to calculate the marginal effect and their standard errors from the combined first and second part of the model. (34)

The Park test, used as a diagnostic test to examine the model fit, verified the use of a gamma distribution with a log link as the best-fitting GLM for consistent estimation of coefficients and marginal effects of medical expenditures. (21,30,36,38) Using the Variance inflation factor (VIF) test, and taking into account the complex survey design, it was determined that no multicollinearity problems existed between predictors of the two-part model. The F-test for the two-part regression model was found to be significant, indicating good significance of the overall model.

To control for confounding, socio-demographic factors including age, sex, race, marital status, education, health insurance, metropolitan statistical area (MSA) status, region, income level and comorbidities were included in the final model. All analyses were performed at the person-level using STATA 13 (StataCorp LP College Station, TX). Only estimates that are statistically significant at the $p < 0.05$ level are discussed in the paper.

RESULTS

Demographic characteristics

Sample demographics are shown in Table 1. Of the total 147,095 adults in the pooled sample, 109,012 (74.1%) individuals had neither depression nor diabetes, 21,261 (14.5%) had depression only, 13,111 (8.9%) had diabetes only and 3,709 (2.5%) had both depression and diabetes. Compared to those with neither, those with both depression and diabetes were more likely to be ages 45–64, female, not married, have lower education, lower income, public insurance and live in the South and non-MSA areas. Individuals in all three categories were more likely to have additional comorbidities than those with neither diabetes nor depression.

Unadjusted cost differences

The results of unadjusted mean medical expenditures by healthcare services over time are shown in Table 2. All costs are per person per year. The overall unadjusted total mean medical expenditures for patients with neither diabetes nor depression was \$4,479 (95% CI 4,363–4,595), for depression only \$8,187 (95% CI 7,887–8,487), for diabetes only \$10,411 (95% CI 10,005–10,816), and for both depression and diabetes \$17,585 (95% CI 16,472–18,699). The total mean medical expenditures for neither increased from 2004/05 (\$4,352 95% CI 4,072–4,632) to 2010/11 (\$4,818 95% CI 4,567–5,068) and for depression only from 2004/05 (\$7,799 95% CI 7,319–8,280) to 2008/09 (\$8,509 CI 7,835–9,183). Conversely, the total mean expenditure for diabetes only declined from 2004/05 (\$11,063 CI 10,065–12,061) to 2010/11 (\$10,028 CI 9,266–10,790), and for both depression and diabetes from 2004/05 (\$18,470 CI 15,648–21,292) to 2010/11 (\$16,518 CI 14,923–18,114). Inpatient, office-based, and prescription medication costs were the three larger components of total medical expenditures. Pairwise comparisons showed that differences in total unadjusted mean medical expenditures between all groups were significant.

Figure 1 shows the mean expenditures by healthcare services per person per year. Those with neither diabetes nor depression show a slight increase of total mean expenditures over time, while those with depression only show a more dramatic increase over the time period.

Those with diabetes only show a slight decrease of total mean expenditures overtime, and those with both diabetes and depression show a more dramatic decrease overtime. Throughout 2004 to 2011 those with depression and diabetes have nearly twice the total mean expenditures of those with either depression or diabetes alone. Those with either depression or diabetes show higher total mean expenditures than those with none, and by 2011 have similar overall total expenditures as a result of the increase for depression and decrease for diabetes expenditures. The decrease of total mean expenditures overtime for those with both depression and diabetes results from significant decreases in inpatient cost for those with both depression and diabetes: 2004/05 (\$7,013 CI 4,772–9,254) to 2010/11 (\$4,570 CI 3,607–5,532).

Adjusted incremental cost differences

The results of the adjusted two-part model on the incremental costs associated with depression and diabetes categories, socio-demographic factors, comorbidities and time trends are shown in Table 3. Average incremental costs are per person per year. In the pooled sample, after adjusting for socio-demographic factors, comorbidities and time trend covariates, the incremental cost of depression only relative to neither diagnosis was increased by \$2,654 (95% CI 2,343–2,966), diabetes was increased by \$2,692 (95% CI 2,338–3,046), and both depression and diabetes was increased by \$6,037 (CI 95% 5,243–6,830) when compared to patients with none.

Estimated US burden of depression and diabetes

Finally, we estimated the average aggregate cost during 2004–2011. Based on the unadjusted mean, the annual average aggregate cost of depression only was estimated at \$238.3 billion, diabetes only \$150.1 billion and depression and diabetes together was \$77.6 billion. The adjusted total incremental cost for depression only increased by \$77.3 billion, diabetes only by \$38.8 billion, and depression and diabetes by \$26.6 billion per year in the US population, when compared to those with neither.

DISCUSSION

Based on a national sample of adults, we found 14.5% had depression only, 8.9% had diabetes only and 2.5% had both depression and diabetes. Compared to those with neither, those with depression and/or diabetes were more likely to be older, have lower education and/or income, and additional comorbidities. While in unadjusted analyses the pooled sample showed higher expenditures for those with diabetes than those with depression, after adjustment both showed a similar incremental cost of approximately \$2,600 per individual per year than those with neither. Those with both diabetes and depression had significantly higher costs, with an incremental cost of above \$6,000 per individual per year. The differences in cost remained relatively stable over time with a slight decrease in diabetes costs and a slight increase in depression costs between 2004 and 2011. This cost in annual aggregate was estimated at \$238.3 billion for depression only, \$150.1 billion for diabetes only, and an additional \$77.6 billion for comorbid depression and diabetes.

This study adds to our understanding of the significant economic burden created by comorbidities, specifically comorbid conditions for two highly prevalent diseases. The incremental cost of either or both of these diseases has changed little between 2004 and 2011. Given the average cost of over \$4,000 per person per year spent on healthcare, this incremental cost of diabetes (additional \$2,654), depression (additional \$2,692), and both conditions (additional \$6,034) can have a major impact on the lives of individuals. With the exception of stroke and CVD, other comorbidities had an incremental costs of less than \$2,000 per year. This study highlights the significant burden placed on individuals, especially within the context that comorbid depression and diabetes is also associated with less personal income per year. (39) In addition, an important finding of this study is that comorbid depression and diabetes results in higher incremental costs than the sum of the costs for each diagnosis alone. Considering the economic perspective may help policy makers recognize treating depression can have a dramatic effect on cost reduction beyond just the cost of depression alone. Most medical costs incurred by patients with type 2 diabetes is related to complications and comorbidities. (40) In a population-based sample of people with diabetes, a study found that having major depression was associated with an approximately 70% increase in overall health service costs compared with not having any depressive disorder. (41) Our study supports these findings and further highlights the tremendous cost savings possible through more aggressive treatment.

A second important finding is that while costs of depression increased over time, the cost of diabetes decreased over time. This may indicate the emphasis placed on managing physical comorbidities related to diabetes is in fact decreasing costs to the individual. Breaking the total expenditures into cost categories, it can be seen that decreases over the 8 years in inpatient costs for patients with diabetes led to a decrease in total costs for this group. This was also the case for patients with both diabetes and depression. This is an important finding in that efforts made to address comorbidities and better manage diabetes should lead to decreased need for inpatient services. Mental comorbidities, and specifically comorbid depression, may need additional emphasis in screening, diagnosis and treatment, to slow the increasing cost over time as untreated symptoms impact the health of individuals. Strategies such as collaborative depression care in the primary care setting may offer an effective way to improve treatment of mental comorbidities at the same time as physical comorbidities. A recent review found that preliminary evidence suggests treatment of depression for individuals with diabetes is cost-effective, specifically collaborative care programs. (42) Providers, insurers and health policy makers should increase awareness of the medical and economic burden of depression whose cost has risen to match a common chronic physical disease, diabetes, and whose combined cost increases individual expenditures above simply an additive value of the two conditions.

This study is strengthened by the use of nationally representative data and a novel two-part cost estimation model, however, there are several limitations worth mentioning. First, though the data was pooled to provide trends over time, it was collected using a cross-sectional panel design, so causality cannot be discussed. Secondly, self-reported comorbidities may not be as reliable as determination of medical diagnosis, so additional work should be done on the cost of other comorbidities. Finally, the data was weighted to reflect the US population, but cannot be generalized outside the United States.

In conclusion, the economic burden of diabetes and depression in adults is large and has not changed significantly between 2004 and 2011. While the cost of diabetes has dropped slightly, the cost of diagnosed depression has increased to incrementally \$2,654 per person per year. The cost of both diabetes and depression also dropped slightly but continues to cost incrementally \$6,037 more than neither diagnosis, with a pooled estimate of \$17,585 per individual per year spent on healthcare. Given the prevalence of both diabetes and depression, the unadjusted aggregate cost to the US is sizeable, indicating a significant economic burden to individuals diagnosed with these diseases and the health systems treating them.

Acknowledgments

Funding Source: This study was supported by Grant K24DK093699-01 from The National Institute of Diabetes and Digestive and Kidney Disease (PI: Leonard Egede).

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HIGHLIGHTS

Estimated incremental cost of comorbid diabetes and depression in U.S. from 2004–2011.

Incremental cost of depression was \$2,506, diabetes was \$2,673 and both were \$5,917.

Annual aggregate cost in billions was \$288.2 for depression, \$119.1 for diabetes and \$99.0 for both

Incremental cost changed little between 2004 and 2011; but aggregate costs remain high.

Figure 1.
Medical expenditures by diabetes and depression status among U.S. adults: 2004–2011

Table 1

Sample demographics by depression and diabetes categories among U.S. adults

Variables	All (%)	None (%)	Depression only (%)	Diabetes only (%)	Depression and diabetes (%)	P-value
N (n)	190,212,167 (147,095)	142,279,537 (109,012)	29,107,263 (21,261)	14,413,188 (13,113)	4,412,179 (3,709)	
Age category						
Age 18–44	45.1	49.5	44.2	13.2	14.8	<0.001
Age 45–64	35.9	33.6	39.8	45.8	50.8	
Age 65–85	19.0	16.9	16.0	41.0	34.4	
Gender						
Male	45.6	47.8	33.1	52.4	37.2	<0.001
Female	54.4	52.2	66.9	47.6	62.8	
Race/ethnicity						
Non-Hispanic White	71.7	70.8	81.0	61.0	74.7	<0.001
Non-Hispanic Black	10.6	10.8	6.5	17.0	9.5	
Hispanic or Other	17.7	18.4	12.5	22.0	15.8	
Marital status						
Married	55.3	56.4	47.4	60.7	51.0	<0.001
Non-married ⁺	21.3	18.3	29.1	30.4	38.7	
Never married	23.4	25.3	23.5	8.9	10.3	
Education category						
<High school	16.8	15.8	16.3	25.0	25.1	<0.001
High school	30.1	29.3	30.9	34.3	34.9	
College or more	53.1	54.9	52.8	40.7	40.0	
Insurance						
Private	71.5	73.7	67.8	62.4	54.6	<0.001
Public	16.8	13.8	21.7	29.3	38.8	
Uninsured	11.7	12.5	10.5	8.3	6.6	
Metropolitan statistical status						
MSA	83.4	83.9	83.0	80.9	78.3	<0.001

Variables	All (%)	None (%)	Depression only (%)	Diabetes only (%)	Depression and diabetes (%)	P-value
Non-MSA	16.6	16.1	17.0	19.1	21.7	
Census region						
Northeast	18.6	18.8	17.7	18.4	16.7	<0.001
Midwest	22.7	22.5	24.6	20.4	23.6	
South	36.1	35.9	34.3	39.9	40.3	
West	22.6	22.8	23.4	21.3	19.4	
Poverty category						
Poor/NEA	15.2	13.5	20.2	18.5	25.8	<0.001
Low Income	12.9	12.4	13.6	15.9	16.3	
Middle Income	30.2	30.2	30.0	30.8	29.7	
High Income	41.7	43.9	36.2	34.8	28.2	
Chronic conditions						
Hypertension	33.9	28.4	35.2	72.5	77.3	<0.001
CVD	14.1	11.3	16.7	29.1	39.4	<0.001
Stroke	3.6	2.5	4.8	9.0	14.7	<0.001
Emphysema	2.1	1.5	4.0	3.8	8.5	<0.001
Joint pain	37.6	33.0	48.2	52.1	66.3	<0.001
Arthritis	26.5	21.8	35.0	44.9	60.7	<0.001
Asthma	10.4	9.0	15.3	10.9	22.1	<0.001
Year category						
Year 2004/05	24.2	24.5	24.6	21.6	20.1	<0.001
Year 2006/07	24.6	24.7	24.7	23.8	24.6	
Year 2008/09	25.4	25.3	24.5	26.8	27.3	
Year 2010/11	25.8	25.5	26.2	27.8	28.0	

N - weighted sample size; n - unweighted sample size; %, weighted percentage.

⁺ Non-married stands for widowed/divorced and separated.

None are individuals with neither depression nor diabetes; depression only are individuals with depression but without diabetes; diabetes only are individuals with diabetes but without depression; depression and diabetes are individuals with both depression and diabetes.

Table 2

Mean and 95% CI total health care expenditure by depression and diabetes categories among U.S. adults (reported as dollars in 2014)

	None	Depression only	Diabetes only	Depression and diabetes
Total Cost				
2004/05	\$4,352 (4,072–4,632)	\$7,799 (7,319–8,280)	\$11,063 (10,065–12,061)	\$18,470 (15,648–21,292)
2006/07	\$4,340 (4,157–4,524)	\$7,923 (7,385–8,460)	\$10,512 (9,755–11,270)	\$18,110 (15,757–20,464)
2008/09	\$4,397 (4,226–4,568)	\$8,509 (7,835–9,183)	\$10,192 (9,487–10,897)	\$17,558 (15,609–19,507)
2010/11	\$4,818 (4,567–5,068)	\$8,500 (7,924–9,076)	\$10,028 (9,266–10,790)	\$16,518 (14,923–18,114)
Pooled sample	\$4,479 (4,363–4,595)	\$8,187 (7,887–8,487)	\$10,411 (10,005–10,816)	\$17,585 (16,472–18,699)
Inpatient				
2004/05	\$1,250 (1,124–1,376)	\$2,143 (1,841–2,444)	\$3,257 (2,676–3,837)	\$7,013 (4,772–9,254)
2006/07	\$1,272 (1,145–1,339)	\$2,032 (1,730–2,335)	\$3,262 (2,757–3,766)	\$6,189 (4,573–7,805)
2008/09	\$1,173 (1,057–1,290)	\$2,152 (1,846–2,458)	\$3,041 (2,541–3,541)	\$4,890 (3,822–5,957)
2010/11	\$1,422 (1,255–1,590)	\$2,376 (1,987–2,765)	\$2,928 (2,431–3,424)	\$4,570 (3,607–5,532)
Pooled sample	\$1,280 (1,211–1,349)	\$2,179 (2,003–2,355)	\$3,109 (2,845–3,373)	\$5,546 (4,798–6,294)
Office-based				
2004/05	\$1,042 (985–1,100)	\$1,851 (1,710–1,992)	\$2,393 (1,926–2,861)	\$3,184 (2,619–3,748)
2006/07	\$1,146 (1,082–1,210)	\$1,913 (1,696–2,130)	\$2,119 (1,912–2,325)	\$3,060 (2,709–3,411)
2008/09	\$1,193 (1,130–1,256)	\$2,022 (1,880–2,163)	\$2,205 (2,010–2,400)	\$3,241 (2,860–3,621)
2010/11	\$1,218 (1,148–1,288)	\$2,028 (1,874–2,182)	\$2,029 (1,829–2,229)	\$3,435 (2,755–4,116)
Pooled sample	\$1,151 (1,116–1,185)	\$1,954 (1,870–2,039)	\$2,176 (2,036–2,316)	\$3,239 (2,993–3,486)
Medication				
2004/05	\$823 (772–874)	\$2,052 (1,937–2,167)	\$3,103 (2,925–3,280)	\$5,109 (4,641–5,577)
2006/07	\$787 (752–821)	\$2,281 (2,054–2,509)	\$3,190 (3,007–3,373)	\$5,373 (4,815–5,930)
2008/09	\$818 (775–861)	\$2,297 (2,143–2,451)	\$3,004 (2,798–3,211)	\$5,607 (5,086–6,129)
2010/11	\$934 (823–1,046)	\$2,303 (2,138–2,468)	\$3,010 (2,786–3,235)	\$5,477 (4,922–6,033)
Pooled sample	\$841 (805–877)	\$2,235 (2,141–2,328)	\$3,071 (2,964–3,179)	\$5,413 (5,143–5,683)
Outpatient				
2004/05	\$453 (417–490)	\$709 (622–795)	\$1,138 (835–1,442)	\$879 (673–1,084)
2006/07	\$434 (399–470)	\$691 (579–802)	\$785 (662–908)	\$1,188 (878–1,498)
2008/09	\$423 (386–459)	\$901 (630–1,172)	\$871 (691–1,050)	\$1,571 (626–2,516)
2010/11	\$490 (440–540)	\$697 (593–801)	\$920 (702–1,138)	\$1,053 (765–1,341)
Pooled sample	\$450 (430–471)	\$748 (671–826)	\$922 (819–1,025)	\$1,192 (907–1,477)
ER				
2004/05	\$166 (151–181)	\$256 (220–292)	\$190 (149–230)	\$495 (332–658)
2006/07	\$167 (155–179)	\$259 (222–296)	\$227 (189–266)	\$443 (325–560)
2008/09	\$199 (180–218)	\$314 (275–352)	\$279 (220–339)	\$433 (330–537)
2010/11	\$194 (178–211)	\$321 (273–369)	\$324 (268–380)	\$434 (339–528)
Pooled sample	\$182 (174–190)	\$288 (267–309)	\$260 (235–285)	\$448 (391–505)

	None	Depression only	Diabetes only	Depression and diabetes
Dental				
2004/05	\$333 (317–349)	\$366 (339–392)	\$294 (250–337)	\$386 (233–539)
2006/07	\$340 (325–356)	\$372 (338–406)	\$319 (265–373)	\$401 (307–496)
2008/09	\$340 (321–358)	\$355 (317–393)	\$287 (243–332)	\$473 (320–626)
2010/11	\$320 (302–339)	\$348 (313–383)	\$321 (267–376)	\$377 (223–531)
Pooled sample	\$333 (324–342)	\$360 (342–378)	\$306 (280–332)	\$411 (339–483)
Home health				
2004/05	\$185 (–1.0–372)	\$270 (178–362)	\$477 (340–615)	\$1,089 (747–1,432)
2006/07	\$96 (77–114)	\$233 (175–290)	\$427 (266–589)	\$1,168 (766–1,569)
2008/09	\$156 (97–216)	\$319 (224–413)	\$370 (280–460)	\$1,070 (713–1,427)
2010/11	\$140 (98–182)	\$301 (219–383)	\$342 (248–436)	\$855 (537–1,174)
Pooled sample	\$144 (93–195)	\$281 (239–323)	\$399 (332–466)	\$1,038 (856–1,219)
Other				
2004/05	\$97 (90–103)	\$150 (133–168)	\$208 (163–253)	\$312 (230–393)
2006/07	\$94 (87–102)	\$139 (118–159)	\$180 (135–225)	\$286 (193–378)
2008/09	\$92 (84–99)	\$146 (122–171)	\$132 (109–154)	\$269 (186–353)
2010/11	\$95 (87–103)	\$123 (106–140)	\$150 (122–178)	\$314 (159–469)
Pooled sample	\$94 (91–98)	\$139 (129–149)	\$165 (148–182)	\$294 (236–352)

None are individuals with neither depression nor diabetes; depression only are individuals with depression but without diabetes; diabetes only are individuals with diabetes but without depression; depression and diabetes are individuals with both depression and diabetes.

Table 3

Two-part regression model: Incremental effects of health care spending by depression and diabetes categories among adults accounting for health care expenditure (reported as dollars in 2014).

Variables	Incremental Effect	95% CI	p value
Primary independent variables ^a			
None	--	--	--
Depression only	\$2,654***	2,343 – 2,966	<0.001
Diabetes only	\$2,692***	2,338 – 3,046	<0.001
Diabetes and Depression	\$6,037***	5,243 – 6,830	<0.001
Age			
Age 18–44 (ref)	--	--	--
Age 45–64	\$1,178***	1,142 – 1,613	<0.001
Age 65–85	2,119***	1,804 – 2,433	<0.001
Gender			
Female	\$927***	696 – 1,158	<0.001
Race/ethnicity			
Non-Hispanic White (ref)	--	--	--
Non-Hispanic Black	–\$2	–329 – 334	0.989
Hispanic or others	–\$810***	–1,136 – –485	<0.001
Marital Status			
Married (ref)	--	--	--
Not married ^b	–\$597***	–833 – –361	<0.001
Never married	–\$646***	–971 – –321	<0.001
Education			
<High school (ref)	--	--	--
High school	\$693***	372 – 1,015	<0.001
College or more	\$939***	699 – 1,179	<0.001
Insurance Status			
Private (ref)	--	--	--
Public insured	\$805***	410 – 1,200	<0.001
Uninsured	–\$3,204***	–3,421 – –2,986	<0.001
MSA status			
MSA	\$349**	89 – 609	0.008
Census region			
Northeast (ref)	--	--	--
Midwest	–\$41	–398 – 316	0.820
South	–\$439**	–763 – –115	0.008

Variables	Incremental Effect	95% CI	p value
West	\$78	−394 – 551	0.745
Poverty Category			
Poor/NEA (ref)	--	--	--
Low Income	−\$712 **	−1,139 – −285	0.001
Middle Income	−\$1,099 ***	−1,484 – −714	<0.001
High Income	−\$789 **	−1,209 – −368	<0.001
Chronic Conditions ^c			
Hypertension	\$1,328 ***	1,126 – 1,530	<0.001
CVD	\$3,475 ***	3,104 – 3,842	<0.001
Stroke	\$2,832 ***	2,283 – 3,381	<0.001
Emphysema	\$1,884 ***	1,308 – 2,461	<0.001
Joint Pain	\$973 ***	758 – 1,187	<0.001
Arthritis	\$1,681 ***	1,415 – 1,948	<0.001
Asthma	\$1,444 ***	820 – 2,068	<0.001
Year			
Year 2004/05 (ref)	--	--	--
Year 2006/07	−\$48	−397 – 301	0.788
Year 2008/09	−\$236	−570 – 97	0.166
Year 2010/11	\$160	−214 – 534	0.402

* Level of significance $p < 0.05$;

** level of significance $p < 0.01$,

*** level of significance $p < 0.001$

^a None indicates individuals with neither depression nor diabetes; depression only are individuals with depression but without diabetes; diabetes only are individuals with diabetes but without depression; depression and diabetes are individuals with both depression and diabetes.

^b Non-married stands for widowed/divorced and separated.

^c Reference for each chronic conditions was not having that specific condition.